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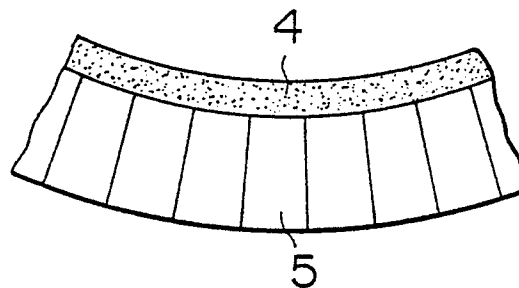
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D-6200 Wiesbaden(DE)(54) **Rotary kiln.**

(57) The present invention is directed to a rotary kiln in which fire bricks with which a shell is lined at positions corresponding to tires-arranging portions are coated, on the free surfaces of said bricks, with fire insulating brick layers or fire insulating castable material layers, and it is also directed to bricks used in the rotary kiln.

FIG. 5



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Rotary Kiln

2. FIELD OF THE INVENTION AND PRIOR ART

The present invention relates to the burning of a cement, more particularly to a rotary kiln which is constituted so as to prevent the mechanical breakage of the rotary kiln itself from occurring easily at a firing time of an operation beginning.

As shown in Fig. 9 attached hereto, a rotary kiln is provided with one shell a, fire bricks b with which the shell a is lined, and 3 or 4 ring-like tires c disposed at certain intervals around the outer periphery of the shell a. The thus constituted rotary kiln is supported on a pair of rollers d. Strip-shaped iron plates e which are called supporting blocks are loosely interposed between the shell and the tires. In other words, the shell is slidingly brought into contact with the tires with the interposition of these supporting blocks e.

Now, when the rotary kiln is rotated together with the tires, a small deviation takes place between the shell and the tires every one rotation of the rotary kiln owing to a difference between the outer diameter of the kiln and the inner diameter of the supporting blocks. This deviation has the unit of "mm/rpm" and is called "a creep of the kiln".

By allowing this creep of the kiln, the mechanical breakage of the rotary kiln can be prevented. For this reason, the inner diameter of the tires must be designed to be a little larger than the outer diameter of the rotary kiln, taking a thermal expansion due to a temperature difference into consideration, when it is intended to obtain the suitable creep of the kiln by bringing the supporting blocks into contact with the tires in a lower portion and separating the supporting blocks from the tires in an upper portion of the kiln even at a high temperature at which the rotary kiln is driven as well as at ordinary temperature. However, an allowable degree of the inner diameter of the tires is limited.

In general, at the time of the firing, the temperature difference between the shell and the tires is great, and therefore, in the case of a usual way, it is necessary that prior to main burning, a fuel is burnt at a feed rate of 1.0 to 2.0 kiloliter per hour (in terms of heavy oil) for a period of 24 to 72 hours in order to preheat the rotary kiln and its ancillary parts to an enough degree. Fig. 1 shows a relation between the creep of the kiln and a time in the case that the preheating is carried out for 48 hours. As understood from this drawing, the mechanical breakage of the rotary kiln does not take place, in so far as the above-mentioned way is employed.

3. OBJECT AND SUMMARY OF THE INVENTION

In recent years, however, an attempt has been made to curtail the above-mentioned preheating time from the viewpoint of a thermal economy, and the main burning is often commenced after a preheating period of 6 to 12 hours. As a result, a temperature of the shell is raised before the heat has reached the tires sufficiently, and therefore the expansion of the shell is greater than that of the tires, so that the space between the shell and the tires becomes small. In consequence, the shell is fastened tightly by the tires, and the creep of the kiln cannot be obtained any more. If the rotary kiln is rotated forcibly in this state, the supporting blocks will shave the inner peripheries of the tires. the shell will be deformed, and the mechanical breakage will occur easily.

