April 5, 1966 JIRO MATSUDA 3,243,893

COOLING MACHINE UTILIZING PACKED LAYERS

Filed Feb. 2, 1962

Fig. 1.

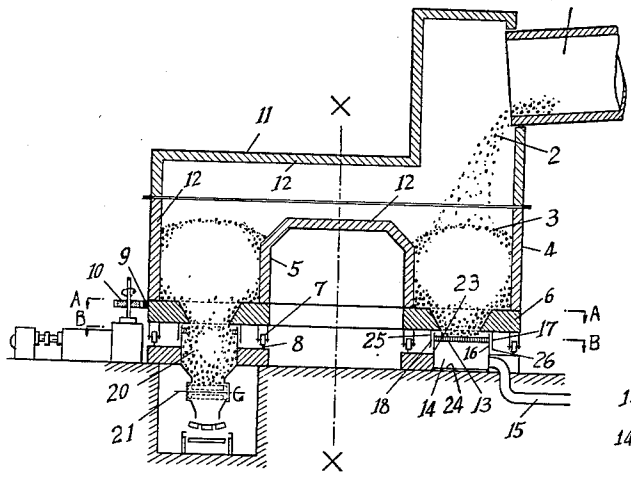


Fig. 4.

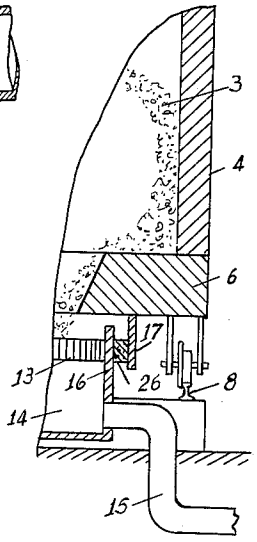


Fig. 2.

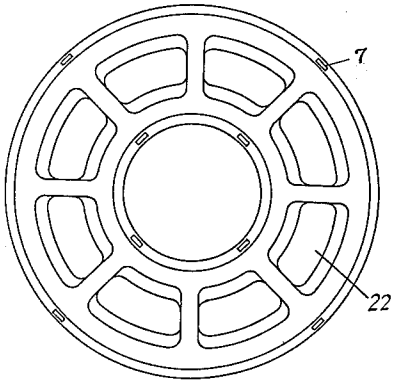
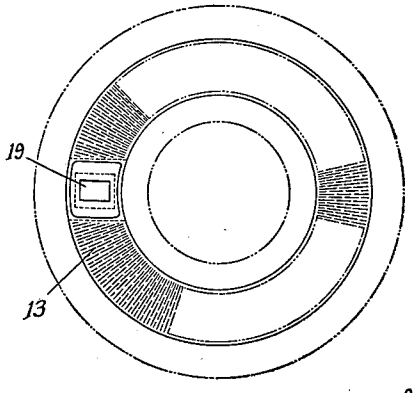


Fig. 3.



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COOLING MACHINE UTILIZING PACKED LAYERS

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The present invention has it as an object to cool granular or agglomerated materials such as cement clinker, which are calcined within a furnace and exhausted at a high temperature, by means of air, and to effectively collect and utilize the retaining heat in the air; and it may be practiced for cooling quicklime and the like in addition to the cement clinker as exemplified in the illustrated embodiment.

It has been generally known that packed layers are used for cooling clinker by means of air, the cooling may be performed with less amount of air in comparison to the cooling machines which are commonly used, thus most of the air at a high temperature may be utilized as secondary air for combustion in the furnace, and therefore the thermal loss is less than that of the cooling machines in the prior art, and various types of cooling machines utilizing packed layers were proposed in the past. However, those cooling machines were not very satisfactory in view of the facts that they must process materials at a very high temperature exhausted from a furnace, that the materials to be cooled often include agglomerated materials, and that upon using packed layers it is required to uniformly perform the throw-in or take-out of the materials to be cooled onto or from the packed layers at all portions of said layers and also to cause the cooling air to pass through the packed layers uniformly at all portions of said layers.

