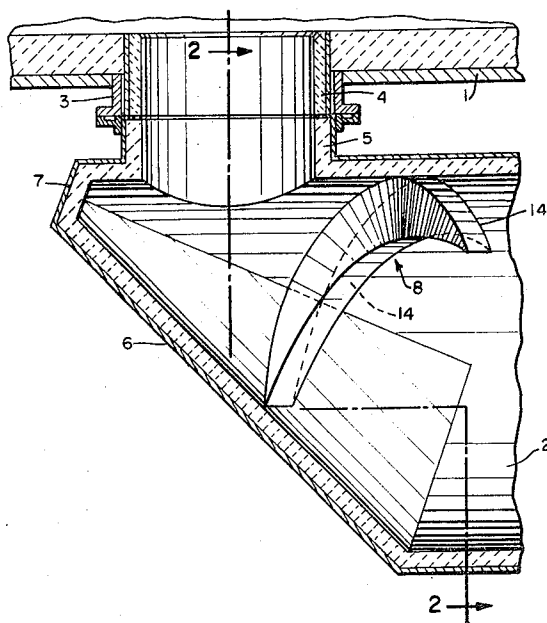




SHEET 1 OF 3

FIG. 1

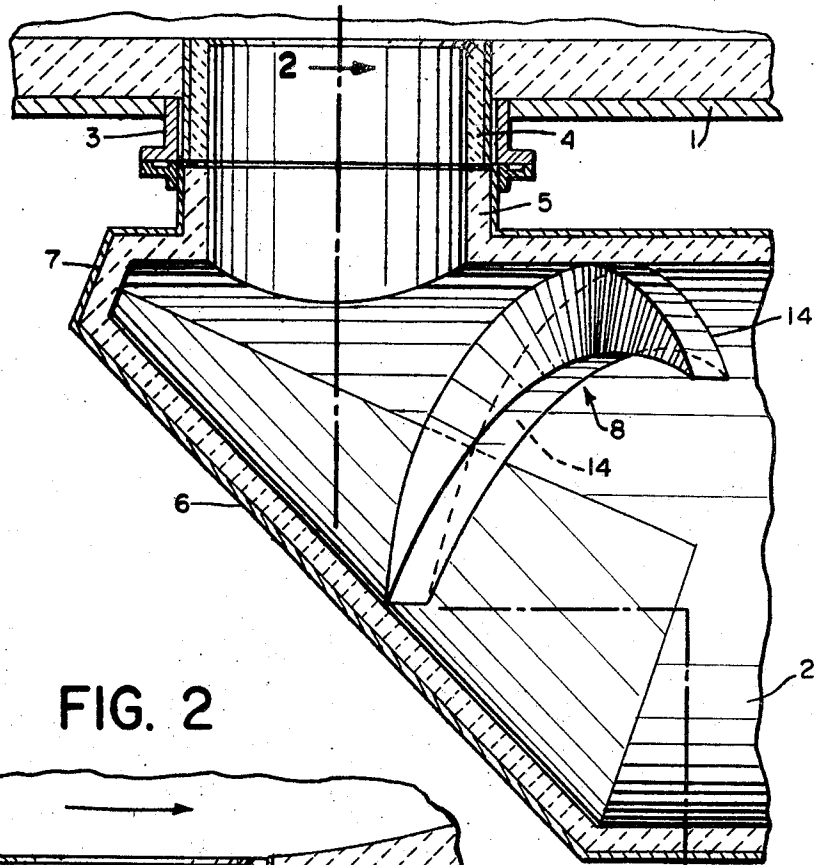


FIG. 2