The inventors of the present application have found that these phenomena take place in a specific time zone after the firing. Fig. 2 shows a 6 hours' preheating process. As exhibited in this drawing, the rotary kiln is driven discontinuously and the preheating process is simultaneously carried out after the firing, and during this period, the creep of the kiln decreases continuously (see the dotted line in Fig. 2). However, after the feed of a material to the rotary kiln and after the commencement of a continuous operation of the rotary kiln, coating does not adhere sufficiently to the burning sections for a period of 1 to 2 hours. During this period of time, in the burning sections, the heat is liable to be transmitted to the shell through the fire bricks, so that the shell expands and the creep of the kiln decreases noticeably. As a result, the mechanical breakage of the rotary kiln occurs. However, when this time zone has elapsed, the coating adheres to the burning sections, and the tires are also preheated to an enough degree, so that the creep of the kiln increases and is stabilized at a suitable value.

The present inventors have found that the remarkable decrease in the creep of the kiln which occurs in a specific time zone alone after the firing can be eliminated by improving the structure of the bricks, and the present invention has been completed on the basis of this knowledge.

That is, an object of the present invention is to provide a rotary kiln in which each brick comprises the combination of a fire insulating brick and a fire brick, and a shell is lined with the bricks at positions corresponding to tires-arranging portions of the rotary kiln so that the fire insulating bricks may face to the inside of a kiln furnace and so that the fire bricks may face to the side of the shell.

Another object of the present invention is to provide a rotary kiln in which fire bricks with which a shell is lined at positions corresponding to tires-arranging portions of the rotary kiln are coated, on their surfaces facing to the inside of a kiln furnace, with a fire insulating castable material.

Still another object of the present invention is to provide bricks for a rotary kiln which comprises the combination of fire insulating bricks and fire bricks.

A further object of the present invention is to provide bricks for a rotary kiln in which fire bricks are coated, on their free surfaces, with a fire insulating castable material.

4. BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 shows a relation between a creep of a kiln and a time in the case that preheating is performed for 48 hours in a conventional preheating manner;

Fig. 2 shows a relation between the creep of the kiln and the time in the case that the preheating is performed for 6 hours, the solid line being connected with the rotary kiln which is lined with bricks improved by the present invention, the dotted line being connected with the rotary kiln which is lined with conventional bricks;

Fig. 3 is a sectional view of the combined brick used in the present invention;

Fig. 4 is a sectional view in the case that Fig. 3 is seen from side;

Figs. 5 and 7 are sectional views of a brick coated with a fire insulating castable material regarding the present invention;

Figs. 6 and 8 are sectional views in the case that Figs. 5 and 7 are seen from side;

Fig. 9 (I) is a schematic view of the rotary kiln, and a part thereof is cut out; and

Fig. 9 (II) is a cross-sectional view of the rotary kiln.

5. DETAILED DESCRIPTION OF PREFERRED EMBODIMENT

As shown in Fig. 3 and Fig. 4 (which is a sectional view in the case that Fig. 3 is seen from side), a brick 3 comprises the combination of a fire insulating brick portion 1 having a thickness of 15 to 75 mm and a fire brick portion 2 having a thickness of 200 to 230 mm.

The fire insulating brick portion 1 has, for example, a refractoriness of SK 40 or more and a thermal conductivity of 0.6 to 1.2 cal/mhr°C, and the fire brick portion 2 has, for example, a refractoriness of SK 40 or more and a thermal conductivity of 1.8 to 2.4 cal/mhr°C.

A shell of a rotary kiln is lined with these combined bricks, and in this case, it is most effective that the combined bricks are disposed at positions on the shell corresponding to tires-arranging portions for supporting the rotary kiln, particularly at shell positions corresponding to tire portions in burning sections of the rotary kiln.