In the cooling machine according to the present invention, in order to achieve the recovery of retained heat within the materials to be cooled with a high efficiency by overcoming the disadvantages of the known cooling machines utilizing packed layers, the packed layers are formed in a horizontal ring shape in such manner that the main body of the cooling machine is formed of two vertical and coaxial cylinders and a ring-shaped base frame which is provided with a plurality of tapered holes, under said main body there is fixedly provided a ring-shaped grate separately from said main body so as to close the tapered holes of the base frame, and thus said packed layers are formed within an annular space formed by the two vertical cylinders and the base frame, the hot clinker being thrown thereinto so as to be uniformly distributed by rotating the packed layers integrally with the main body, through driving means consisting of a gear provided on the outer periphery of the ring-shaped base frame of the main body and a pinion engaging with said gear, by the aid of means for rotatably mounting said main body consisting of a plurality of wheels mounted under the outer and inner cylinders and circular rails fixed secured on the ground so as to engage with said wheels, a provision is made so that the cold clinker may be uniformly taken out of the packed layers without being interrupted by agglomerated materials mixed in the material to be cooled even if they exist, in such manner that there are provided a take-out opening having a sufficiently large dimension at one portion of the ring-shaped grate, a take-out hopper under the take-out opening, and a feeder beneath the take-out hopper which enables to take-out the materials within the hopper continuously while air-sealing the inner space of the hopper from an external atmosphere, and the clinker at a high temperature exhausted from the furnace is caused to fall directly onto

an upper surface of the packed layers so that the troubles due to the high temperature of the clinker may not arise at all whereby there is no tendency that the packed layers become extremely uneven in thickness resulting in unbalance of air flow within the packed layers and decrease the efficiency of the cooling machine, so that an efficient and practical cooling machine may be obtained.

These and other objects and advantages of the present invention will become more apparent upon a perusal of the following description taken in connection with the accompanying drawings, in which:

FIG. 1 is a longitudinal section view of an embodiment of the present invention,

FIG. 2 is a cross section view of the same taken along a section line A—A in FIG. 1,

FIG. 3 is another cross section view of the same taken along a section line B—B in FIG. 1, and

FIG. 4 is an enlarged broken-away view of a portion of FIG. 1.

Now explaining in more detail with reference to the drawings, hot clinker **2** which was calcined in a cement kiln **1** will continuously fall down on packed layers **3** of clinker. The main body of the cooling machine consists of outer and inner cylinders **4**, **5** arranged coaxially and vertically, and a base frame **6** mounting the outer and inner cylinders **4**, **5** thereon, and these components **4**, **5** and **6** are rotated about an axis X—X by means of a gear **9** provided on the outer periphery of the base frame **6** and a pinion **10** engaging with the gear, as they are carried upon rails **8** through a plurality of wheels **7** mounted beneath the base frame **6** along its outer and inner peripheries. The pinion **10** could be driven at any desired speed by means of a prime motor.

Since the packed layers of clinker formed within an annular space confined by the outer and inner cylinders **4**, **5** and the base frame **6** of the main body of the cooling machine are rotated together with the main body, the falling position of the hot clinker from the kiln **1** with respect to the packed layers will move continuously, and thus the clinker is dispersed uniformly on the packed layers. The exhaust end of the kiln **1** is located eccentrically with respect to the main body of the cooling machine so that the clinker **2** exhausted from the kiln **1** may fall directly upon the packed layers **3**. In addition, in order to make the upper surface of the packed layers **3** as flat as possible, the diameters of the outer and inner cylinders **4**, **5** are appropriately selected so that the radial width of the packed layers ring may not exceed a certain dimension. A top cover of the cooling machine is shown at **11**, which is fixed above and separately from the main body by any suitable means so as to maintain a gap space therebetween. Also it communicates at one portion with the clinker exhaust end of the kiln and is arranged in such manner that the air at a raised temperature after collecting heat from the clinker may be introduced thereby into the kiln.

The inside of the outer cylinder **4** and inner cylinder **5** of the main body and the top cover is provided with a lining of fire brick **12**.

