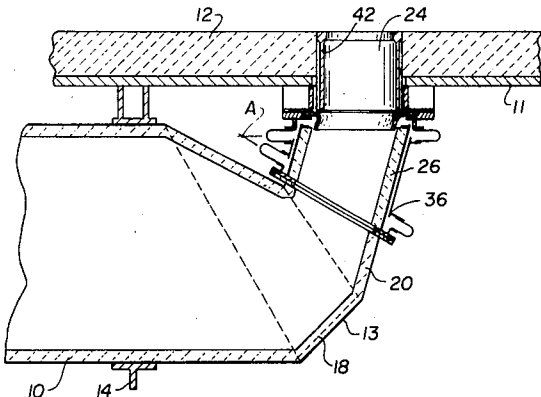


- [54] **ROTARY KILN WITH COOLING CELLS**
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- [30] **Foreign Application Priority Data**
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- [52] **U.S. Cl.** **432/80**
[51] **Int. Cl.** **F27b 7/38**
[58] **Field of Search** **432/78, 80, 209**
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Primary Examiner—John J. Camby
Attorney, Agent, or Firm—Kurt Kelman

[57] **ABSTRACT**
A rotary kiln comprises a kiln body and a cooling cell body mounted on the kiln body for rotation therewith. A feed channel interconnects the kiln and cooling cell bodies in a tight manner and provides communication between the interiors of the kiln and cooling cell bodies through the port. The feed channel includes an expandible bellows sleeve having respective ends tightly affixed respectively to the kiln and the cooling cell body, and a tube section having one end affixed to the kiln or cell body and the other end free, the tube section being positioned within the bellows sleeve and having a refractory interior wall. Material falling out of the rotary kiln body through the port is guided by the tube section into the cooling cell.