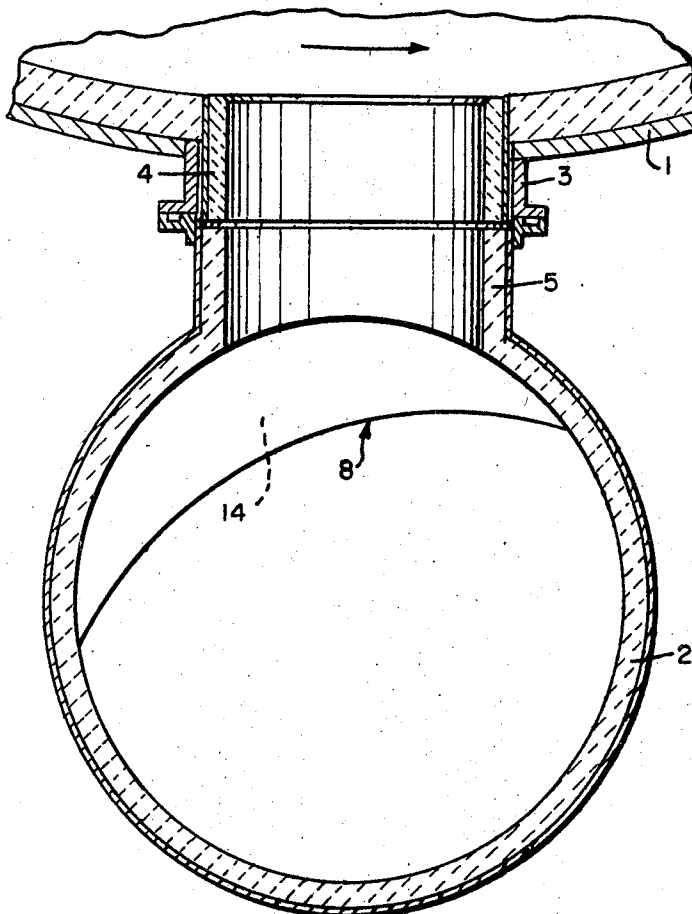


FIG. 3

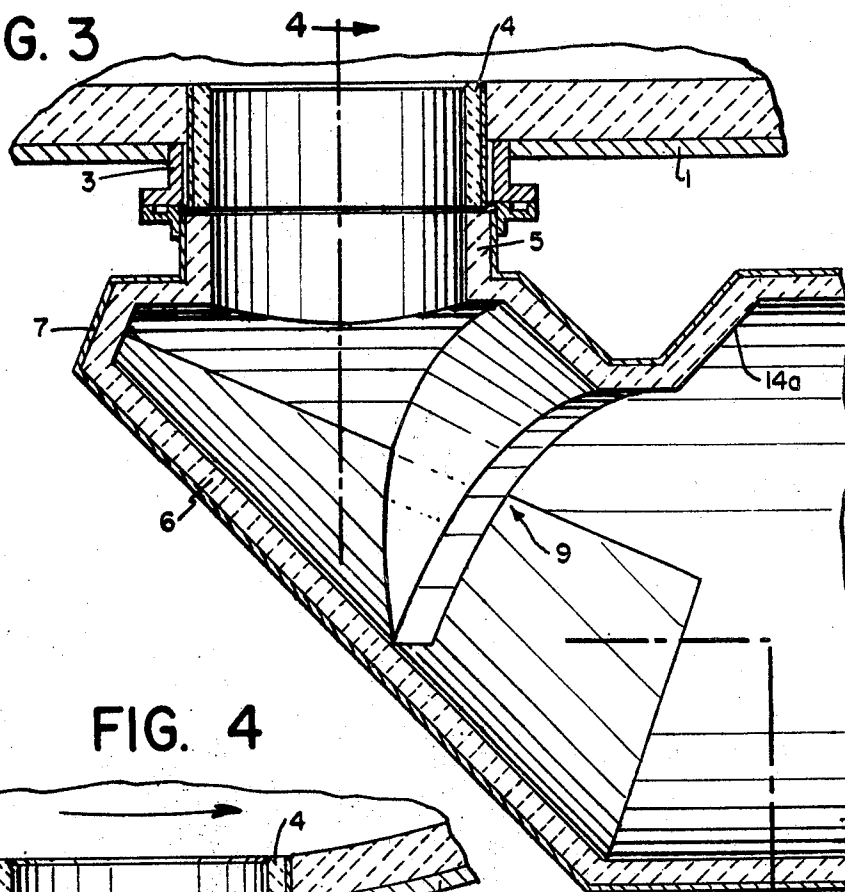


FIG. 4

