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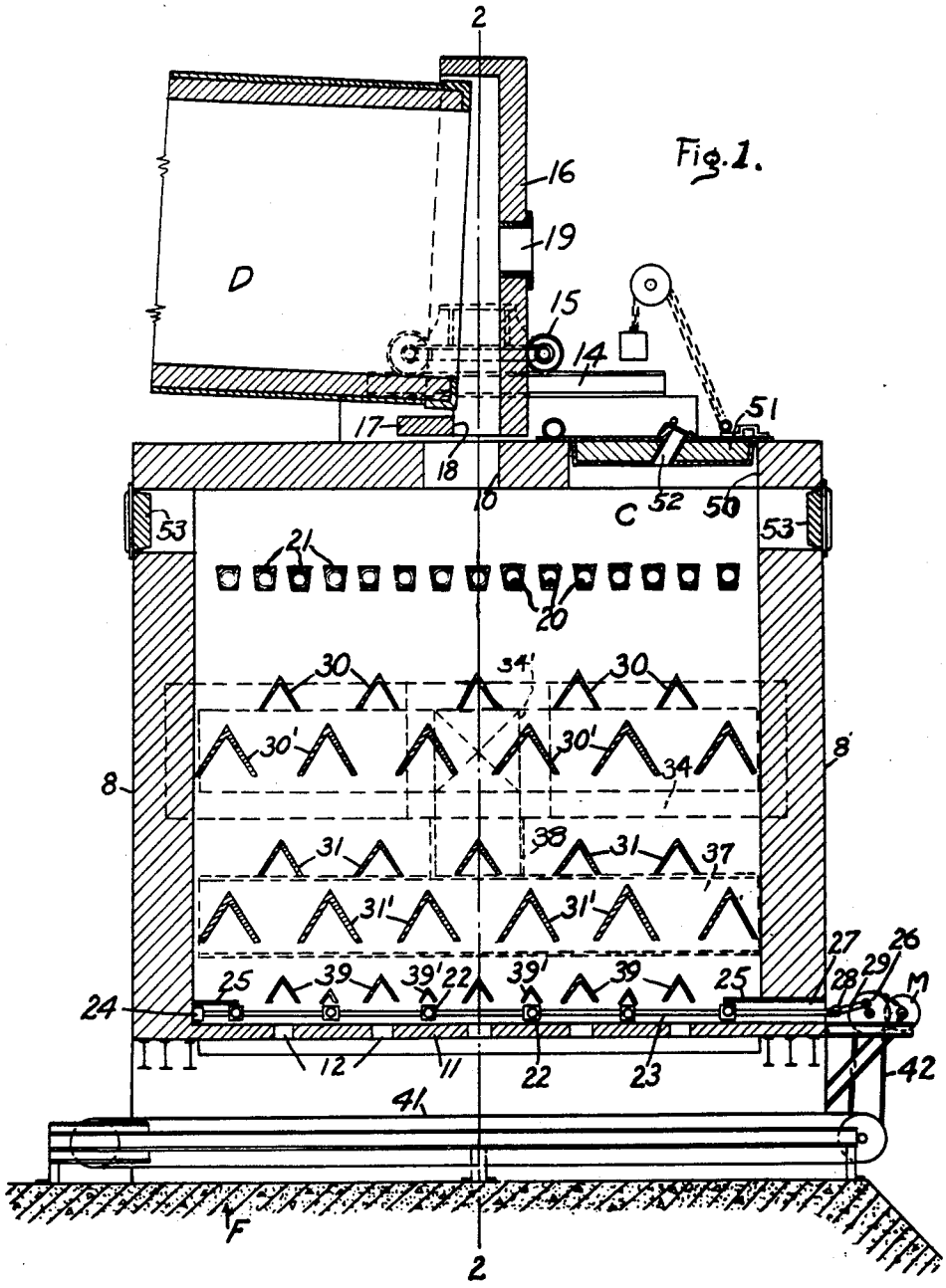
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June 12, 1945. J. E. KENNEDY 2,377,943

MEANS FOR COOLING MATERIAL

Original Filed Jan. 7, 1939 2 Sheets-Sheet 1

Fig. 1.



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Fig. 2.

