

Description

The present invention relates to a roller hearth kiln and more particularly to a combination of connection means for connecting a ceramic roller with a metallic drive shaft in such a kiln.

Various types of roller hearth kilns are known which are used to sinter articles which are conveyed on a number of ceramic rollers arranged along a tunnel of the kiln. The rollers may be replaced by new rollers when they wear away or are damaged. The rollers also must be periodically demounted and cleaned when glaze on the articles is unintentionally applied to the rollers. On replacing or cleaning, the operation of the kiln must be stopped. If it takes a long time to demount the rollers from the kiln, productivity will be reduced.

Japanese Utility Model Publication Sho 64-4072 discloses a modification of a roller hearth kiln. FIGURES 10, 11 and 12 in the accompanying drawings show such an apparatus for driving rollers. The apparatus comprises a number of rollers 2 extending from opposite sides of the tunnel through the walls 1 of the kiln. A rotary drive device 3 holds each of the rollers at one end and a support device 4 rotatably supports each of the rollers 2 at the other end. Each of the rollers 2 is kept in a spring 5 which is wound therearound at one end 2a. The outer periphery of the spring 5 is pressed by a plurality of pawls 7, such that the roller 2 is connected with a drive shaft 10 through a cylinder 8 via the spring 5. The drive shaft 10 is rotatably supported by a support frame 11 and receives a drive power from a source of drive through a sprocket 12. The driven end 2b of the roller 2 is supported, in two-point linear contact as shown in FIGURES 11 and 12, by a pair of receiver rollers 9 which are mounted on brackets 17 attached at frames 18 on the side hearth walls 1a. When the drive power is transmitted to the rollers 2 to rotate them, the receiver rollers 9 are also rotated.

In the prior art driving mechanism as mentioned above, each of the rollers 2 may be removed from the connection structure to draw the roller 2 in the right-hand direction as viewed in FIGURE 10. At this time, the spring 5 wound around the roller end 2a will be passed through the hearth at high temperature. Thus, the spring 5 will reduce its resiliency and may be accidentally removed out of the roller 2.

If there is any trouble in the hearth, the rollers might be driven in the reverse direction to convey articles toward the inlet side of the hearth. In such a case, a frictional force is created between each of the roller ends 2a and the corresponding spring 5, and will loosen the winding of the spring 5 to raise the pawls 7 into its opened state. Thus, the pawls 7 might be disengaged from the corresponding roller 2.

In the prior art, the rollers 2 made of ceramics were produced with an increased dispersion in exter-

nal diameter for reason of manufacturing. Such an increased dispersion could produce a slippage between each of the rollers 2 and the corresponding receiver roller 9 to make the speed of conveyance in the roller irregular. Therefore, the conveyance of articles is not good. For example, a manufacture tolerance equal to $\pm$ one millimeter may exist when a roller has its external diameter equal to 25 mm. A difference equal to six millimeters in distance of conveyance may exist between each adjacent rollers through one complete revolution when a plurality of such rollers are used. This results in irregularity of conveyance due to the slippage between the rollers 2. Furthermore, either of the ceramic roller 2 and the metallic receiver roller 9 is liable to be worn away since the two rollers have a difference in hardness. For example, if the external diameters of adjacent rollers 2, as shown in FIGURE 11, are respectively equal to 24 mm and 26 mm and the external diameter of the respective receiver rollers 9 is equal to 40 mm, a deviation equal to 6 mm will be created between one roller 2 having its external diameter of 26 mm and the corresponding receiver roller 9 when the other roller 2 having its external diameter of 24 mm is rotated through one complete revolution. This results in slippage between the rollers to increase the wear.

It is therefore an object of the present invention to provide a roller hearth kiln having means for connecting a metallic rotary drive shaft with a ceramic roller in a positive manner.

Another object of the present invention is to provide an apparatus for driving rollers in the roller hearth kiln comprising means for performing the mounting and demounting of ceramic roller on the corresponding rotary drive shaft in a rapid manner.