11 Claims, 5 Drawing Figures



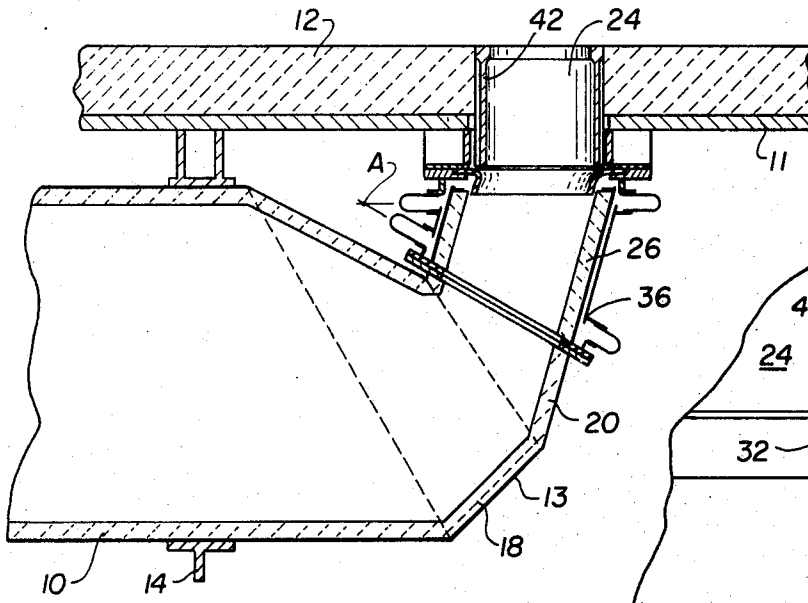


FIG. 1

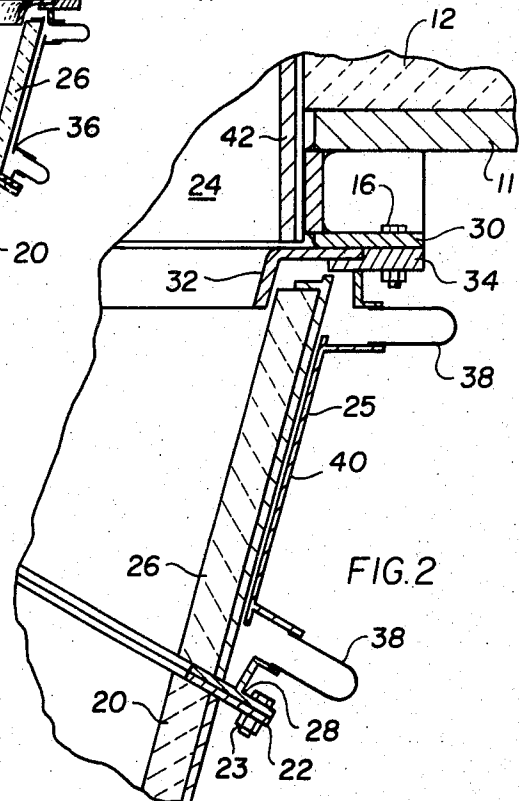


FIG. 2

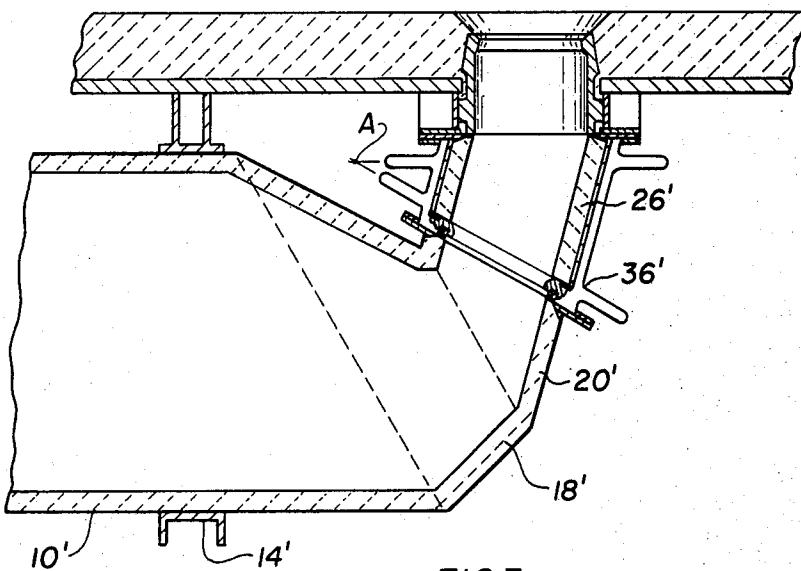
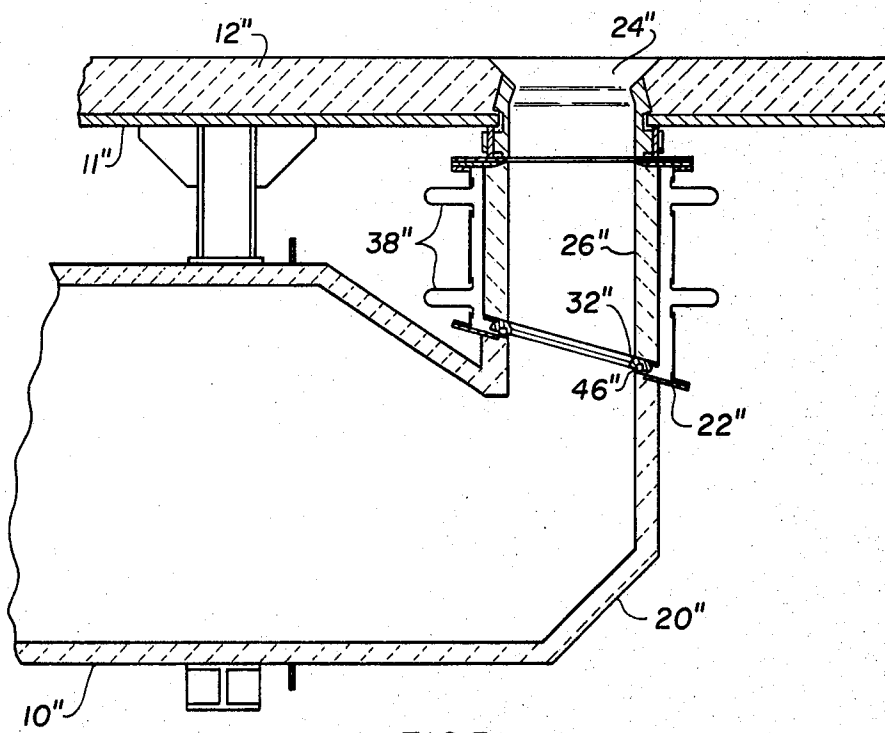
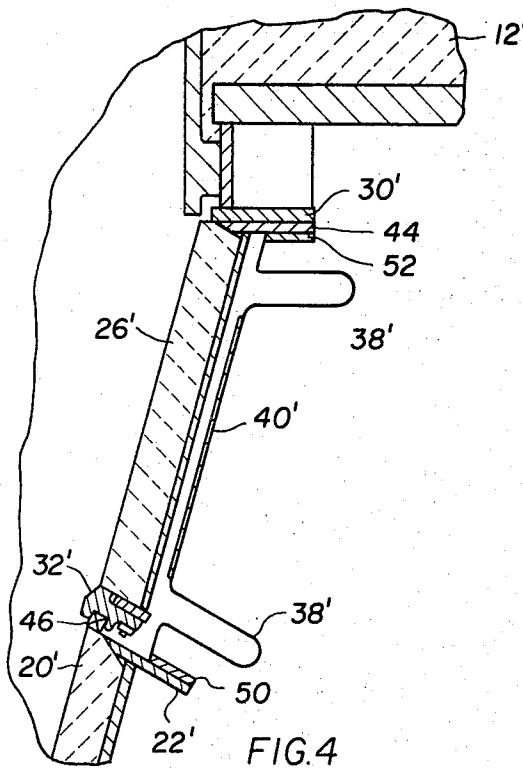