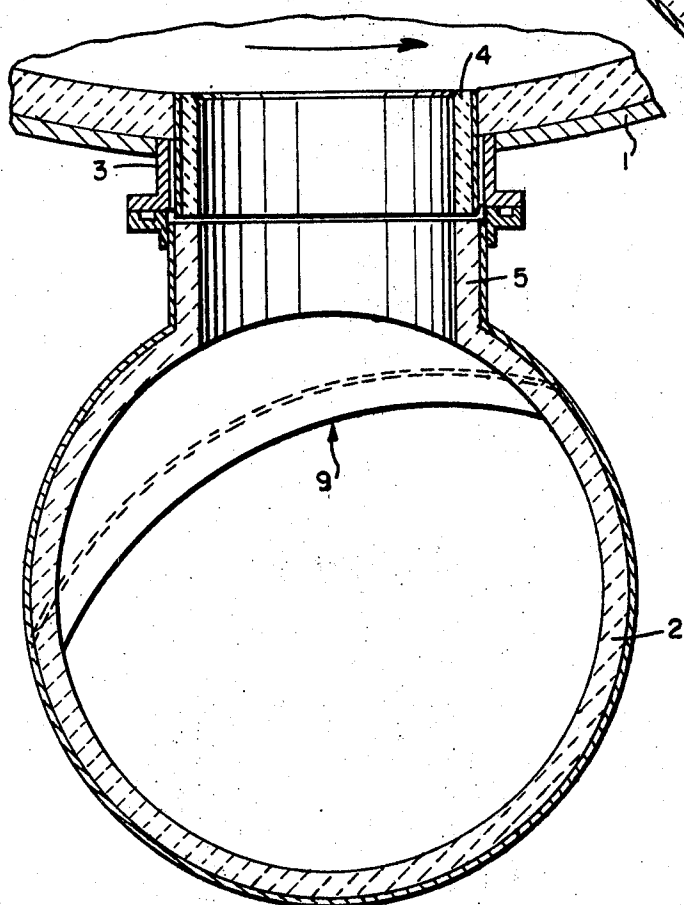


FIG. 5

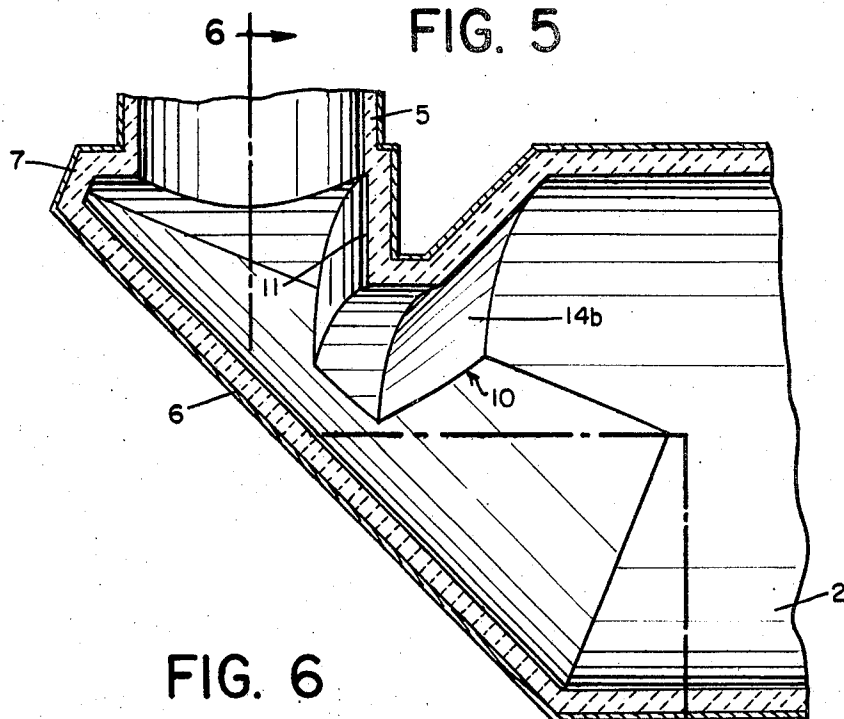
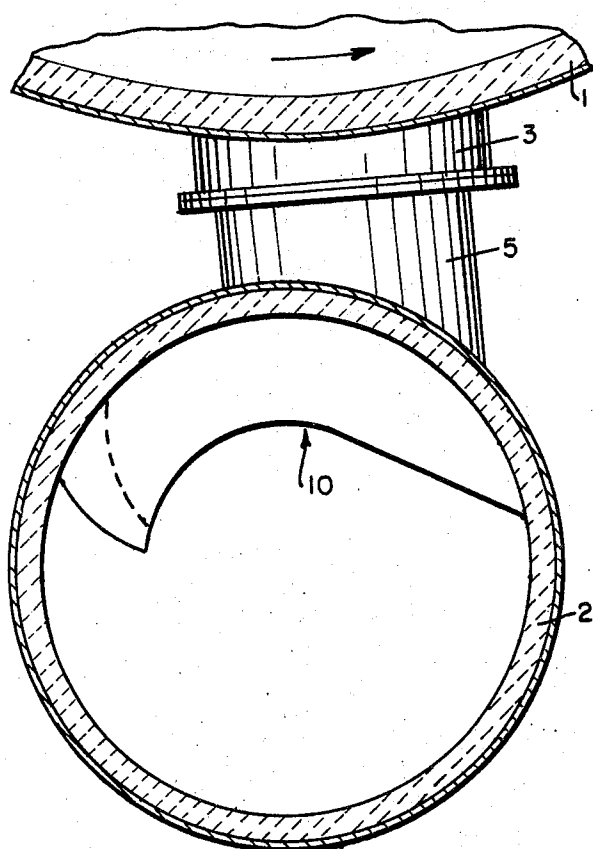