A further object of the present invention is to provide an apparatus for driving rollers in the roller hearth kiln, comprising means for supporting the rollers without direct slippage to reduce the abrasion in the rollers and to improve the durability in the rollers, even if there is an appreciable dispersion in external roller diameter.

The present invention provides a roller hearth kiln as set out in claim 1. Preferred optional features of the invention are set out in claims 2 to 11.

With the embodiment of claim 2, when the resilient means such as a leaf spring mounted on the holder fixed to the drive shaft is depressed, the connection tube can be easily removed out of the corresponding holder. With the embodiment of claim 6 the roller is for example inserted into the metallic connection tube detachably mounted on the metallic rotating shaft. When the fastening means is then tightened against the connection tube, the inner wall of the connection pipe is urged against the outer wall of the roller over a larger contact area through the flexure of the connection tube wall at the slit. Thus, each of the rollers can be tightly and resiliently joined to the cor-

responding one of the connection tubes.

In the embodiment of claim 10, the coil spring wound about each of the ceramic rollers at its driven end is brought into contact with the corresponding one of the supporting rollers such that the driven end of the ceramic roller will be supported by the supporting roller through the coil spring. Therefore, any slippage occurring between the driven end of the ceramic roller and the supporting roller can be absorbed by the coil spring.

In the accompanying drawings:

FIGURE 1 is a schematical cross-section of a roller hearth kiln comprising a roller driving apparatus constructed according to the present invention.

FIGURE 2 is a cross-sectional view, in an enlarged scale, illustrating a section shown by A in FIGURE 1.

FIGURE 3 is an exploded and perspective view illustrating the primary portion of the roller connection in the roller driving apparatus of the present invention.

FIGURE 4 is a cross-sectional view, in an enlarged scale, illustrating a section shown by B in FIGURE 1.

FIGURE 5 is a side view of the roller supporting portion in the roller driving apparatus as viewed from the direction of arrow V in FIGURE 4.

FIGURE 6 is a graph illustrating the relationship between the axial displacement and the tension in the coil spring.

FIGURE 7 is a cross-sectional view illustrating the primary portion of a modified roller connection in the roller driving apparatus constructed according to the present invention.

FIGURE 8 is a cross-sectional view illustrating the primary portion of a further modified roller connection in the roller driving apparatus constructed according to the present invention.

FIGURE 9 is an exploded and perspective view illustrating the primary portion of the roller connection shown in FIGURE 8.

FIGURE 10 is a front elevational view of a roller driving apparatus in the prior art roller hearth kiln.

FIGURE 11 is a side view illustrating conveying rollers and receiver rollers in the prior art roller hearth kiln.

FIGURE 12 is a perspective view illustrating driving roller and receiver rollers in the prior art.

Embodiments of the invention will now be described by way of example with reference to the drawings.

In FIGURE 1 through 6, a roller hearth kiln constructed according to the first embodiment of the invention is shown.

The roller hearth kiln comprises a number of ceramic pipe-shaped rollers 21 arranged side by side through the walls 1 of the kiln. When these rollers 21 are rotated, articles to be heat treated (not shown) will be heat-treated while moving along a path of convey-

ance within the hearth. Each of the rollers 21 is held at one end 21a by a rotary drive device 22 with the other end 21b thereof being supported by a support device 23.

The rotary drive device 22 includes a rotary drive shaft 27 which is rotatably supported by a support frame 25 through bearings 26. The rotary drive shaft 27 includes a sprocket 28 fixedly mounted thereon at the middle of the shaft. A chain is passed over the sprocket 28 and operatively connected to a drive motor (not shown). Thus, a drive power can be transmitted from the drive motor to the roller 21 at its one end (drive end) 21a through a holder 30 and a connection tube 32.

The holder 30 defines a connection 40 together with the corresponding connection tube 32. FIGURE 2 shows the details of the connection 40 indicated by a circle A in FIGURE 1. The holder 30 is made of any suitable metal and formed into a cylindrical configuration. The holder 30 fixedly receives one end 27a of the rotary drive shaft 27 and in turn is inserted into the connection tube 32.