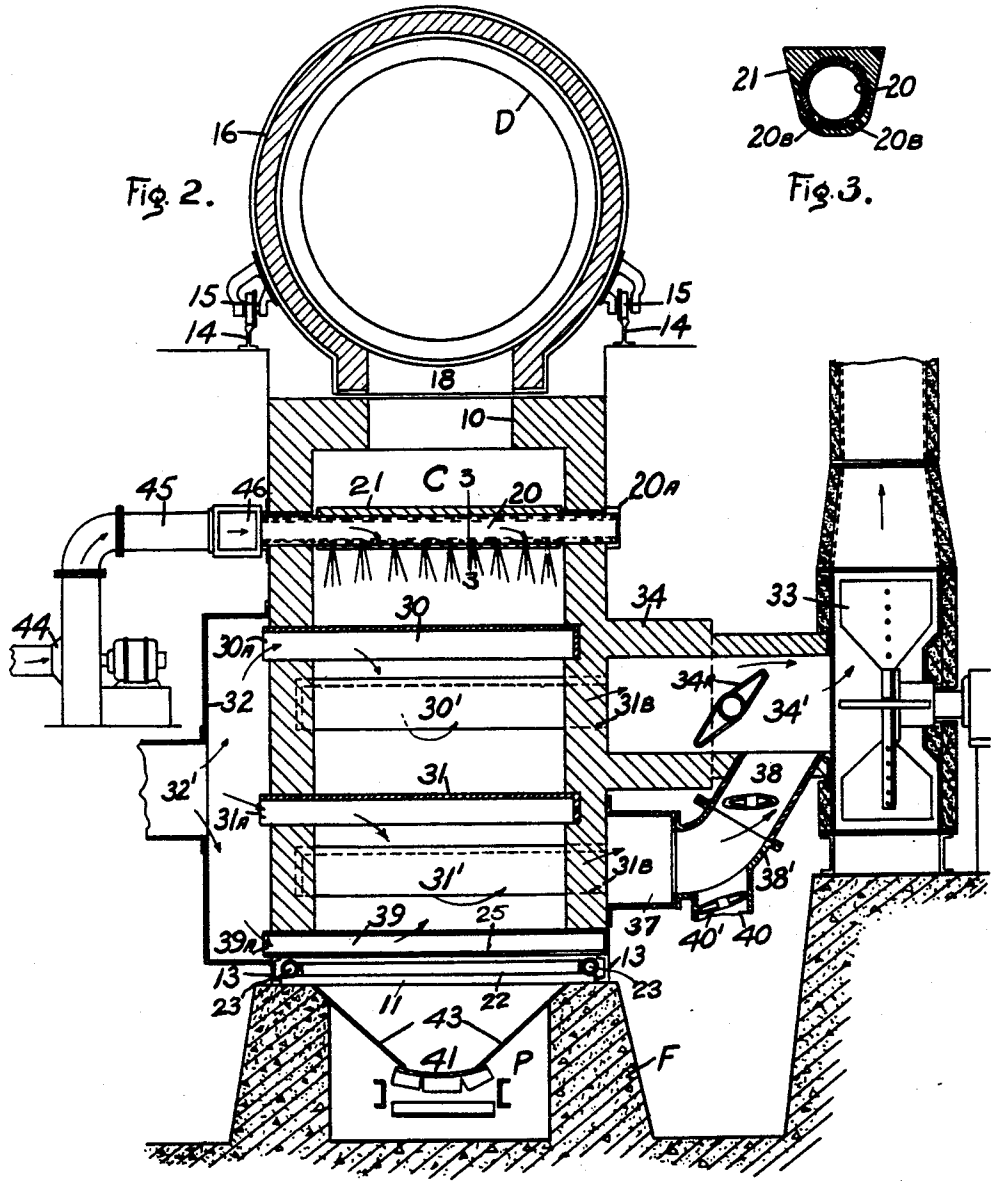


Fig. 3.