FIG. 6



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ROTARY KILN

BACKGROUND OF THE INVENTION

This invention relates to a rotary kiln, such as a cement kiln. Kilns of this type are equipped with cooler tubes attached in planetary fashion around the outlet end of the kiln and adapted to receive and cool the rotary kiln product by means of air which is caused to flow through the cooler tubes in countercurrent to the rotary kiln product. Each cooler tube communicates with the interior of the kiln through an interconnecting chute which is provided with an oblique wall part inclined to the axis of the cooler tube. The oblique wall is located opposite the opening of the chute into the cooler tube on the side of the cooler tube which is remote from the kiln. The part of the cooler tube close to the kiln retains its circular cylindrical form throughout.

With constructions of the type described the interconnecting chute may be advantageously quite short. One of the advantages of a short chute manifests itself in applications where the material treated in the kiln is of the type which tends to stick to the wall of the chute. In such cases the shortness of the chute lessens the tendency of such material to do so.

Another advantage attributable to short chutes relates to the backspill problem. During the rotation of the kiln, the material will, dependent upon its behaviour of sliding, begin to fall and move down from the kiln through the interconnecting chute at about the time the corresponding cooler tube is passing through its lowermost position. The flow of material through the chute will then increase to a maximum before decreasing and ultimately stopping entirely when the chute approaches its horizontal position. At that time a quantity of material that has accumulated along the lowermost generatrix of the chute will during the continued rotation of the kiln re-enter the kiln as backspill. This backspill is inevitable to some extent but should be limited as far as possible because the backspill of material has a highly abrasive effect on the kiln lining. The shorter the chute, the smaller the amount of backspill and the less the wear on the kiln lining. In view of the wear it is therefore desirable to make the chute as short as possible.

Short chutes, on the other hand, have certain drawbacks. For example, short chutes are less suitable for furthering the advancement of the rotary kiln product through the cooler tube than other constructions. Thus, the advantages associated with the short chute construction including the negligible tendency for caking in the chute and negligible backspill into the kiln, may be lost as a result of the reduced conveying capacity.

SUMMARY OF THE INVENTION

In accordance with the present invention the drawbacks associated with short chute constructions are overcome by providing a specially constructed deflector within each cooler tube to the side of the cooler tube adjacent to the kiln and adjacent to the opening of the chute into the cooler tube. The deflector is oriented such that during rotation of the cooler tube it will further the conveyance of the rotary kiln product along the cooler tube away from the point where the chute opens into the cooler tube.