The holder 30 includes a recess 30a formed on the outer peripheral wall thereof. Within the recess 30a, a leaf spring 44 is fastened by a pin 42 at the mounting portion 44a of the leaf spring 44. The leaf spring 44 also includes a folded portion 44b resiliently engaging the inner edge of a positioning aperture 46 which is formed in the cylindrical connection tube 32. Thus, the holder 30 can be connected with the connection tube 32. The external diameter of the holder 30 is substantially equal to the internal diameter of the connection tube 32.

The connection tube 32 includes a pair of diametrically opposing slits 48 formed therein at the opened end 32a facing the corresponding roller 21. Each of the slits 48 extends axially up to about 50% of the whole length of the connection tube 32. The length of the axial slits 48 is desirably between 40% - 80% of the whole length of the connection tube 32. If the length of the axial slits 48 is less than 40% of the whole length of the connection tube 32, a clamping force will be insufficiently exerted between the holder 30 and the connection tube 32 by a combination of bolt 52 and nut 54 which is used as fastener means. If the length of the axial slits 48 is more than 80% of the whole length of the connection tube 32, the connection tube 32 will be reduced in its strength. It is appropriate that the width of the axial slits 48 is ranged between 0.5 mm and 2 mm. If the width of the slits 48 is less than 0.5 mm, the slits 48 do not provide a satisfied resilience with bending to the gap. If the width of the slits 48 is more than 2 mm, the connection tube 32 will also be reduced in its strength.

The connection tube 32 includes a pair of diametrically opposing openings 50 each of which is formed therethrough at a position angularly offset about 90 degrees from the corresponding slit 48 at the longi-

tudinally middle portion thereof. Each of the openings 50 receives a bolt 52 which extends outward at one end from the opposite sidewall of the connection tube 32. The outward extended end of the bolt 52 is fixed by a nut 54. When the nut 54 is tightened against the bolt 52, the connection tube 32 is firmly clamped against the corresponding roller 21 at one end 21a. At this time, the axial slits 48 will be reduced in width at the opened end 48b rather than the closed end 48a. Thus, the connection tube 32 can be more firmly clamped against the ceramic roller 21 at the one end 21a. Since the inner wall of the connection tube 32 is urged against the outer wall of the end 21a of the roller 21 under uniform pressure, stress concentration can be avoided to provide a tightly resilient connection between the connection tube 32 and the corresponding roller 21.

If the roller 21 become damaged, or broken, pushing the roller 21 in the opposite direction of arrow C as shown in FIGURE 2 results in that the leaf spring 44 will contact its right slope with the inner wall of said connection tube 32, and the leaf spring 44 is depressed at its folded portion 44b to disengage it from the positioning aperture 46. Thus, after rotating and pulling the roller 21, the connection tube 32 and the corresponding roller 21 can be drawn out together in the direction of arrow C in FIGURE 2. Furthermore, the roller 21 can be rapidly drawn out from the wall 1 of the hearth toward the support device 23. In such a manner, the damaged roller 21 can be removed rapidly and simply from the kiln.

When a roller 21 is to be mounted in the kiln, the roller 21 is resiliently joined at one end 21a with the connection tube 32 which in turn is moved in the direction opposite to the direction of arrow C in FIGURE 2. The connection tube 32 then receives the holder 30 with the positioning aperture 46 thereof being resiliently engaged by the folded portion 44b of the leaf spring 44. In such a manner, the connection tube 44 can be connected firmly with the holder 30.

On the other hand, the support device 23 comprises a bracket 34 fixedly attached to the opposite side wall 1 of the hearth, stationary shafts 35 fixedly mounted on the bracket 34 and a pair of metallic supporting or receiver rollers 36 each of which is rotatably mounted on the stationary shaft 35 through a bearing. The receiver roller 36 rotatably supports the corresponding roller 21 at the other end 21b thereof through a coil spring 60 which will be described later.

