

July 29, 1958

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COMBINED KILN AND COOLER

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2 Sheets-Sheet 1

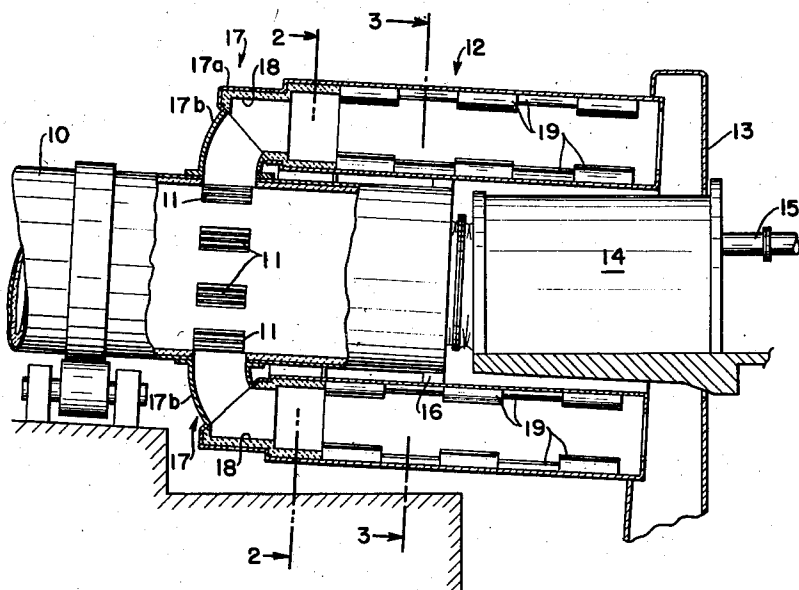


FIG. 1

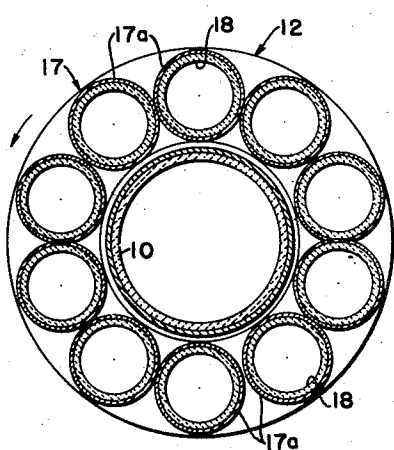


FIG. 2

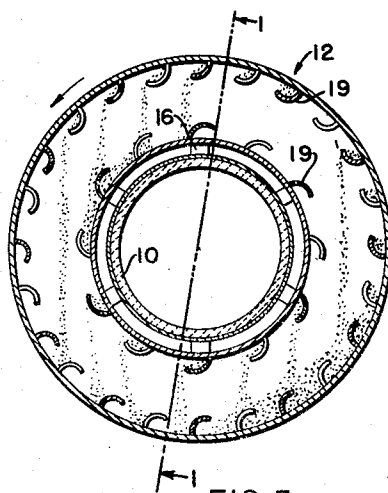


FIG. 3

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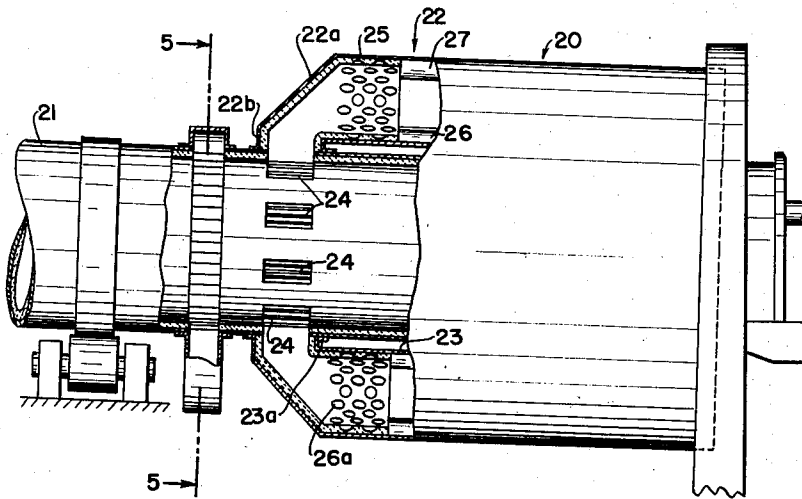