FIG. 3



ROTARY KILN WITH COOLING CELLS

The present invention relates to tubular rotary kilns equipped with cooling tubes or cells which are disposed around the output end of the kiln, with their axes substantially parallel to the rotary axis of the kiln body.

In this type of rotary kiln, the output end of the kiln body defines ports whence feed channels lead into the cooling cell bodies so that material to be cooled falls through the ports into the cells when the same are rotated into a position below the kiln body. Cooling air blown across the cells passes into the kiln body and is used therein as secondary heating air, having been brought to an elevated temperature by heat exchange with the material in the cell which is being cooled by the air.

The feed channels must provide a fluid-tight connection between the kiln and cooling cell bodies while permitting their relative displacement due to the differences in expansion between the cooling cell and kiln bodies.

It is the primary object of the present invention to provide an improved feed channel which fulfills these conditions and which may be readily dismantled to permit replacement and/or access to the interior of the cooling cells or the ports in the kiln wall.

The above and other objects of this invention are accomplished with a feed channel including an expansible bellows sleeve having respective ends fluid-tightly affixed respectively to the kiln and the cooling cell body, and a tube section having respective ends. The tube section is positioned within the bellows sleeve and has a refractory interior wall, and one end of the tube section is affixed to a selected one of the bodies while the other end is free. Material falling out of the rotary kiln body through the port is guided by the tube section into the cooling cell.

The above and other objects, advantages and features of the present invention will become more apparent from the following detailed description of certain now preferred embodiments thereof, taken in conjunction with the accompanying drawing wherein

FIG. 1 is a cross sectional view showing the inlet of a cell of the rotary kiln, with its feed channel and a portion of the kiln, the section being taken along a plane containing the axis of the kiln and the cell;

FIG. 2 is a similar half-view, on an enlarged scale, of the feed channel of FIG. 1;

FIG. 3 is a view similar to that of FIG. 1 and showing another embodiment of this invention;

FIG. 4 is a view similar to that of FIG. 2, showing the feed channel of the embodiment of FIG. 3; and

FIG. 5 is a view similar to that of FIG. 1 and showing a third embodiment.