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UNITED STATES PATENT OFFICE

2,377,943

MEANS FOR COOLING MATERIAL

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Original application January 7, 1939, Serial No. 249,689. Divided and this application November 7, 1941, Serial No. 418,131

3 Claims. (Cl. 34—170)

This invention relates to means for heat treating, such as calcining or sintering, material in rotary kilns used in the lime, cement, chemical and allied industries, and relates particularly to means to cool the calcined or sintered material as it is discharged from the kiln, the present application being a division of my co-pending application, Serial No. 249,689, filed January 7, 1939, and issued March 17, 1942, as Patent No. 2,276,496.

It is the primary object of the invention to provide improved means for cooling calcined or sintered material adapted to be placed in communication with and receive calcined or sintered material in heated condition from the outlet of a kiln and effect progressive cooling of the material, and to provide means for this purpose that is simple in construction and operation and highly efficient in use.

In the calcining of material to produce clinker for use in making cement it has been found that by a quick quenching and cooling of the calcined material or clinker it may be more easily and efficiently reduced or ground and produce a better cement.

It is the principal object of the invention to provide means including a casing having an inlet opening in the top through which to deliver calcined material from a kiln into the casing, and the provision of means in the casing to intercept the material delivered into the casing and adapted for the delivery of a cooling medium, such as air, in a spray into the casing to the cooling action of which the calcined material is subjected as it gravitates over said means to quickly quench the heated material, and then subject the material collected in a bed in the casing to the further direct action of a cooling medium to progressively cool the quenched material to a lower temperature.

It is another object of the invention to provide means for quickly quenching and cooling calcined material or clinker including a casing having an opening in the top through which to deliver material discharged from a kiln and having a grate bar bottom arranged to support a bed of material in the casing, and means to feed material from the casing through the grate bar bottom and cause the bed of material to move uniformly downward in the casing, provide the casing with a horizontal row of laterally spaced tubes extending transversely of the casing with the ends extending through opposite side walls of the casing and having one end closed and the opposite end connected to means to deliver a cooling medium, such as air, from a source of supply into said tubes and discharge the cooling medium from the tubes in a spray through perforations in the lower wall portion of the tubes and to which spray of the cooling medium the material or clinker is subjected as it gravitates over the tubes, the provision of horizontal rows of channel members supported in inverted position to extend transversely of the casing below the tubes, said channel members having one end closed with the open ends of the members of alternate rows opening through opposite side walls of the casing, and the provision of means connected to the open ends of the channel members opening through one side wall of the casing to induce the flow of the cooling medium into the casing, through the voids in the bed of material in the casing and out of the open ends of the channel members opening through the opposite side wall of the casing, and means to control and regulate the volume of the cooling medium flowing into and through the casing by way of said channel members.

Further objects and advantages of the invention will hereinafter appear.

In the drawings accompanying and forming a part of this application,

Figure 1 is a longitudinal sectional view of a cooler embodying the invention and showing the same in relation to the firing and discharge end of a rotary kiln to receive material therefrom.

Figure 2 is a sectional view taken on the line 2—2 of Figure 1; and

Figure 3 is a cross sectional view of one of the tubes or conductors for discharging a cooling medium in a spray into the casing, the section being taken on the line 3—3 of Figure 2.

In carrying out the embodiment of the invention illustrated in the drawings there is provided a casing or housing 6, shown as of rectangular form and constructed of suitable material, which may consist of brick of refractory material, and comprising opposite side walls 6, 7, end walls 8, a top 9 having an inlet opening 10 substantially centrally therein, and a bottom 11 formed of a horizontal row of laterally spaced bars having openings in the form of parallel slots 12 between the bars extending transversely of the casing and arranging the bottom in the form of a bar grate adapted to support a bed of material in the casing and permit delivery of material from the casing through the slots or spaces between the bars.

The casing is supported upon a suitable foundation, shown as constructed of concrete F, by

sills 13 extending longitudinally below the side walls of the casing and supported upon opposite side walls of a pit P in the foundation.

The casing is mounted with the inlet opening 10 disposed below the firing and outlet end of a rotatable cylindrical drum of a rotary kiln D and in relation to means including a track 14 for engagement of the wheels of a carriage 15 carrying a hood 16 adapted to be moved toward and away from the outlet end of the drum D, and consisting of a disk member of larger diameter than the kiln drum and having an annular flange 17 adapted to engage about the end of the drum when the hood is moved toward the same, the hood flange having an opening 18 adapted to be disposed above the inlet opening 10 of the casing. The kiln is adapted to be fired by a fluent fuel, such as pulverized coal in suspension in an air stream, and for this purpose the hood is provided with a central opening 19 for the passage of a burner, not shown.

