

[54] **DEVICE FOR SECURING A RACEWAY TO THE CASING OF A ROTARY TUBE SUCH AS A ROTARY KILN, PARTICULARLY**

3,384,356 5/1968 Durinck 308/204

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[57] **ABSTRACT**

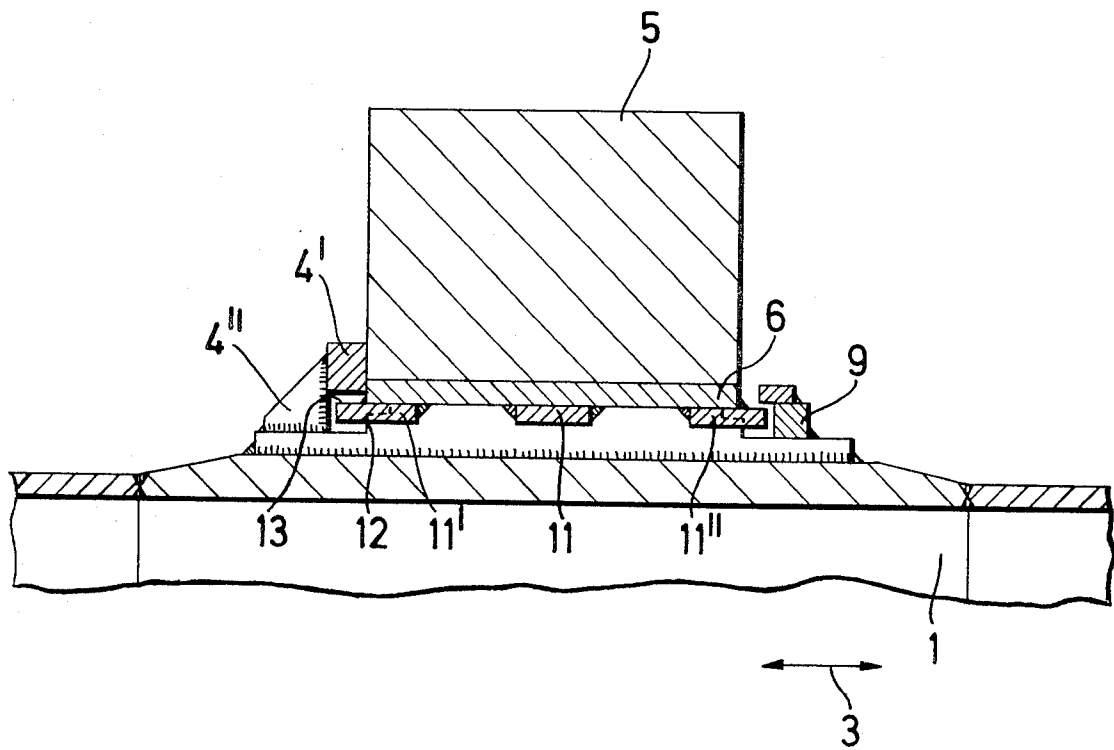
A combination includes a rotary tube having an outer casing, a race having an inner diameter that is greater than the outer diameter of the rotary tube casing at a location thereof at which the race is to be secured onto the casing so that an intermediate space is formed between the race and the casing at the location, and a multiplicity of liner plates releasably received in the intermediate space and substantially uniformly distributed on the periphery of the casing so as to secure the race on the casing.