Referring now to the drawing, the rotary kiln is represented by its refractory wall 12 lining metallic shell 11 and has affixed thereto a plurality of cooling cells represented in the drawing by cell 10, the axis of rotation of the tubular kiln and the axes of the cells being substantially parallel to each other. The cells are affixed to the kiln at its outlet end and turn with the kiln about its rotary axis.

Each cell body is affixed to shell 11 of the kiln body by means of two support rings. FIG. 1 shows only one of the support rings 14 positioned near the inlet end of the cell. The other support ring (not illustrated) is linked to the collar of the kiln by a system of pivoted

rods or like means suitable to permit the cell to move freely in the direction of its longitudinal axis.

Cell 10 is constituted by a generally cylindrical body having a frusto-conical inlet end 18. The interior wall of the cell, or at least its inlet end, is lined with a refractory material. The refractory material lining the interior of the frusto-conical inlet end 18 of the cell is constituted by refractory bricks whose long wear is assured by the archway effect produced by the shape of the inlet end.

The large base of the frusto-conical inlet end is adjacent the cylindrical main body of cell 10 while its small base is adjacent the feed channel connecting the cell to the interior of the kiln. The axis of the frusto-conical inlet end is inclined in respect of the axis of the cylindrical main body, i.e., it encloses an obtuse angle therewith, and the bases of the frusto-conical inlet end 18 extend in two planes inclined in respect of the axis of the main body, i.e., they enclose acute angles with this axis. In this manner, material which falls into the cell when the same is in its lower path of revolution about the rotary axis of the kiln moves away from the inlet end of the cell when the cell rises again.

The cell has a cylindrical end portion 20 in alignment with tubular section 26 constituting the feed channel for the cell. The feed channel is adjacent and in communication with port 24 in the kiln wall. The material fed from the interior of the kiln into the cells for cooling therein passes through the feed channel whose axis is inclined in respect of the axis of the port downstream thereof, i.e. the axis of the feed channel 26 encloses an obtuse angle with the axis of port 24. The interior of the feed channel is lined with refractory material. In the illustrated embodiments, the cooling cell body and the feed channel comprise a metallic outer shell 13 and 25, respectively, and a refractory lining.

The outer end of cylindrical end portion 20 carries flange 22 and one end of tubular section 26 carries co-operating flange 28, the two flanges being affixed to each other by bolts 24 to interconnect the cylindrical end portion 20 of cell 10 with feed channel 26. The opposite end of tubular section 26 is free and slightly spaced from flange 30 affixed to collar 11 of the kiln about port 24. The space between the opposite end of tubular section 26 and flange 30 is interiorly closed by a refractory steel ring 32. Steel ring 32 is clamped in position between flange 30 and clamping ring 34 held together by bolts 16. This refractory steel ring protects the refractory lining of tubular section 26 at the inlet end and prevents the escape of granular material through the space between the tubular section and port 24.

The tubular feed channel section is surrounded by an expansible bellows 36 whose opposite ends are soldered, welded or otherwise attached to flange 28 and clamping ring 34, respectively. This bellows assures a tight connection between the kiln and the cell and is formed by two bellows portions 38, 38 at the respective ends of the bellows and interconnected by a sleeve 40. The two bellows portions extend in respective planes intersecting in line A outside the feed channel. The planes of contact between flanges 22 and 28, on the one hand, and between flange 30 and clamping ring 24, on the other hand, also intersect along a line outside the feed channel and at the same side as the cell in respect of the feed channel. The tubular section 26 is positioned entirely between these two planes, which

facilitates the assembly and disassembly of the tubular section.

Port 24 is lined with a refractory steel sleeve 42 to protect the refractory lining of the kiln from wear and tear.

The embodiment of FIGS. 3 and 4 differs from that of FIGS. 1 and 2 only in the manner of mounting the feed channel, like parts being designated by like reference numerals in both embodiments, except that the numerals in FIGS. 3 and 4 are primed.