The base frame **6** of the main body comprises a number of tapered holes **22** as shown in FIG. 2, and a ring-shaped grate **13** is provided so as to block the holes **22**, in order to prevent the clinker within the main body from falling through these holes, this ring-shaped grate **13** being fixed separately from the rotatable main body at a certain distance. The tapered holes **22** are of sufficiently large dimension to enable large blocks in the clinker to pass therethrough easily.

The main body is rotatable, whereas the grate **13** is fixed. However, as the clinker within the main body is forced in the direction of rotation of the main body

through the base frame 6, it will slide over the grate 13, and thus the clinker packed layers will rotate together with the main body at the same speed.

Under the grate 13 is provided an annular air chamber 14 which is formed of two cylinders 16, 23 arranged coaxially and vertically and a base plate 24, and thus the air blown into the air chamber through an air piping 15 enters into the packed layers through the grate 13 to cool the clinker. The air piping 15 connects a blower and the air chamber 14 to introduce cooling air supplied from the blower into the air chamber. The grate 13 is provided with a lot of small orifices or slits on its entire surface for passing air.

The rotatable main body and the air chamber 14 are air sealed from an external atmosphere, by means of two coaxial cylinders 17, 25 mounted beneath the base frame 6, two coaxial cylinders 16, 23 forming the air chamber, and packings 26, 18 for blocking the gap spaces between 17 and 16 and between 25 and 23, respectively. The grate 13 is provided with an opening 19 for taking out the cooled clinker from the packed layers therethrough as shown in FIG. 3. In addition, under the opening 19 is fixedly secured a take-out hopper 20, under which is also provided a rotary feeder 21 for continuously taking out the clinker in the take-out hopper 20 and also for air sealing the inner space of the take-out hopper 20 from an external atmosphere. Thus the clinker in the packed layers 3 sliding over the grate and rotating together with the main body of the cooling machine, continuously flows into an exhausting hopper 20 through the opening 19, and is then exhausted outwardly by means of an exhausting rotary feeder 21. The opening 19 provided on the grate 13 and the take-out hopper 20 are of sufficiently large dimension to enable a large block in the clinker to pass therethrough freely.

Since the take-out hopper 20 communicates with the packed layers 3 through the opening 19, the inner space of the hopper 20 is always filled by clinker, and consequently as the clinker within the hopper 20 is taken out through the rotary feeder 21, the clinker in the packed layers flows into the hopper 20 by such amount as corresponding to the taken-out amount, and the upper surface of the packed layers 3 lowers by the corresponding amount. However, since the take-out operation of the clinker by means of the rotary feeder 21 is performed continuously because of the fact that the take-out hopper 20 is fixed, whereas the packed layers are rotating, it is possible to lower the clinker packed layers 3 continuously and uniformly at their every portions, and also it is possible to maintain the depth of the packed layers always constant by controlling the take-out rate through the rotary feeder 21 so as to become equal to the falling rate of the clinker from the kiln 1 onto the packed layers.

Although the take-out hopper 20 is provided so as to extend through the air chamber 14, a provision is made such that the air-tightness between the air chamber 14 and an external atmosphere may not be lost.

While an example of employing a rotary feeder has been shown above as a device for taking out clinker from the take-out hopper, the rotary feeder may be replaced by any other devices having a similar function, without affecting upon the function of the cooling machine.

As described in the above, the present invention provides a cooling machine having a high efficiency, in which clinker is uniformly dispersed on packed layers, and continuously and uniformly exhausted from their bottom to maintain a stability of the packed layers, and in which cooling air is uniformly supplied into the entire packed layers.