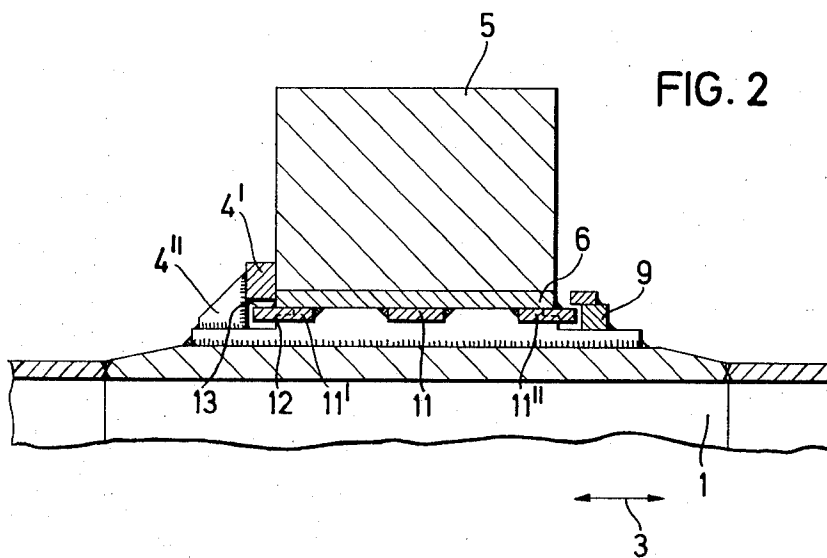
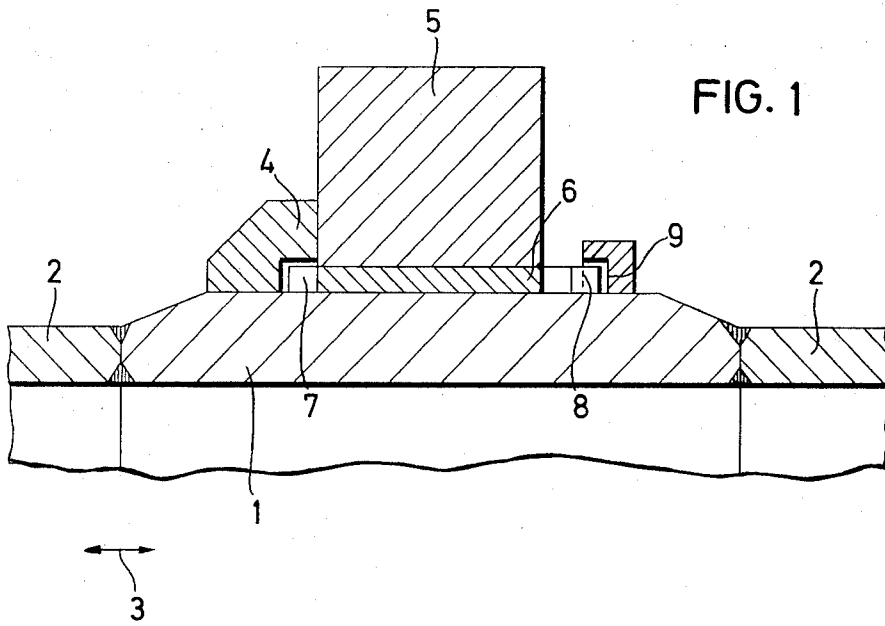
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[58] **Field of Search** 308/203, 204, 202, 36,
308/37

[56] **References Cited**
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8 Claims, 5 Drawing Figures