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In accordance with the teachings of this invention the deflector may be constructed in the form of an arch, the convex surface of which is in contact with the wall of the cooler tube. Alternatively it may take the form of an inwardly directed projection in the tube wall, preferably covered with lining material. The use of such a projection ensures effective cooling of the deflector.

The deflector may further be designed with a bounding surface constituting essentially a tangent plane to the interconnecting chute. This will reduce to a minimum the volume of the cooler tube from which backspill into the kiln may take place.

The edge of the deflector may have a constant radius of curvature, which is the simplest arrangement, or it may have a varying radius of curvature having its maximum where the edge meets the rotary kiln product, which may improve the conveying capacity.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a cross-sectional longitudinal view taken through an end part of the kiln and part of a cooler tube;

FIG. 2 is a cross-sectional view along the lines 2—2 in FIG. 1;

FIG. 3 is a cross-sectional view corresponding to FIG. 1, but of an alternative embodiment;

FIG. 4 is a cross-sectional view taken along the lines 4—4 in FIG. 3;

FIG. 5 is a cross-sectional view corresponding to FIG. 1 but of another embodiment; and,

FIG. 6 is a cross-sectional view taken along the lines 6—6 in FIG. 5.

DETAILED DESCRIPTION OF THE INVENTION

In FIGS. 1 and 2, a rotary kiln has a shell 1 and is equipped with a number of cooler tubes attached in planetary fashion around the outlet end of the kiln with their axes parallel or substantially parallel to the axis of the kiln and adapted to receive and cool the rotary kiln product by means of air which is caused to flow through the cooler tubes in countercurrent to the rotary kiln product. Each cooler tube 2 communicates with the interior of the kiln through an interconnecting chute which consists of a tube end 3 projecting from the kiln shell 1 and in which there is retained an inner tube 4 joining a tube end 5 projecting from the cooler tube 2. Inside the kiln the free end of the inner tube 4 is flush with a lining with which the kiln is provided.

Opposite the point where the chute opens into the cooler tube 2, the tube 2 has an oblique wall 6, which may be part cylindrical, part conical or both, and to which is connected a small, flat end wall 7.

A deflector 8 is provided in the cooler tube directly after the point where the interconnecting chute opens into the cooler tube 2. The deflector 8 which is generally of crescent shape having a maximum height between about 15—25 percent of the inside diameter of the cooler tube and a working edge or surface 14 of substantially constant radius of curvature. The axis of symmetry of the deflector is displaced relative to the chute. That is, the axis of symmetry is displaced relative to the line of closest approach between the cooler tube and kiln through an angle of 15°—30° about the axis of the cooler tube in the direction of rotation, indicated in the figure by an arrow. The deflector 8 defines a helix having a pitch varying between 20° and 60°. With

the construction described the conveyance of the rotary kiln product away from the opening of the interconnecting chute into the cooler tube 2 during the rotation of the kiln and tube is significantly improved.

FIGS. 3 and 4 show an alternative embodiment of the deflector in the form of an inwardly directed bulbous projection 9 in the tube wall and covered with lining material. The projection 9 defines a channel of symmetrical trapeziform cross-section with an apex angle of about 90°, and is oriented in the cooler tube similarly as the arch 8 described above in connection with FIGS. 1 and 2. The working surface or edge of this embodiment is indicated by reference numeral 14a. The projection 9 is formed by cutting an opening in the cylindrical cooler tube wall into which opening is welded an angular lug of plate material. This will provide a stronger deflector than that obtained with the use of an arch, and the deflector may be kept at a relatively low temperature since it is cooled from outside by the atmospheric air.

FIGS. 5 and 6 show a modification of the deflector disclosed in FIGS. 3 and 4. Here, the deflector also takes the form of an inwardly directed bulbous projection 10 in the tube wall and covered with lining material. The projection 10 has a boundary surface 11 constituting essentially a tangent plane to the inner surface of the interconnecting chute. The projection is in this case formed as a channel of unsymmetrical, trapeziform cross-section with an apex angle of about 45°.

