Sept. 27, 1966 G. NIEMITZ 3,274,701

STATIONARY CIRCULAR CONTACT COOLER FOR CALCINED LIME AND OTHER MATERIALS

Filed March 3, 1964

Fig. 1

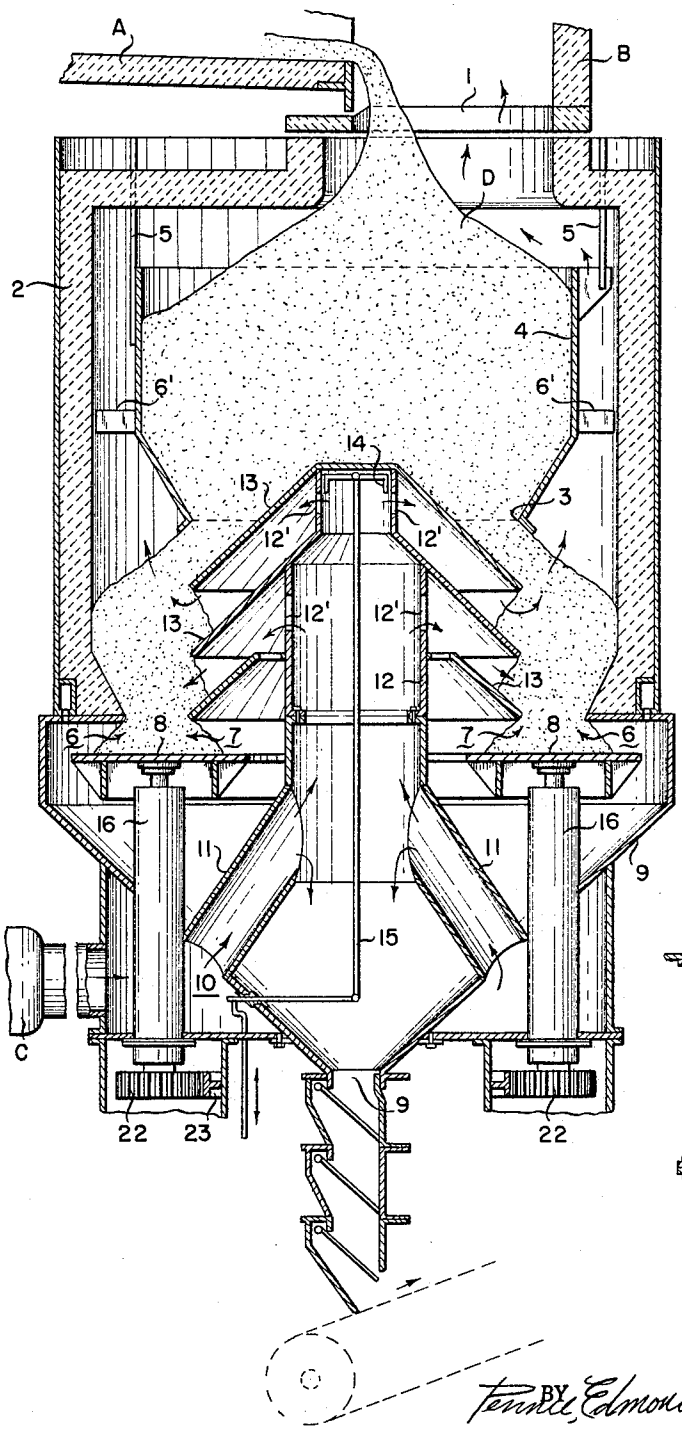
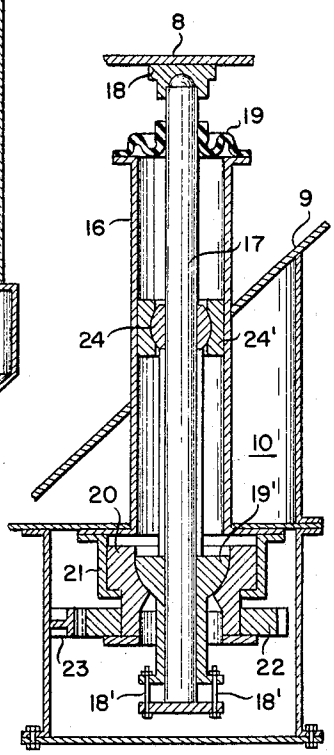


Fig. 2



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United States Patent Office 3,274,701 Patented Sept. 27, 1966

3,274,701

STATIONARY CIRCULAR CONTACT COOLER FOR CALCINED LIME AND OTHER MATERIALS

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Filed Mar. 3, 1964, Ser. No. 349,107
10 Claims. (Cl. 34—164)

The present invention relates to improvements in apparatus for cooling calcined or sintered materials, such as lime, cement, ores and the like as discharged from rotary kilns, for example.