The disposition of the combined bricks on the shell is carried out so that fire insulating bricks 1 may face to the inside of the rotary kiln and so that fire bricks 2 may face to the side of the kiln shell. If the relation of this disposition is inversely taken, the fire insulating brick will be easily broken during the operation of the rotary kiln because of a poor strength, which fact leads to the peeling of all the combined bricks disadvantageously. When the fire insulating bricks are arranged on the inner side of the rotary kiln, an excessive heat at the time of firing can be shut out, so that a creep of the kiln can be prevented from extremely decreasing until coating has adhered sufficiently to the tires-arranging portions in the rotary kiln. After this time zone has elapsed, the coating adheres thereto and the creep of the kiln is kept in a normal state. Therefore, in the event that the fire insulating brick is broken afterward, any serious trouble will not take place, since the tires have already been heated and expanded.

In the present invention, the combined bricks are disposed on the shell positions corresponding to the tires-arranging portions in an ordinary manner, so that a desired effect can be obtained. However, these combined bricks may be disposed at different positions than the tires-arranging portions. If such a disposition is employed, an initial heat spoiling at the firing can be inhibited conveniently, which fact is effective to prolong a lifetime of the bricks.

A castable material used in the present invention is a kind of monolithic refractories.

A fire insulating castable material means a castable material having a smaller thermal conductivity than the fire bricks to be coated.

As an example in which the fire bricks with that the shell is lined are coated with the fire insulating castable material, there is an integrally formed article composed of the fire insulating castable portion 4 of 15 to 75 mm in thickness and the fire brick portion 5 of 200 to 230 mm in thickness, as shown in Figs. 5 and 6 (which is a sectional view in the case that Fig. 5 is seen from side).

In this case, for example, the fire bricks 5 having a refractoriness of SK 40 or more are coated with the fire insulating castable material 4 having a refractoriness of 1,800°C.

The most effective positions where the fire insulating castable materials are arranged are positions on the shell corresponding to tires portions for supporting the rotary kiln, particularly positions corresponding to tires-arranging portions in burning sections of the rotary kiln, and positions which are 2 to 3 meters away forward and backward from the centers of the tire portions.

When the fire bricks 5 are coated with the fire insulating castable material 4, the excessive heat at the firing can be shut out, so that the creep of the kiln can be prevented from extremely decreasing until the coating has adhered sufficiently to the tires-arranging portions in the rotary kiln. After this time section has elapsed, the coating adheres thereto and the creep of the kiln is kept in a normal state. Therefore, in the event that the fire insulating brick is broken afterward, any serious trouble will not take place, since the tires have already been heated and expanded.

In the present invention, the operation of coating the bricks with the fire insulating castable material may be carried out by blowing or casting the fire insulating castable material 4 all over the surfaces of the fire bricks 5 with which the shell portions corresponding to the tires-arranging portions are lined in an ordinary manner. This operation permits obtaining the desired effect, but it is also possible to coat other portions than the tires-arranging portions with this fire insulating castable material. In such a case, an initial heat spoiling at the firing can be inhibited conveniently, which fact is effective to prolong a lifetime of the bricks. Further, as shown in Figs. 7 and 8, even the fire bricks which have been thinned to a wall thickness of 100 to 200 mm owing to the operation can be recovered up to a desired wall thickness by coating these thin bricks with the fire insulating castable material, with the result that the effect of the present invention can be built up.

By lining the shell positions corresponding to the tires-arranging portions of the rotary kiln with the combined bricks of the insulating bricks and the fire bricks so that the fire insulating brick portions may face to the inside of the rotary kiln and so that the fire brick portions may face to the side of the kiln shell, or alternatively by coating, with the fire insulating castable material, the whole surfaces of the fire bricks facing to the inside of the furnace with which the shell positions corresponding to the tires-arranging portions are lined, an extreme diminution in the creep of the kiln can be prevented and the mechanical breakage of the rotary kiln which easily occurs at the firing can be inhibited.

In consequence, the preheating period of time of from firing to main burning can be shortened remarkably, so that an energy loss necessary for the preheating can be decreased.

Furthermore, even the fire bricks which have become thinner than their original wall thickness, i.e., which have become so thin as to be thrown away owing to the operation, can be recovered and reused by coating these thin bricks with the fire insulating castable material.