The modification disclosed in FIGS. 5 and 6 also vary from the examples of the preceding figures in that the interconnecting chute 5 does not lead symmetrically into the cooler tube, but is offset in relation to the center line of the cooler tube so that the tube end 5 of the chute extends substantially tangentially into the cooler tube 2. This construction advantageously provides a greater free fall distance between the kiln and opening of the chute into the cooler tube. The projection 10 is also provided with a working edge or surface 14b having a curvature of varying radius. The maximum radius of curvature occurs where the edge meets the rotary kiln product.

I claim

1. In a rotary kiln having a plurality of cooler tubes mounted in planetary fashion around the outlet end of the kiln with the inlet end of each tube connected to the kiln by a communicating chute, the improvement which comprises an oblique wall forming at least part of the cooler tube and positioned substantially opposite the opening of the chute into the cooler tube and a deflector member positioned within the cooler tube on the side thereof adjacent to the kiln and adjacent to the opening of the chute into the cooler tube and said oblique wall in the path of falling kiln product, said deflector comprising a generally crescent-shaped projection with a convex surface disposed substantially in contact with the internal wall of the cooler tube and having a working surface adapted to cooperate with said oblique wall to convey the falling kiln product along the cooler tube away from the portion where the chute opens into the cooler tube during rotation of the cooler tube.

2. The improvement according to claim 1 wherein the maximum height of the deflector is less than about 25 percent of the inside diameter of the cooler tube.

3. The improvement according to claim 2 wherein the crescent-shaped deflector member has a generally helically configured working surface.

4. In a rotary kiln having a plurality of cooler tubes mounted in planetary fashion around the outlet end of the kiln with the inlet end of each tube connected to the kiln by a communicating chute, the improvement which comprises a deflector member in the form of a generally crescent-shaped projection having a convex surface disposed substantially in contact with the internal wall of the cooler tube and having a maximum height less than about 25 percent of the inside diameter of the tube, said deflector member further having a generally helically configured working surface adapted to convey the falling kiln product along the cooler tube away from the portion where the chute opens into the cooler tube during rotation of the cooler tube, the axis of symmetry of said helically configured arch-shaped deflector forming with the line of closest approach between the cooler tube and kiln an angle of less than 30°.

5. The improvement according to claim 4 wherein the working edge of the deflector has a constant radius of curvature.

6. The improvement according to claim 5 wherein the pitch of helix defined by the deflector member is less than about 60°.

7. In a rotary kiln having a plurality of cooler tubes mounted in planetary fashion around the outlet end of the kiln with the inlet end of each tube connected to the kiln by a communicating chute, the improvement which comprises a deflector member positioned within the cooler tube on the side adjacent to the kiln and adjacent to the opening of the chute into the cooler tube in the path of the falling kiln product, said deflector comprising a channel-shaped projection of symmetrical trapeziform cross-sectional configuration having a working surface adapted to convey the falling kiln product along the cooler tube away from the portion where the chute opens into the cooler tube during rotation of the cooler tube.

8. The improvement according to claim 7 wherein the trapeziform configured channel-shaped projection has an apex angle of about 90°.

9. In a rotary kiln having a plurality of cooler tubes mounted in planetary fashion around the outlet end of the kiln with the inlet end of each tube connected to the kiln by a communicating chute, the improvement which comprises a deflector member positioned within the cooler tube on the side adjacent to the kiln and adjacent to the opening of the chute into the cooler tube in the path of the falling kiln product, said deflector comprising a channel-shaped projection of unsymmetrical trapeziform cross-sectional configuration having a working surface adapted to convey the falling kiln product along the cooler tube away from the portion where the chute opens into the cooler tube during rotation of the cooler tube.

10. The improvement according to claim 9 wherein one surface of the channel-shaped projection is disposed substantially in tangential relationship with respect to the inner surface of the chute interconnecting the kiln and cooler tube.

11. The improvement according to claim 10 wherein the trapeziform configured channel-shaped projection has an apex angle of about 45°.

12. The improvement according to claim 11 wherein the working edge of the deflector has a varying radius

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of curvature with the maximum radius of curvature being located at the point along said edge which meets the kiln product.

13. The improvement according to claim 12 wherein the center axis of the chute is offset in relation to the

center line of the cooler tube.

14. The improvement according to claim 13 wherein a portion of the deflector is exposed to the atmosphere.

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