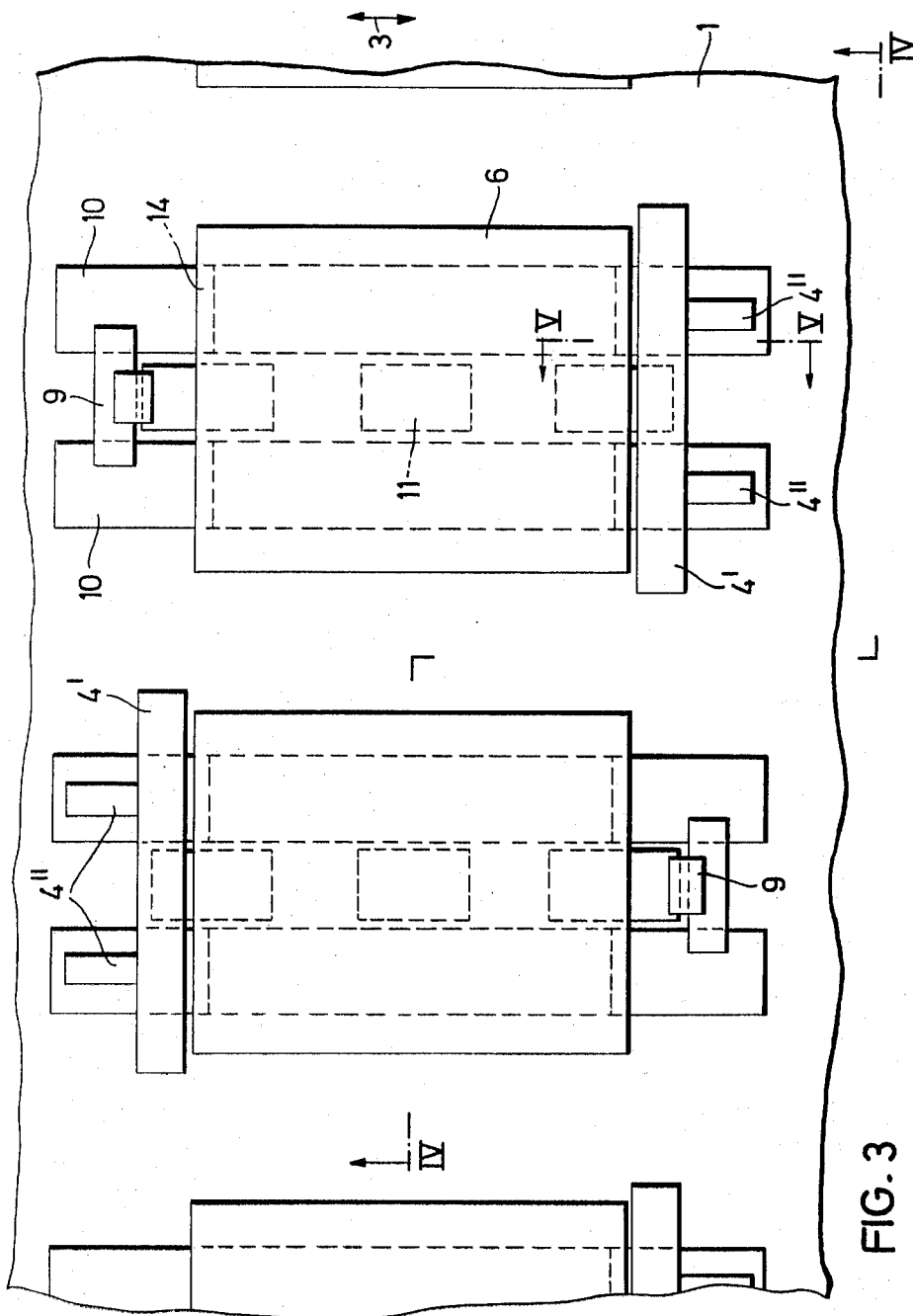


FIG. 3

FIG. 4

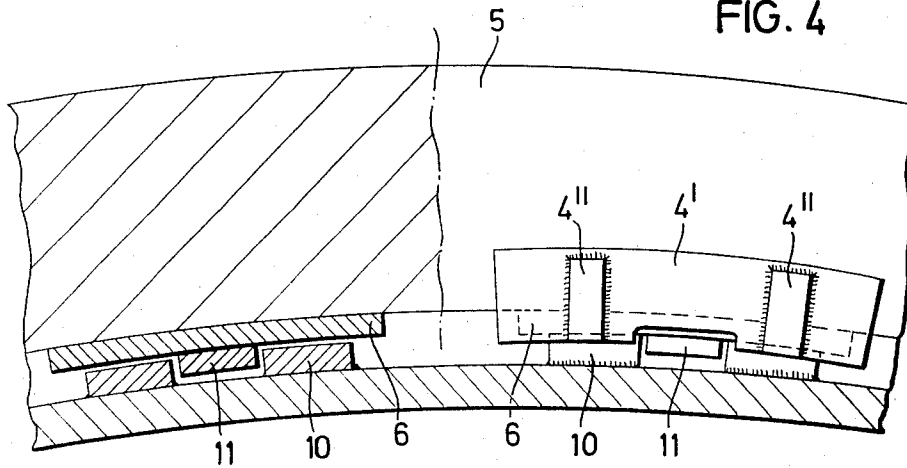
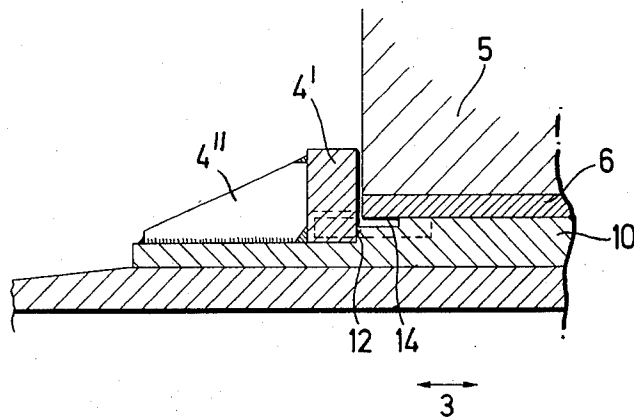


FIG. 5



DEVICE FOR SECURING A RACEWAY TO THE CASING OF A ROTARY TUBE SUCH AS A ROTARY KILN, PARTICULARLY

The invention relates to a device for securing a race or raceway to the casing of a rotary tube such as the casing of a rotary kiln, particularly.

Large rotary tubes, such as rotary kilns particularly, are provided with races at at least two locations thereon in the longitudinal direction thereof. In the region of the races, rollers are located below the rotary tube or kiln for supporting the latter, the races being rollable on the rollers. For this purpose, it is necessary that the races and the casing of the rotary tube be formed with such dimensions that the requirements for ruggedness or sturdiness are adequately taken into account and, accordingly, that the structural development and assembly of the combination be effected so that deformation of the rotary tube casing (ovality) is held to as little as possible at this location. Only if the deformation of the rotary tube casing is kept as little as possible, also during the period of operation, and in the case of rotary kilns, also under the additional influences of thermal stresses, will there be no damage to the rotary tube lining, such as, for example, a ceramic fire-resistant lining, due to the deformations acting upon the lining continuously through the rotary tube casing as a result of the rotation. This requirement as to ruggedness is accounted for by providing the rotary tube casing with a portion of increased wall thickness in the region of the race i.e., the race supporting portion, and by securing the race with special fastening means onto this reinforced or thickened casing part.

Since the casing of the rotary tube is relatively easily deformable in spite of the increased wall thickness of the race supporting portion thereof, while the race per se is circularly rigid and therefore retains its circular shape better even under load, the rotary tube casing fits snugly into the race in the lower region, whereas in the upper region play develops between the rotary tube casing and the race i.e., within the bore of the latter, over a course of time. Due to this deformation, wear-free rolling of the rotary tube casing in the as such enlarged race bore is impossible, and practice has shown that wear occurs between the race and the rotary tube casing or the race shoes seated on the rotary tube casing, which contributes to the increase in the difference of diameters in addition to the accompanying lasting deformations which are in part also promoted by thermal stresses. The ovality of the rotary tube casing thereby further increases in the region of the race and, since the deformation revolves in accordance with the rotation of the rotary tube or kiln, the casing of the rotary tube or kiln experiences at this location a continuously alternating ever more greatly increasing deformation, which disadvantageously effects the durability of the fire-resistant ceramic lining of the tube or kiln, and reduces the life thereof in this region.