Claims

1. A rotary kiln in which each brick comprises the combination of a fire insulating brick and a fire brick, and a shell is lined with said bricks at positions corresponding to tires-arranging portions of said rotary kiln so that said fire insulating bricks may face to the inside of a kiln furnace and so that said fire bricks may face to the side of said shell.

2. A rotary kiln in which fire bricks with which a shell is lined at positions corresponding to tires-arranging portions of said rotary kiln are coated, on the whole surfaces of said bricks on the inside of a kiln furnace, with a fire insulating castable material.

3. Bricks for a rotary kiln in which fire bricks are formed on their free surfaces with fire insulating brick layers.

4. Bricks for a rotary kiln in which fire bricks are formed on their free surfaces with fire insulating castable material layers.

FIG. 1

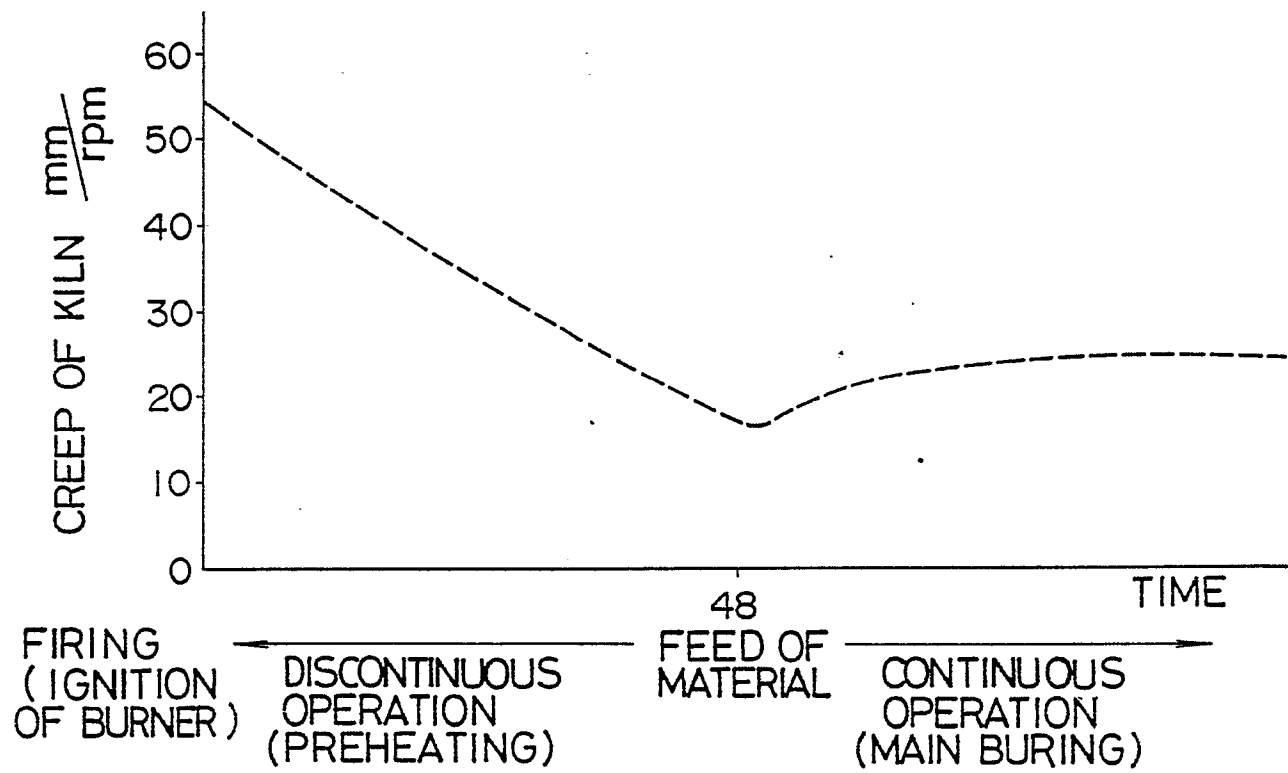


FIG. 2

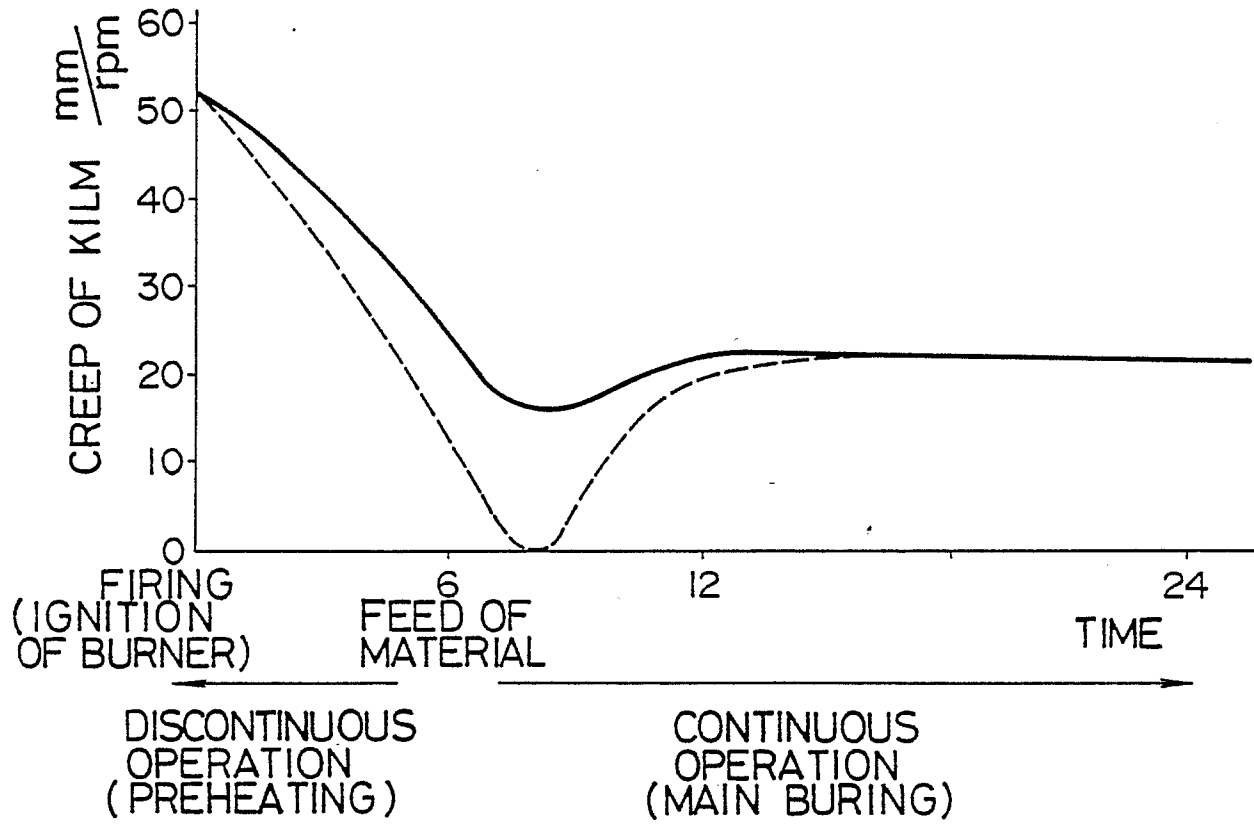


FIG. 3

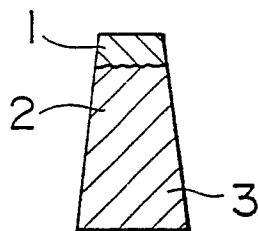


FIG. 4

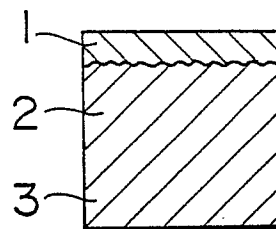


FIG. 5

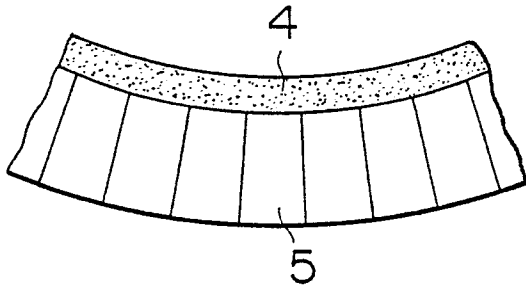


FIG. 6

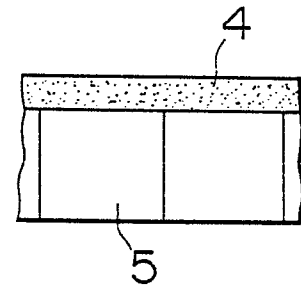


FIG. 7

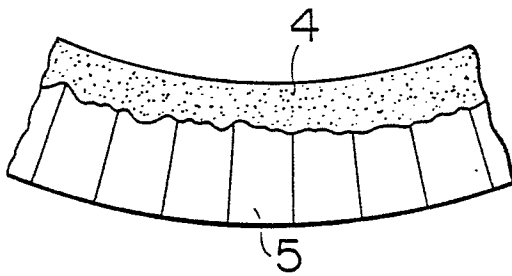


FIG. 8