The kiln drum is supported to rotate on an axis inclining to the horizontal with the lower end constituting the firing end as well as the discharge end and through which end the material is discharged from the kiln. As the material is discharged from the drum through the inlet opening 18 in the hood flange and the inlet opening 10 into the top of the casing C it is adapted to be collected in the casing in a bed by the arrangement of the grate bottom of the casing. The material in its passage through the casing is received upon and intercepted by means extending transversely of the casing chamber adapted for the discharging of a cooling medium, such as air, in a spray into the casing.

The present invention is particularly adapted for quickly cooling calcined material, such as clinker for use in making cement, delivered from a kiln into the casing. For this purpose means is provided in the casing to first quench the calcined material and then progressively cooling the quenched material to a lower temperature, and is effected by contacting a cooling medium, such as air, directly with the material. As shown this means comprises a horizontal row of laterally spaced tubes or conductors 20 extending transversely of the casing adjacent the top thereof and spaced below the opening 10 with the opposite ends of the tubes extending through openings in the opposite side walls of the casing and having one end closed by caps 20a. The opposite ends of the tubes are connected in communication with a manifold 46 connected by a conduit 45 to the outlet of the casing or housing of a fan 44 adapted to supply the cooling medium under pressure to the tubes 20, the tubes being provided with two rows of perforations and the tubes disposed with said perforations or outlet orifices below the axis of the tubes and the orifices arranged to direct the streams of the cooling medium in a direction diverging downwardly from each other, as shown at 20B in Figures 2 and [illegible]. The tubes 20 are adapted to receive thereon material, in the form of nodules or granules, delivered from the kiln through the inlet opening 10 of the casing, the material gravitating over the tubes and through the spaces between the tubes when it is subjected to the direct action of the streams or spray of the cooling medium discharged through the tube perforations or orifices and effecting a quick quenching of the material.

The material delivered from the kiln into the casing is at a calcining temperature of from 1500 to 2500 degrees Fahrenheit and should any of the material accumulate on the tubes it may injure the tubes. The tubes are, therefore, provided with a jacket of a suitable protecting material 21, such as refractory material, the jacket being shown of greater width at the top than at the bottom so that the opposite side walls of the jackets of adjacent tubes form downwardly diverging walls of the spaces or passages between the tubes, as shown in Figures 1 and 3. The jacket of protecting material is provided with perforations in register with the perforations in the tubes, and the outer surface of the lower portion of the jacket at the corners through which the perforations extend preferably are arranged of arcuate form or rounded, as shown in Figure 3.

The material gravitating over the tubes 20 falls on the casing bottom and is caused to accumulate thereon by means hereinafter described to provide a bed of the material in the casing having a level below the tubes 20 after which the material is ejected or fed from the casing through the spaces between the bars of the grate bottom to cause the bed of material to move gradually and uniformly downward in the casing. The material accumulating in the casing bridges the spaces in the bottom and to eject the material through said spaces means reciprocatory transversely of the grate bars is provided, and comprising, as shown in Figure 1, a series of ejector bars 22 of less width than and disposed above the grate bars, said ejector bars being connected in parallel spaced relation at the ends by rods 23 with an ejector bar disposed above and extending parallelly of the grate bars midway the sides thereof, as clearly shown in Figure 1. The one end of the bar carrying rods 23 are slidably guided in members, as at 24, and shelves 25 extending longitudinally of and inwardly from opposite side walls of the casing overhang the end ejector bars to prevent material accumulating at the outer sides of said ejector bars which may interfere with the reciprocatory movement of the ejector bars. The ejector bar carrying rods 23 are operatively connected at the opposite ends to means to reciprocate the same, shown as an electric motor M having a drive connection with a wheel or disk 26 connected to the ends of the bar carrying rods extended through an opening 27 at the juncture of the bottom with a side wall of the casing and connected together at the ends by a rod 28 extending parallelly of the bars 22, and said rod pivotally connected intermediate the ends to a link 29 eccentrically and pivotally connected to the wheel or disk 26.