In order then to prevent relative movement between the race and the casing of the rotary tube, attempts have been made heretofore to fix the race on the rotary tube casing by shrink-fitting or by effecting a form-locking connection through riveting or gearing between the race and the casing of the rotary tube. Relative movement between race and rotary tube casing was thereby in fact initially suppressed in peripheral direction of the rotary tube, however the increasing de-

formation of the rotary tube casing, which is attributable partially to lasting deformations in connection with the relatively high temperatures to which the rotary tube casing is subjected in spite of the fire-resistant lining, cannot be prevented. The consequence thereof is that, in the course of time, the shrink-fit loosens or that, due to the changes in geometry that are produced, the rivets are sheared off or the structural members forming the gearing or toothing break.

In the heretofore known fastening devices for the race there is therefore produced, after a relatively short time, such a wearing of the seat of the race on the casing of the rotary tube which, for example in the case of a rotary kiln, renders the operation of the kiln no longer adequately reliable, on the one hand, because damage to the lining occurs very rapidly and, on the other hand, as the wearing becomes stronger, the rotary tube casing proper finally becomes damaged. In order to avoid such damage, extensive and costly repair work is generally required, for the performance of which, the rotary tube or kiln must be shut down. The race must then, respectively, be removed from its seat. In many cases, the entire race supporting portion of the casing must be removed and replaced by a new one. In addition to the high costs of repair, long interruptions of operation are furthermore a result thereof, which, in turn, are accompanied by considerable expense in modern large plants.

It is accordingly an object of the invention to provide a device for securing races which avoids the foregoing disadvantages.

With the foregoing and other objects in view, there is provided in accordance with the invention, in combination, a rotary tube having an outer casing, a race having an inner diameter that is greater than the outer diameter of the rotary tube casing at a location thereof at which the race is to be secured onto the casing, so that an intermediate space is formed between the race and the casing at the location, and a multiplicity of liner plates releasably received in the intermediate space and substantially uniformly distributed on the periphery of the casing so as to secure the race on the casing. Through this inventive construction, it is possible to reproduce a race seat in due order without any great cost of repairs if, after a given running time, the play between rotary tube casing and race permissible during operation of the rotary tube is exceeded. A considerable advantage apparent therefrom is that in order to reproduce an orderly seat for the race, it is not necessary at all to remove the race, but rather a race seat can be reproduced in good order during a brief break in the operation by replacing one set of liner plates with a new set of liner plates that have a suitably greater thickness than that of the replaced set of plates.

In accordance with another feature of the invention, the combination includes bracing means and retaining means secured to the rotary tube casing, and locking means, preferably formed of respective noselike projections, are provided on the lining plate, the locking means being connectible with at least one of the bracing means and the retaining means. By this feature of the invention, assurance is advantageously provided that the lining plates are securely fixed on the rotary tube casing and cannot fall off even if, after a very long operating period, play develops between the outer diameter of the rotary tube casing, which is established by the liner plates, and the inner diameter of the race.

In accordance with a further feature of the invention, the bracing means is located on the rotary tube casing directly adjacent the race and in the vicinity of at least one of the liner plates, the bracing means being of such height above the casing that both the race and the one of the liner plates is braceable thereon in axial direction. This feature provides the assurance that neither the race nor the liner plates can be displaced in axial direction on the rotary tube casing under the effect of axial thrust which is produced in rotary tubes and especially in rotary kilns that are mounted at an inclined angle with respect to the horizontal.

In accordance with an added feature of the invention, race shoes are secured to the rotary tube casing, each of the liner plates resting upon at least one of the race shoes. Assurance is thereby provided that the race seat is cooled to a given degree by the air which passes between the race shoes, that, moreover, when damage occurs to the fire-resistant lining in the region of the race, the liner plate and especially the race is widely protected against the local higher casing temperature then occurring at this location, and that even for a complete wearing of the liner plates, the rotary kiln casing proper is still adequately protected by the race shoes and, furthermore, this construction provides a good seat for the liner plates and simplifies the assembly as well as the production of a releasable connection of the liner plates with the casing of the rotary tube.