Various types of cooling units have been provided for cooling the foregoing materials and the primary object of the present invention is to provide an improved air contact cooler including a soaking pit for the hot calcined material to be cooled.

A further object of the invention is to provide a gyratory discharge device for discharging the cooled material.

In accordance with the invention, the improved cooler comprises a shell forming a soaking pit for the hot calcined material, a connecting baffled cooling structure over which the hot material is adapted to move, a movable table onto which the cooled material is delivered and means for gyrating the table to feed the cooled material away from the cooling zone for discharge from the apparatus.

In a preferred construction, the gyrating table comprises an annular or ring-shaped disc supported by a plurality of rods or posts mounted in an eccentric support supported in a frame for rotation.

The improved apparatus includes other features and structures described more in detail hereinafter in connection with the accompanying diagrammatic drawing, in which:

FIG. 1 is a vertical sectional view with parts broken away of a cooler constructed in accordance with the invention, and

FIG. 2 is an enlarged detailed view, partly in section of one of the gyrating supports for the annular discharge disc.

The cooler as shown in FIG. 1 comprises a cylindrical shell 2 of refractory material having a top opening 1 for receiving burnt lime, for example, from a rotary kiln A provided with a known type of end hood B. The cooler is provided with a soaking pit formed by a heat resisting alloy steel shell 4 having a frusto-conical bottom portion. The shell 4 is supported in the refractory casing 2 by means of rods 5 and held in spaced relation to the inner wall of the shell 2 by means of spacer guides 6' so that the shell 4 is maintained concentric with the insulated cooler shell 2.

The soaking pit in the shell 4 is particularly useful for burnt lime because the heat transfer coefficient of calcium or magnesium oxides is so low that either a very high temperature difference is necessary in the kiln, or the heated limestone must be "soaked" or retained at its normal calcining temperature for a long retention time to permit the heat to penetrate from the particle surface to the inner core in order to completely calcine the calcium or magnesium materials. The temperature of the shell of the calcined particles is raised sufficiently high in the flame zone of the kiln A to store enough heat to complete the calcination of the particles to their core when stored for some time in the soaking pit of the shell 4. Therefore, it is only necessary to store the highly heated particles after discharge from the kiln without previously removing the heat in the shells of the particles. This means that no air or very little air should be permitted to pass through the shell 4. A practical solution

of the problem is provided by the apparatus shown in the drawing, in which the calcined product is discharged from the kiln A through the inlet 1 and is stored in the soaking pit chamber 4. The soaked material at the bottom of the chamber 4 discharges through the annular opening 3 along the uppermost of an outwardly sloping series of spaced frusto-conical members 13 forming an air cooling zone. Below the lowest member 13, the material passes onto a ring-shaped gyrating discharge disc 8, which is located so that the material flowing between the bottom of the shell 2 and the lowermost cone section 13 rests on the disc 8. The gyrating motion of this disc causes the material to be discharged continuously but at varying locations around the disc through the annular openings 6 and 7.

As the cooled material falls off the disc 8 toward the hopper cone 9, it slides therealong and is discharged through an outlet 9' provided with a vertical series of conventional type flaps which alternately open and close in response to the weight of the material thereon. The cooled material finally flows onto a belt conveyor below the outlet 9'.

Air for cooling is passed under pressure from a blower C into an annular air space 10 around the bottom of the hopper 9, from which air flows through a plurality of ducts 11 into the lower portion of a cylindrical air distributor 12 having openings 12' through which air flows between the conical sections into the material resting on the disc 8. The quantity of air flowing through the upper passages 12' is controlled by a shiftable valve or damper means 14 operated through a linkage 15 of suitable construction and arrangement. At times it may be necessary to throttle the air through the upper passages 12' in order to avoid too much short circuiting and insufficient cooling.

Some of the air entering through the ducts 11 flows out the bottom of the air distributor 12 and around the annular disc 8 and through the material occupying the annular zone 6 and 7.

The discharge openings provided at 6 and 7 can be kept large enough to permit discharge of relatively large pieces of the cooled product without the possibility of blocking the passageways between the annular disc 8 and the lower part of the shell 2 and lower conical element 13. The discharge over the outer rim at the point 6 and the inner rim at the point 7 provides for the feeding of the material from the cooling zone over the whole cross-sectional area of the cooling bed, thus overcoming the common difficulty of a stationary heat exchanger, in which portions of the material do not travel through the cooling zone as fast as other portions. Therefore, the apparatus of the present invention assures a more uniform cooling of all of the particles of the calcined material passed through the cooler. Furthermore, there is no loss of cooling air.

The material in and moving through the annular passageway 3 is intended to prevent the flow of hot air from the cooling zone into the soaking pit. Furthermore, the soaking shell 4 is spaced from the outer shell 2 to provide a passageway. The flow of air through the different parts of the apparatus is indicated by arrows. The hot air flowing over the top of the shell 4 and around the upper part of the bed of material D therein passes through the opening 1 into the firing end of the kiln A where it is utilized as secondary air for the burner or burners normally extending through the closure B.