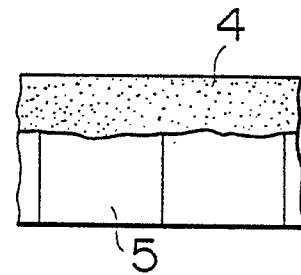
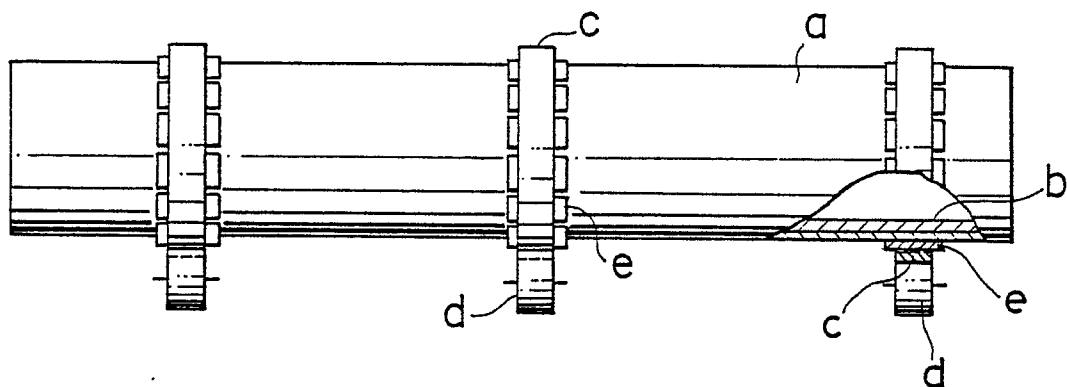
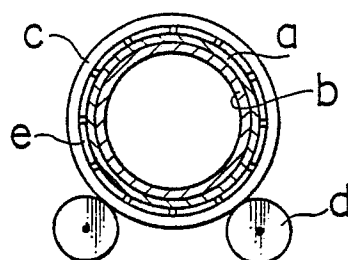


FIG. 9

(I)



(II)





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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
X,Y	US-A-2 633 347 (A.W. HEYMAN) * Column 2, lines 5-25; figures * ---	1,2	F 27 B 7/28 F 27 B 7/22 F 27 D 1/00
Y	FR-A-1 557 822 (SOCIETE DES FORGES ET ATELIERS DU CREUSOT) * Abstract; figures * -----	2	
			TECHNICAL FIELDS SEARCHED (Int. Cl.4)
			F 27 B
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 17-11-1987	Examiner COULOMB J.C.
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			