In accordance with additional features of the invention, each of the race shoes has a supporting length that is shorter than the width of the race. Furthermore, the liner plates, as viewed in peripheral direction of the rotary tube casing, project respectively over the edges of the race shoes which support the liner plates in the region of the ends thereof. Through this feature, the advantage is derived that end pressure between the inner surface of the race and the outer surface of the liner plates is reduced in this region, and the wearing that occurs due to relative movement between race and rotary tube casing, which is instituted after a very long period of operation, is considerably reduced in the region of the "trailing" edge, so that the inner surface of the race is protected from damage.

Other features which are considered as characteristic for the invention are set forth in the appended claims.

Although the invention is illustrated and described herein as embodied in device for securing a raceway to the casing of a rotary tube such as a rotary kiln, particularly, it is nevertheless not intended to be limited to the details shown, since various modifications and structural changes may be made therein without departing from the spirit of the invention and within the scope and range of equivalents of the claims.

The construction and method of operation of the invention, however, together with additional objects and advantages thereof, will be best understood from the following description of specific embodiments when read in connection with the accompanying drawings, in which:

FIG. 1 is a fragmentary longitudinal sectional view of a rotary kiln showing a race supporting portion thereof with liner plates and a race seated thereon in accordance with the invention;

FIG. 2 is a view similar to that of FIG. 1 of a preferred embodiment of the invention which includes race shoes;

FIG. 3 is a top plan view of FIG. 2, rotated through 90° with the race omitted;

FIG. 4 is a fragmentary sectional view of FIG. 3 taken along the line IV—IV in the direction of the arrows; and

FIG. 5 is a fragmentary sectional view of FIG. 3 taken along the line V—V in the direction of the arrows.

Referring now to the drawing and first, particularly, to FIG. 1 thereof, there is shown in longitudinal section a race supporting portion 1 of a rotary kiln which has a greater wall thickness than that of the adjacent portions of the rotary kiln casing wall 2, and on one side of which a bracing member 4 is directly secured to the race supporting portion 1. A race 5 is slid over the race supporting portion 1. The race 5 is formed with a bore of greater diameter than the outer diameter of the race supporting portion 1. Into the intervening space thus formed between the inner surface of the race 5 and the outer surface of the race supporting portion 1, a liner plate or shim 6 is releasably inserted from the side of the race supporting portion 1 located opposite the side thereof at which the bracing member 4 is secured. The liner plate 6 is formed at the ends thereof, as viewed in axial direction of the rotary kiln as represented by the double-headed arrow 3, with respective noselike extensions 7 and 8 which serve as locking members. The extension 7 engages in a recess formed in the bracing member 4, while the extension 8 is clasped by a claw-like retaining member 9 which is firmly though detachably secured, for example by welding, to the race supporting portion 1. The liner plate 6 is thereby secured against displacement both in peripheral direction of the rotary kiln as well as in radial direction thereof. As shown for example in FIG. 3, a multiplicity of liner plates 6 of similar construction are distributed over the outer peripheral surface of the rotary kiln and are respectively secured by corresponding bracing members 4 and retaining members 9.

Thus, in an advantageous construction of the invention, the bracing members 4, respectively viewed in axial direction of the rotary kiln, are secured on only one side of the liner plate while, viewed in peripheral direction of the rotary kiln, the bracing members 4 with regard to at least a respective liner plate, are disposed alternately on the one or on the other side of the race, and, respectively, on the side of the race, for each liner plate located opposite the bracing members 4, respectively, at least one (detachable) retaining member 9 is disposed. There is thereby assured, on the one hand, that the race is entirely fixed in both axial directions, and that, on the other hand, the possibility exists, nevertheless, without removing the race, to exchange the liner plate after only detaching and removing the retaining member 9. The thickness of the liner plate is selected so that, for example, for a rotary kiln, with regard to the diameter of the rotary kiln and the temperature prevailing in the respective race supporting portion, a given amount of play exists in cold condition thereof, i.e., the liner plates can consequently be loosely inserted. However, at operating temperature, due to the different thermal expansions of the race supporting portion and of the race, a firm race seat analogous to a shrink-fit connection is achieved. If play should develop again after a very long operating period due to remaining deformation, which can in fact cause corresponding wear after a given period, new and suitably thicker liner plates are inserted after the retainer

member 9 has been detached. The exchange of the liner plates requires only that the kiln be cooled, without requiring the race to be removed.