The material after passing over the tubes 20 and accumulated in a bed in the casing is subjected to the direct action of a cooling medium, such as air, to effect progressive cooling of the quenched material to a lower temperature. For this purpose there is disposed between the tubes 20 and the bottom of the casing superposed laterally spaced horizontal rows of channel members, preferably of V or acute angle shape in cross section, supported in inverted position with the channels of said members open to the casing and extending parallelly of the tubes 20. The channel members are arranged in pairs of superposed rows, shown as two in number 30, 30' and 31, 31', with the upper members 30, 31 of each pair of members of less cross sectional dimension than and extending parallelly of the spaces between the members 30', 31' of each pair of members. The channel members are closed at one end and are supported at the ends in the

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opposite side walls 6, 7, of the casing with the open ends of the members 30, 31 opening through the side wall 6 to the exterior of the casing, as at 30A, 31A to constitute inlets for the cooling medium into the casing, and the members 30', 31' opening to the exterior of the casing through the opposite side wall 7 of the casing, as at 30B, 31B, and constituting outlets for the cooling medium from the casing, and thus permitting the cooling medium or air to be admitted into the casing and pass through the voids in the bed of the material at different levels in the casing. To connect the open ends 30A, 31A of the channel members 30, 31 with a common source of the cooling air or medium they are connected in communication with a chamber formed by an open end casing 32 secured at the open end to the side wall 6 of the casing C, the casing 32 having a central inlet adpted for the connection of a conduit thereto, as at 32'.

Means are provided for inducing the flow of the cooling medium through the open ends of the channel members 30, 31 into and through the voids in the bed of material in the casing and out through the open ends of the channel members 30', 31', as indicated by the arrows, and comprises a fan 33. A manifold 34 in the form of a box like structure, shown as constructed integral with and extending longitudinally of and laterally from intermediate the top and bottom of the side wall 7 of the casing C, is in communication with the open ends of the channel members 30', said manifold having an outlet member 34' connected in communication with the inlet to the housing of the fan 33. The open ends of the channel members 31' are in communication with a manifold 37 which is connected midway the ends by a conduit 38 to the outlet member 34' of the manifold 34 adjacent the connection thereof with the fan, as shown in Figure 2.

A further horizontal row of laterally spaced inverted channel members extending parallelly of the pairs of rows of channel members is interposed between the lowermost row of channel members 31' and the grate bars 11 of the bottom of the casing. The end members and alternating members 39 of said row of channel members extend parallelly of and below the spaces between the members 31' and above the spaces between the grate bars 11 and are of greater cross sectional dimension than the other members 39' alternating therewith, the latter members 39' being disposed above and midway the sides of the grate bars 11. The channel members 39, 39' are also closed at one end and are mounted at the ends in the opposite side walls 6, 7 of the casing C with the open ends opening through the wall 6 in communication with the inlet casing 32, as at 39A. By disposing the channel members 39 to bridge the spaces between the grate bars 11 the material gravitating over the channel members 39 is directed onto the grate bars 11, and the channel members 39' being disposed midway the sides of the grate bars 11 with the ejector bars disposed below the same relieve the ejector bars of the weight of the material in the casing C which might interfere with the reciprocatory movements of the ejector bars and delivery of material from the grate bars, and said members 39, 39' in conjunction with the grate bars 11 cooperating to support the bed of material in the casing C with the material on the grate bars in position at opposite sides of the ejector bars to be readily ejected from the grate bars by the reciprocation of the ejector bars.