FIG. 4

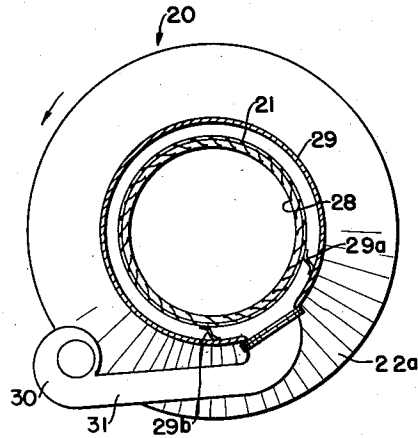


FIG. 5

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COMBINED KILN AND COOLER

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7 Claims. (Cl. 263—32)

This invention relates to rotary kilns for the production of cement clinker and like materials and is concerned more particularly with a rotary kiln having novel means mounted thereon for cooling the burned product and pre-heating air for use as secondary air of combustion. The new cooler is so constructed that the material being discharged from the kiln is efficiently cooled by being repeatedly lifted and showered through a stream of cooling air and, at the same time, the lifter elements and other parts of the cooler are not subject to damage as a result of exposure to injuriously high temperatures.

The kiln of the combined kiln and cooler of the invention is generally of conventional construction but has a plurality of openings through its shell wall in a circumferential row near its lower or discharge end. The cooler comprises a chamber of annular cross-section mounted on the kiln to enclose and project beyond its lower end and the upper end of the cooler is connected to the interior of the kiln through the openings. The chamber is provided with lifter elements mounted on the inner surfaces of its walls and, as the kiln rotates, these elements raise the burned material and let it drop. Air is drawn through the chamber into the kiln, where it is available for combustion and, as the material falls through the air stream, it is cooled and the air is pre-heated. In order to protect the lifter elements from excessive temperatures, the kiln and cooler are so constructed that the burned material is subjected to preliminary cooling either just before or just after it leaves the kiln and such preliminary cooling within the kiln may be utilized for the rapid cooling or quenching of the burned material to impart specific characteristics thereto.

For a better understanding of the invention, reference may be made to the accompanying drawings, in which

Fig. 1 is a view partly in elevation and partly in longitudinal section of the lower end of a rotary kiln equipped with a cooler in accordance with the invention;

Figs. 2 and 3 are sectional views on the lines 2—2 and 3—3 of Fig. 1, respectively;

Fig. 4 is a view partly in elevation and partly in longitudinal section of the lower end of a rotary kiln equipped with a modified form of the cooler of the invention; and

Fig. 5 is a sectional view on the line 5—5 of Fig. 4.

The combined kiln and cooler of the invention in the form illustrated in Fig. 1 includes an inclined rotary kiln 10, which is provided at a distance from its lower end with a plurality of discharge openings 11 through the wall of its shell. The openings lie in a circumferential row and grate bars are mounted in the openings to prevent the discharge of large lumps of material.

The cooler includes a chamber 12 of annular cross-section, which encloses and projects beyond the lower end of the kiln, and the lower end of the chamber is open and extends into a casing 13 having an opening for the usual shield 14 for the burner tube 15. The chamber

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is mounted on the kiln ties 16 and, at the upper end of the chamber, a plurality of tubes 17 lead from the chamber to the kiln at the respective openings 11. Each tube has a section 17a parallel to the axis of the kiln and containing a refractory lining 18, and another section 17b between section 17a and the kiln shell, which is curved and unlined.

A plurality of lifter elements 19 are mounted on the inner surfaces of both the inner and outer walls of the cooling chamber and the elements may be arranged in spaced relation in longitudinal rows with the elements in adjacent rows in staggered relation. The elements are so constructed that, as the kiln rotates, the elements lift the material and discharge it within the parts of the chamber lying both above and below the axis of the kiln. Cooling air is drawn in by the kiln draught through casing 13 and through the chamber into the kiln through openings 11 and the material raised by the lifter elements is thus showered through the air stream flowing through the chamber. The cooled material issuing from the lower end of the chamber enters the casing 13 and is removed from the casing by any suitable means.