In FIGS. 2, 3, 4 and 5, there is shown a preferred embodiment of the invention. According to the sectional view of FIG. 2 and the top plan view of FIG. 3, several so-called race shoes 10, located adjacent and in spaced relationship to one another and parallel to the axial direction represented by the double-headed arrow 3, are firmly welded onto the race supporting portion 1 of a rotary kiln, the race supporting portion 1 attaining a larger diameter in accordance with the height of the race shoes 10.

A race 5 is slid over the race shoes 10 and, in accordance with the invention, due to the greater inner diameter of the race 5 as compared to the outer diameter of the race supporting portion 1 together with the race shoes 10 welded thereon, a corresponding intermediate space remains therebetween. Liner plates 6 are slid into this intermediate space and uniformly distributed on the periphery of the kiln, the liner plates 6 lying on respectively two race shoes 10 and being of such thickness that, with regard to the different thermal expansions of the race supporting portion 1 and of the race during operation, a firm connection between the race and the casing of the rotary kiln is formed.

In accordance with an advantageous construction of the device of the invention, each race shoe 10 is longer than the width of the race 5 and the respectively projecting end is stepwise broken off, the edge of the step being disposed respectively in an elongation of the lateral surface of the race and thus forming in axial direction an abutment or stop surface for the bracing members 4. Onto this broken-off step, on the one side of the race, the bracing member 4 is welded, the surface 12 of the step serving simultaneously as abutment or stop surface for the bracing member 4 and thus considerably simplifying the assembly of the device of the invention. The height of the bracing member 4 is chosen so that both the race 5 as well as the liner plate 6 abut the bracing member 4 in axial direction. The end view in FIG. 4 shows an embodiment of such a bracing member 4 that is formed of a ring segment 4' which is firmly connected through two props 4'' to the race shoe 10.

According to the invention, in the embodiment of FIG. 4, nose-like locking members 11 are secured respectively to the underside of the liner plates 6 and are disposed between two respective race shoes 10, the width, respectively, of a locking member 11 corresponding substantially to the intermediate space between two race shoes 10. Thereby, in a relatively simple manner, assurance is provided for dependably securing the liner plate 6 against displacement in peripheral direction.

The nose-like locking or securing members 11' and 11'' (FIG. 2) located at the ends of the liner plates 6, as viewed in axial direction of the rotary kiln, project outwardly over the liner plates, in accordance with the invention, and are retained by the bracing members 4 and the retaining member 9. For this purpose, for example, there is provided, in the ring segment 4' of the bracing member, a recess 13 into which the projecting part of the locking or securing member 11' extends. On the side opposite the bracing member 4, a somewhat hook-shaped retaining member 9 is located on the race shoes 10 and overlaps with the upper part thereof, as viewed in FIG. 2, the projecting end of the securing or

locking member 11''. Thereby, the liner plate 6 is secured against displacements in axial and in radial directions.

In FIG. 5, there is shown in enlarged view a section taken along the line V—V in FIG. 3, from which the special inventive construction of the race shoes 10 is discernible. The supporting surface of the race shoe 10 is shorter than the width of the race 5 and the liner plate 6 slipped thereunder. This is achieved by the fact that, respectively, as viewed in axial direction, i.e., in direction of the double-headed arrow 3, the race shoes 10 are twisted at the ends thereof so that a ledge 14 is formed. Accordingly, the width of the liner plates 6, as is apparent from the partial section at the left-hand side of FIG. 4, is of such dimension that, as viewed in peripheral direction, the liner plates 6 stand out over or project beyond the outer edges of the race shoes 10 supporting the same. Through this construction, assurance is provided that the seating surface of the race 5 is not exposed to any end pressures with corresponding deformation and damage to the seating surface.