It may not be desirable to cool certain materials heat treated in and discharged from the kiln into the casing to as low a temeprature as other materials, and means are, therefore, provided to regulate the flow of the cooling medium through the grizzly tubes 20 and the open ends of the channel members 30, 31, 39 and 39' into and through the voids in the bed of material in the casing, or into and through the voids in the body of material at different levels in the casing. For this purpose the conduits 34' and 38 are provided with manually operative adjustable closure or valve means, and shown in the form of dampers 34A and 38', respectively, with the closure 34A arranged in the outlet member 34' within the connection of the conduit 38 with said outlet member 34'. It will be obvious that by actuating the closure member 34A to shut off the outlet member 34' from the fan and the closure member 38' is actuated to open the conduit 38 to the inlet of the fan 33 that the cooling medium or air will be drawn into the casing through the open ends of the channel members 30, 31, 39 and 39', but that the greater portion of such air will be drawn into the casing through the open ends of the channel members 31, 39 and 39'. Also that by actuating the closure 38' to shut off the conduit 38 from the fan inlet and the closure 34A is actuated to open the outlet member 34' to the fan inlet that the greater portion of the cooling medium or air will be drawn into the casing C through the open ends of the channel members 30, 31. The cooling medium or air will be drawn into the casing through the open ends of the channel members 30, 31, 39 and 39' and through a greater or less portion of the bed of material in the casing C depending upon whether either one or both of the conduits 34' and 38 are connected to or shut off from the fan inlet. Should the material heat treated and discharged from the kiln consist of lime which may not be completely burnt in order to effect a complete burning and curing of the lime the motor for fan 44 is stopped so that no cooling medium or air will be discharged from the tubes 20 into the casing C, the closure 38' is actuated to open the conduit 38 to the fan and the closure 34A is actuated to shut off the outlet member 34' from the fan 33 with the result that the cooling medium or air is drawn into the lower portion of the casing C only through the channel members 31, 39 and 39' through the bed of material between said channel members with practically no air drawn into the casing through the channel members 30, the upper portion of the casing in effect constituting a soaking pit in which the lime is subjected to the action of the heat retained in the material and causing unburnt lime to be completely burnt and cured and thus producing a better lime.

The air discharged from the fan 33 may be utilized as a heated secondary air supply to a boiler furnace or to the burner firing the kiln, or it may be utilized as a heated air supply to the reducing chamber of a tube mill in pulverizing coal to be mixed with the pulverized coal to serve as the conveying vehicle therefor and a part of the fuel mixture. It may be found that when the fan 33 is connected to the casing C through the conduit 38 that the air exiting from the casing will be at so low a temperature that it is not desirable to use it as a secondary air supply for burning fuel, but it is desired to cool the material passing through the casing C to a low tempera-

ture. In such case the conduit 38 is shut off from the outlet member 34' by the closure means 38', and said conduit is provided with auxiliary outlet means in the form of a conduit 40 in communication with the conduit 38 through the wall thereof for the connection of a fan thereto and discharging the air to the atmosphere, said conduit 40 also being provided with a closure or valve in the form of a damper 40' to connect and shut off the conduit 40' from the conduit 38.

The material fed from the bottom of the casing C is delivered onto a travelling conveyer 41 arranged to travel longitudinally of the pit P and convey such material to and deliver it from one end of the pit, as shown in Figure 1. The conveyer may be driven from the motor M by a belt 42 passing around a pulley on the shaft of the wheel or disk 26 and a pulley rotatable with a conveyer supporting drum. Guides 43 converge downwardly from the opposite ends of the openings between the grate bars of the casing bottom to the opposite sides of the conveyer, as shown in Figure 2.

To gain access to the casing C it is provided with a manhole 50 having a removable closure 51 and the closure arranged with a peep hole 52 having a transparent closure for observing the condition of the material on the tubes 20. The casing C is also provided with openings in the opposite end walls 8 opening to above the tubes 20 and removable closures for said openings, as shown at 53, said openings being adapted for entering an implement into the casing to break up clumps of material that may have been discharged from the kiln onto the tubes 20 in the casing.

Having described my invention, I claim:

1. In means for cooling clinker discharged from a kiln, a casing into the top of which the clinker to be cooled is discharged and having a grate bar bottom arranged to support a bed of clinker in the casing, means reciprocatory transversely of the grate bar bottom to continuously feed the clinker from the bottom of the casing and cause the bed of clinker to gravitate uniformly downward in the casing, a horizontal row of laterally spaced tubes extending transversely of and spaced downwardly from the top of the casing over which the clinker delivered into the casing gravitates, said tubes having one end closed and orifices spaced longitudinally of the tubes, means connected to the open end of the tubes operative to deliver a cooling medium under pressure into the tubes and discharge the cooling medium in sprays through the tube orifices and subject clinker delivered into and gravitating over said tubes and at the top of the clinker bed in the casing to said sprays of cooling medium and quickly quench the clinker, channel members open at one end and mounted in inverted position in the casing in vertically spaced horizontal rows extending transversely in the casing below and parallel to the tubes and over which channel members the clinker gravitates as the bed of clinker moves to the grate bottom, the open ends of certain rows of the channel members opening through one side wall of the casing and the open ends of the other rows of channel members opening through the opposite side wall of the casing, suction means, means to connect the suction means to the open ends of the channel members opening through one side wall of the casing to draw a cooling medium into the casing through the open ends of the channel members opening through the opposite side wall of the casing and through the voids in the bed of clinker and out of the casing to cool the quenched clinker to a lower temperature, and regulatable means in said connections of the channel members with the suction means adjustable to vary the connections of the suction means with the channel members and vary the flow of the cooling medium into and through the voids in the bed of clinker in the casing.

2. In means for cooling clinker discharged from a kiln, a casing having an inlet in the top for the delivery of clinker to be cooled into the casing and having a grate bar bottom arranged to support a bed of clinker in the casing, bars supported to have reciprocatory movement transversely of the grate bar bottom, means operative to reciprocate said bars and continuously feed clinker from the bed of clinker through the grate bar bottom and cause the bed of clinker to move uniformly in a body downward in the casing, a horizontal row of laterally spaced perforated tubes spaced downwardly from the top and extending transversely of the casing and having one end closed, means connected to the open ends of said tubes operative to deliver a cooling medium under pressure into the tubes and discharge the same in sprays through the tube perforations and subject the clinker gravitating over said tubes to the action of the sprays of the cooling medium to quickly quench the clinker, channel members closed at one end mounted in inverted position in the casing in vertically spaced horizontal rows extending transversely of the casing parallel to and below the tubes with the open ends of successive rows of channel members opening through opposite side walls of the casing, a fan, ducts connecting the fan to the open ends of the rows of channel members opening through one side wall of the casing, said fan being operative to induce the flow of a cooling medium into the open ends of and longitudinally of the other rows of channel members transversely of the bed of clinker in the casing and through the voids in the bed of clinker into and longitudinally of the channel members connected to the ducts and out of the casing through said ducts to the fan to cool the quenched clinker to a lower temperature, and regulating dampers in the ducts to vary the connection of the fan with the channel members and shut off one row of channel members from the fan while maintaining the connection of the channel members of another row with the fan.

3. In means for cooling clinker discharged from a kiln, a casing having an opening in the top through which the clinker to be cooled is delivered from the kiln into the casing and having a grate bar bottom arranged to support a bed of clinker in the casing, means reciprocatory transversely of and operative to continuously feed clinker from the bottom of the bed of clinker through the grate bar bottom and cause the bed of clinker to gravitate uniformly in a body downwardly in the casing, pairs of horizontal rows of inverted channel members with the channel members of one row of larger cross sectional dimension than the channel members of the other row, said channel members being open at one end and extending transversely of and spaced upwardly from the bottom of the casing with the open ends of the channel members of smaller cross sectional dimension of one row of each pair of rows of channel members opening through one side wall of the casing and disposed in a plane above and relative to the spaces between the lower row of channel members of larger cross sectional dimension and the open ends of

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said latter channel members opening through the opposite side wall of the casing, a fan connected to the open ends of the channel members of larger cross sectional dimension to induce the flow of a cooling medium into the open ends and longitudinally of the channel members of smaller cross sectional dimension and transversely of the bed of clinker in the casing and from said channel members through the voids in different layers of the bed of clinker and into and longitudinally of the channel of the channel members of larger cross sectional dimension to the fan, and a horizontal row of laterally spaced tubes having one end closed extending transversely of and below the top of the casing and above the uppermost row of channel members, said tubes having perforations spaced longitudinally of the wall portion disposed below the axis of the tubes and over which tubes the clinker delivered into the casing gravitates, and a fan connected in communication with the open ends of the tubes for delivering a cooling medium under pressure into the tubes and discharge the cooling medium in sprays through the tube perforations and subject the clinker gravitating over the tubes to said sprays of cooling medium and quickly quench the same.

JOSEPH E. KENNEDY.