The provision of the tubes leading from openings 11 to the upper end of the chamber 12 insures that the material issuing from the kiln will be divided into a number of small streams, which will be preliminarily cooled before entering the chamber. The material coming in contact with the lifter elements in the chamber will be thus at a temperature sufficiently low to prevent the lifter elements from being damaged.

The cooler of the combined kiln and cooler in the form shown in Figs. 4 and 5 includes a chamber 20 directly connected to the kiln 21. For this purpose, the outer wall 22 of the chamber has a frusto-conical section 22a extending toward the kiln and a radial section 22b connected to section 22a and also to the kiln shell, while the inner wall 23 of the chamber has a radial section 23a connected to the kiln shell. The kiln is provided with a circumferential row of discharge openings 24 containing grate bars and the sections 22b and 23a of the chamber walls are secured to the kiln shell on opposite sides of the row of openings. The sections 22a, 22b, and 23a of the walls of the chamber are lined with refractory material and the walls 22, 23 also have linings 25, 26 at their upper ends. The linings 25, 26 are formed with cavities, such as that designated 26a, and the cavities act as lifting means for raising hot material and allowing it to fall. Downward from the linings 25, 26, the inner and outer walls of the chamber are provided with lifter elements 27, which are similar in construction and arrangement to the elements 19.

Upward from the row of openings 24, the kiln 21 is formed with openings in a circumferential row, in which are disposed spaced overlapping plates 28. A casing 29 is mounted to enclose the openings containing the plates and the casing has an inlet opening, to which the outlet of a blower 30 is connected by a duct 31. Partitions 29a, 29b within the casing at each side of its inlet opening prevent air from entering the kiln between the plates except through a lower arcuate portion of the kiln, where the plates are covered by material during the normal operation of the kiln. The plates permit air to enter the kiln and pass through the bed of material upon them but prevent the material from escaping between them.

In the operation of the form of the combined kiln and cooler shown in Figs. 4 and 5, the burned material is cooled by air entering the kiln between plates 28 and the material then enters the cooling chamber 20 through the kiln discharge openings 24. In the upper part of the chamber, the material enters the cavities 26a as the kiln rotates, while farther down the chamber 20, the material

is raised and dropped by the lifter elements 21. Accordingly, the material is repeatedly showered through the air stream drawn through the chamber by the kiln draught. The preliminary cooling by the air introduced into the kiln by the blower and also the cooling of the material in the lined part of the chamber insure that, when the material reaches the lifter elements, it will have been reduced in temperature to such an extent that the elements will not be damaged.

I claim:

1. The combination with an inclined rotary kiln having a plurality of openings through its shell wall adjacent its lower end, of a cooling chamber of annular cross-section mounted coaxially on the kiln to rotate therewith and to enclose its lower end and project beyond that end of the kiln, the lower end of the chamber being open, a casing into which the lower end of the chamber extends, means for conducting material issuing from the openings through the kiln shell into the chamber, and lifter elements on the inner surfaces of both the inner and outer walls of the chamber.

2. The combination of claim 1, in which the conducting means are tubes connected to the outer surface of the kiln shell to surround respective openings and leading to the upper end of the chamber.

3. The combination of claim 2, in which the portions of the tubes adjacent the upper end of the chamber are lined with refractory material.

4. The combination of claim 1, in which the inner and outer walls at the upper end of the chamber extend inward and are connected to the kiln shell on opposite sides of the openings.

5. The combination of claim 4, in which the inner and outer walls of the chamber at its upper end are lined with refractory material, the lifter elements are mounted on the walls downward from the lining, and the lining is formed with lifting cavities adjacent the lifter elements.

6. The combination of claim 1, in which the kiln is formed with openings in a circumferential row upward from the openings for the discharge of material, and means are provided for introducing air into the kiln through the upper openings.

7. The combination of claim 6, in which a casing encloses the part of the kiln containing the upper openings, air is blown into the casing, and the casing contains partition members directing the air to openings in a lower arcuate section of the kiln covered by material during operation of the kiln.

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