What I claimed is:

1. A cooling machine utilizing packed layers comprising a horizontal ring-shaped main body confining therewithin an annular space for containing therein packed layers of a material to be cooled, a base member of said ring-shaped main body having a plurality of circumferentially spaced tapered holes extended therethrough; means for rotatably mounting said main body about its vertical axis, a ring-shaped grate horizontally and fixedly mounted and arranged coaxially with and under said main body so as to cover the plurality of tapered holes on said base member of the main body, said grate having a take-out opening at one location and extending below and communicating with said grate for the removal of cooling material; an annular air chamber consisting of outer and inner cylindrical walls arranged coaxially with each other and with said main body, a ring-shaped base plate mounted on said outer and inner cylindrical walls along its outer and inner peripheries, said outer and inner cylindrical walls supporting therebetween said ring-shaped grate at the top of said annular air chamber; an air piping communicating with said air chamber for supplying cooling air from a source of cooling air through said air chamber and through said grate into the packed layers within said main body; an exhausting hopper fixedly secured to the lower end of the take-out opening on said grate so as to extend downwardly through said air chamber, and filled with the material to be cooled; means for air sealing the gap space between the lower surface of the main body and the upper surface of said grate from an external atmosphere; means for continuously driving said main body for rotation about its vertical axis; and fixed means for supplying the material to be cooled onto the packed layers of said material contained within said main body while said main body is being rotated continuously.

2. A cooling machine utilizing packed layers as claimed in claim 1, which further comprises a top cover for said main body, which covers the upper end of said main body so as to allow the rotational motion of said main body but substantially seal the inner space of the main body from an external atmosphere, and in which said fixed means for supplying the materials to be cooled consist of an outlet of a kiln coupled eccentrically with said top cover, whereby the cooling air, after being heated by the retained heat in the packed layers of the materials, is furnished to said kiln through said outlet as secondary air.

3. A cooling machine utilizing packed layers comprising a horizontal main body consisting of outer and inner cylinders arranged coaxially and vertically, a ring-shaped base frame mounted on said outer and inner cylinders along its outer and inner peripheries respectively and having a plurality of tapered holes extending therethrough, and a circular lid fixedly secured to the upper end of said inner cylinder, and thereby confining an annular space for containing therein packed layers of a material to be cooled; means for rotatably mounting said main body about its vertical axis which include a plurality of wheels mounted under the outer and innner cylinders and circular rails fixedly secured on the ground in a coaxial relation with said main body so as to engage with said wheels; a ring-shaped grate having a plurality of small orifices extending therethrough, said grate being horizontally and fixedly mounted under the main body in a coaxial relation thereto so as to cover the plurality of tapered holes on said base frame of said main body, said grate having a take-out opening at one location and extending below and communicating with said grate for the removal of cooling material; an annular air chamber consisting of outer and inner cylindrical walls arranged coaxially with each other and with said main body, and a ring-shaped base plate mounted on said outer and inner cylindrical walls along the outer and inner peripheries of said base plate, and said outer and inner cylindrical walls supporting therebetween said ring-shaped grate at the top of said air chamber; an air piping communicated with said air chamber for supplying cooling air from a source of cooling air through said air chamber and through said grate into the packed layers within said main body; an exhausting hopper fixedly secured to the lower end of the take-out opening on said grate so as to extend down-

wardly through said air chamber and filled with the material to be cooled; means for air sealing the gap space between the lower surface of the base frame of the main body and the upper surface of said grate from an external atmosphere, said air sealing means consisting of outer and inner short cylinders arranged coaxially with each other and with said main body and fixedly secured to the lower surface of said base frame of the main body so as to project downwardly surrounding the upper end of said outer and inner cylindrical walls of said air chamber with small air gaps remaining therebetween, and two circular packing members inserted into said small air gaps; means for continuously driving said main body for rotation about its vertical axis consisting of a gear provided along the outer periphery of said main body and a pinion engaging with said gear, said pinion being in turn driven through a prime motor; a fixed top cover having a circular lower end which opposes the upper end of the outer cylinder of said main body with a small air gap remained therebetween so as to enable the rotation of said main body; and an outlet of a kiln coupled eccentrically with said top cover and communicating the inner space of the

main body with said kiln in such manner that the materials to be cooled which are supplied from said kiln may fall onto said packed layers in the annular space within said main body, and wherein the air supplied through said air piping, said air chamber and said grate and passing through said packed layers upwardly may be furnished, after being heated by the retained heat in the materials, to the kiln as secondary air.

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