As shown, the upper end of tubular feed channel section 26' is not spaced from flange 30' but carries flange 44 affixed to flange 30' carried by kiln 12'. The other end of the tubular section is slightly spaced from flange 22' of cell 10' and this space is interiorly closed by refractory steel ring 32'. This steel ring is affixed to the other end of the tubular section and gasket 46 is positioned between ring 32' and the adjacent end of cylindrical portion 20' of the cell to provide a tight joint between the cell and the feed channel.

The respective ends of bellows 36' are suitably attached to flanges 50 and 52 respectively affixed to flanges 22' and 44.

The embodiment of FIG. 5 differs from that of FIGS. 3 and 4 only in the orientation of the feed channel and the position of the bellows, like parts again being designated by like reference numerals in both embodiments to dispense with the need for a repetition of the description, except that the numerals in FIG. 5 are double primed.

In this embodiment, the axis of the feed channel 26'' is perpendicular to the rotary axis of the kiln, i.e. in alignment with the axis of port 24'', and the bellows portions 38'', 38'' extend in parallel planes perpendicular to the axis of the feed channel.

If desired and if the feed channel is long enough, supplementary bellows portion may be provided intermediate the end portions 38 of the bellows.

What is claimed is:

1. A rotary kiln comprising

1. a kiln body having an output end and defining a port at the output end,

2. a cooling cell body mounted on the kiln body for rotation therewith, and

3. a feed channel interconnecting the kiln and cooling cell bodies in a fluid-tight manner and providing communication between the interiors of the kiln and cooling cell bodies through the port, the feed channel including

a. an expansible bellows sleeve having respective ends fluid-tightly affixed respectively to the kiln and the cooling cell body, and

b. a tube section having respective ends, the tube section being positioned within the bellows

sleeve and having a refractory interior wall, and one of the tube section ends being affixed to a selected one of the bodies while the other end is free, material falling out of the rotary kiln body through the port being guided by the tube section into the cooling cell.

2. The rotary kiln of claim 1, wherein the bellows sleeve comprises two bellows portions at the respective ends of the bellows sleeve and a sleeve portion interconnecting the bellows portions, an support flanges are mounted on the kiln and cooling cell bodies respectively, the ends of the bellows sleeve being affixed to the support flanges.

3. The rotary kiln of claim 2, wherein the planes wherein the two bellows portions extend intersect.

4. The rotary kiln of claim 2, wherein the planes wherein the two bellows portions extend are parallel to each other.

5. The rotary kiln of claim 2, wherein planes wherein the support flanges extend intersect to form a dihedron whose apex is on the same side as the cooling cell in respect of the feed channel, the tube section being positioned entirely within the dihedron.

6. The rotary kiln of claim 1, wherein the tube section comprises a metallic shell and an interior lining of refractory material, and a flange on one end of the metallic shell being affixed to the selected body.

7. The rotary kiln of claim 1, wherein an annular space is defined between the free end of the tube section and the body adjacent thereto, and a protective ring interiorly closes the annular space.

8. The rotary kiln of claim 7, wherein the protective ring is affixed to the kiln body.

9. The rotary kiln of claim 7, wherein the protective ring is affixed to the tube section.

10. The rotary kiln of claim 1, wherein the axis of the feed channel is inclined downstream in the direction of flow of material from the interior of the kiln body into the cooling cell body and in respect to the axis of the port in the kiln body.

11. The rotary kiln of claim 1, wherein the cooling cell body comprises a cylindrical body portion and a frustoconical inlet portion lined with refractory material, the frusto-conical inlet portion of the cooling cell having a large base adjacent the cylindrical body portion thereof and a small base adjacent the feed channel, the planes wherein the frusto-conical inlet portion bases extend being inclined in respect of the axis of the cylindrical portion whereby material falling into the cooling cell from the interior of the rotary kiln body when the same is in the lower part of its rotary path is moved away from the inlet portion when the same ascends.

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