The annular disc 8 is adjustably supported on a plurality of heavy rods 17 in the manner shown particularly in FIG. 2, the rods being mounted in casings 16 attached to the hopper wall 9 and the bottom wall of the air chamber 10. The upper part of each rod 17 is ball-shaped and is seated in a ball socket 18 attached to the

bottom of the disc 8. The rod 17 is sealed with respect to the upper end of the casing 16 by a flexible seal 19.

The rods 17 are used to gyrate the disc 8 for feeding material thereon over its edges into the hopper 9. Accordingly, the central portion of each rod carries a ball pivot 24 mounted in a matching concave bearing 24' fixed to the casing 16 at about the position of the wall of the hopper 9, or about midway between the socket 18 and a spherical bearing sleeve 19' mounted on the lower end of the rod 17 and seated in a matching, spherically concave, eccentric sleeve 20 which is rotatably supported in a flanged bearing 21 bolted to the bottom of the air chamber 10. The lower end of each rod 17 is secured to the flange at the lower end of the sleeve 19' by means of long bolts 18' by which the level of the disc 8 can be adjusted vertically with respect to the annular opening directly above.

When the eccentric sleeves 20 of all the supporting rods 17 are rotated, the rods are gyrated and transmit a corresponding gyrating motion to the annular disc 8 so that the material thereon is caused to feed off the edges into the hopper 9. Various means may be provided for rotating the eccentric sleeves 20 in unison and in a manner necessary to give the plate 8 a gyrating motion. As shown in FIG. 2, the downwardly-projecting flange of the sleeve 20 is provided with an attached gear 22 which is driven by a ring gear 23, which drives all of the eccentric sleeves distributed around the annular disc 8. Any suitable means, not shown, may be provided for driving the annular gear 23 at the desired rate.

The annular disc 8 may be strengthened by flanges provided below, as shown, and four or more supporting rods 17 will be provided depending upon the diameter of the plate 8. The air distributor comprising the casing 12 and the frusto-conical elements 13 may be assembled and supported by any suitable means, such as bars extending out to the main casing 2. The ducts 11 may be used to position the lower part of the air distributor, the upper portion of which preferably extends into the lower portion of the shell 4, as illustrated.

It is to be understood that various modifications may be made in details of construction and that such modifications are intended to be covered within the scope of the appended claims.

I claim:

1. In a cooler for hot calcined material such as that of lime, cement and the like, including an upright insulated shell having an opening at its upper end for receiving hot calcined material from a kiln, a metal shell located in the upper portion of the insulated shell and spaced from its inner surface for receiving said material falling through said opening and providing a soaking chamber therefor, an air distributor located at the lower portion of said metal shell and providing therewith an annular passageway for material to be cooled to flow over the air distributor, means for supplying air to said distributor, means defining an annular outlet passageway for cooled material at the lower part of the air distributor, an annular disc below said outlet passageway for supporting the material along the distributor, and means for moving said disc to feed and discharge cooled material therefrom.

2. A cooler as claimed in claim 1, in which the metal shell providing the soaking chamber for hot calcined material is made of heat resisting alloy steel and includes a cylindrical upper portion open at the top and an inwardly sloping portion attached thereto at the bottom terminating adjacent to the air distributor.

3. A cooler as claimed in claim 1, in which the air distributor includes a cylindrical distributor chamber carrying spaced frusto-conical plates extending outwardly therefrom, means for delivering air into said cylindrical chamber and passageways from said chamber into the spaces between said frusto-conical plates.

4. A cooler as claimed in claim 1, in which the lower portion of the cooler includes an inverted conical-shaped hopper for receiving cooled material from said annular disc, and in which said annular disc is located in the upper portion of said hopper.

5. A cooler as claimed in claim 1, in which the means for moving said annular disc comprises means for gyrating said disc in a substantially horizontal plane.

6. A cooler as claimed in claim 5, in which the means for gyrating said annular disc includes a plurality of rods supported below said disc and on which the disc rests, and means for gyrating said rods.

7. A cooler as claimed in claim 4, comprising an air chamber extending around the body of the hopper, means for introducing air into said air chamber, and ducts extending from said air chamber to said air distributor.

8. A cooler as claimed in claim 7, including a circular series of spaced supports each comprising a rod extending through the air chamber and the hopper to the lower part of the annular disc, and means for adjusting said rods vertically for vertically positioning the disc below said annular outlet passageway.

9. A cooler as claimed in claim 8, including means for gyrating said rods and the annular disc.

10. A cooler as claimed in claim 1, including a plurality of upright rods supporting the annular disc and in which the means for moving said disc includes an eccentric device associated with the lower portion of each rod for gyrating the rod and in turn gyrating the disc, said eccentric device including a rotatable eccentric sleeve and means for rotating said sleeve.

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