From the foregoing description it is furthermore to be noted that, respectively, the projecting end of a race shoe 10 is stepwise broken off, the edge of the step being respectively disposed in an elongation or extension of the lateral surface of the race and, in axial direction, forms an abutment or stop surface 12 for the ring segment 4' of the bracing member.

As noted hereinbefore, the invention of the instant application is not limited to the aforescribed embodiment. Thus, for example, the liner plates can extend over only one or over more than two race shoes. Likewise, the bracing or retaining members can extend over a greater part of the periphery of the rotary kiln.

I claim:

1. In combination, a rotary tube having an outer casing, a race having an inner diameter that is greater than the outer diameter of said rotary tube casing at a location thereof at which said race is to be secured onto said casing, so that an intermediate space is formed between said race and said casing at said location, a multiplicity of liner plates releasably received in said intermediate space and substantially uniformly distributed on the periphery of said casing so as to secure said race on said casing, and race shoes secured to said rotary tube casing, each of said liner plates resting upon at least one of said race shoes, each of said race shoes being longer than the width of said races, and consequently having a projecting end, said projecting end, respectively, being broken off stepwise, the edge of the step being disposed, respectively, in an elongation of the lateral surface of said race and, in axial direction, forming an abutment surface for said bracing means.

2. In combination, a rotary tube having an outer casing, a race having an inner diameter that is greater than the outer diameter of said rotary tube casing at a location thereof at which said race is to be secured onto said casing, so that an intermediate space is formed between said race and said casing at said location, a multiplicity of liner plates releasably received in said intermediate space and substantially uniformly distributed on the periphery of said casing so as to secure said race on said casing, bracing means and retaining means secured to said rotary tube casing, and locking means provided on said lining plate, said locking means being connectible with at least one of said bracing means and said retaining means, said bracing means comprising a

plurality of bracing members which, respectively, as viewed in axial direction of said rotary tube, are secured only on one side of said liner plates and, as viewed in peripheral direction of said rotary tube, said bracing members, with regard to at least one respective liner plate, being disposed alternately on one and on the other side of said race, and respectively, for each of said liner plates, on the side of the race located opposite that at which said bracing members, respectively, are located, at least one retaining member is disposed.

3. The combination of claim 1 wherein said bracing means is located on said rotary tube casing directly adjacent said race and in vicinity of at least one of said liner plates, said bracing means being of such height above said casing that both said race and said one of said liner plates is braceable thereon in axial direction.

4. The combination of claim 1 wherein each of said race shoes has a supporting length that is shorter than the width of said race.

5. The combination of claim 1 wherein said liner plates, as viewed in peripheral direction of said rotary tube casing, project respectively over the edges of said race shoes which support said liner plates in the region of the ends thereof.

6. The combination of claim 2 wherein said retaining member is detachably secured to the respective liner plate.

7. In combination, a rotary tube having an outer casing, a race having an inner diameter that is greater than the outer diameter of said rotary tube casing at a location thereof at which said race is to be secured onto said casing, so that an intermediate space is formed between said race and said casing at said location, a multiplicity of liner plates releasably received in said intermediate space and substantially uniformly distributed on the periphery of said casing so as to secure said race on said casing, bracing means and retaining means secured to said rotary tube casing, and locking means provided on said lining plate, said locking means being connectible with at least one of said bracing means and said retaining means, said locking means being formed, respectively, of noselike projections, said noselike locking projections being respectively secured to the underside of said liner plates, and a respective locking projection being disposed between a pair of spaced race shoes secured to said rotary tube casing and supporting a respective liner plate, said locking projection having a width substantially corresponding to the spacing between said pair of race shoes.

8. The combination of claim 7 wherein, as viewed in axial direction of said rotary tube, said noselike locking projections extend beyond the respective liner plate and are held respectively by one of said bracing means and said retaining means.

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