FIGURE 4 shows the details of a section shown by a circle B in FIGURE 1. As seen from FIGURE 4, the other end (driven end) 21b of the roller 21 includes a stepped portion 21c having an external reduced-diameter portion at 21d. A metallic coil spring 60 is wound about the external reduced diameter portion 21d of the roller 21. The length of the external reduced-diameter portion 21d is preferably between about 10 mm - 100 mm, depending on the size of the

roller 21.

It is desirable that the coil spring 60 is wound in such a direction that when the roller 21 is rotated while the receiver roller 36 is stopped, the coil spring 60 will provide a clamping force against the external reduced diameter portion 21d of the roller 21. This is the reason why the coil spring 60 can be prevented from being accidentally removed from the external reduced-diameter portion 21d of the roller 21. It is also desirable that the coil spring 60 has a predetermined initial tension as shown in FIGURE 6. This initial tension serves to inhibit the longitudinal elongation of the coil spring 60 when it receives heat from the interior of the hearth through the corresponding roller 21. Material of which the coil spring 60 is made is preferably selected from various metal materials each having a hardness substantially equal to that of the receiver rollers 36. In such a manner, the relative abrasion can be positively suppressed between the coil spring 60 and the receiver rollers 36 placed in linear contact with the coil spring 60 at two spaced points as shown in FIGURE 5. It is further suitable that the line diameter of the coil spring 60 is ranged between one - four millimeters. This is for a reason that when the coil spring 60 has been wound around the outer periphery of the corresponding roller 21 and if the line diameter of the coil spring 60 is less than one millimeter, the coil spring 60 can be easily loosened. If the line diameter of the coil spring 60 is more than four millimeters, it becomes difficult to mount it around the roller 21.

In such an arrangement, drive power rotates the rotary drive shaft 27 and is transmitted to the roller 21 through the connection tube 32 via the holder 30 and the leaf spring 44. In such a case, since the drive power is transmitted from the holder 30 to the connection tube 32 through the connection in which the folded portion 44b of the leaf spring 44 is engaged by the positioning aperture 46 in the connection tube 32, the leaf spring 44 will never be removed from the connection tube 32 to provide a positive transmission of power at the connection.

When it is required to remove a roller 21 for replacement or repair, the roller 21 is pressed toward the rotary drive shaft 27 to bend the folded portion 44b of the leaf spring 44 in the radial and inward direction such that the leaf spring 44 will be displaced out of the positioning aperture 46 in the connection pipe 32. The connection tube 32 is then rotated clockwise or counter-clockwise relative to the holder 30 such that the folded portion 44b of the leaf spring 44 will be slidably brought into contact with the inner wall of the connection tube 32. The roller 21 connected with the connection tube 32 is then drawn out from the holder 30. In such a manner, the roller 21 can be easily and simply separated from the holder 30.

When it is desired to mount a roller 21, at first the connection tube 32 connected to the roller 21 is then

fitted over the corresponding holder 30. This causes the folded portion 44b of the leaf spring 44 to flex in the radial and inward direction under its own elasticity and also to slide on the inner wall of the connection tube 32. Thereafter, the adjustment of axial or rotational movement causes the folded portion 44b of the leaf spring 44 to fit into the positioning aperture 46 of the connection tube 32. In such a manner, the connection tube 32 can be firmly connected to the holder 30 in an easy and simple manner.

The roller connecting structure of the illustrated embodiment has an advantage in that each of the rollers 21 can be firmly connected with the corresponding rotary drive shaft 27 through the holder 30 and the connection tube 32 while for any damage in a roller 21, it can be easily and rapidly drawn out from the holder 30 by removing the connection tube 32 out of the holder 30 connected with the rotary drive shaft 27.

The roller connecting structure also has the following advantages:

- (1) No adhesive or adhering step is required to connect a roller 21 with the corresponding connection tube 32.
- (2) It is easy to correct axial offset between the connection tube 32 and the roller 21.
- (3) There is no inconvenience in removal of the connection tube 32 even if an old or damaged roller 21 is replaced by a new roller during running of the kiln.
- (4) A rotational drive power can be transmitted from the rotary drive shaft 27 to the roller 21 through the holder 30 and the connection tube 32 without a specific urging mechanism.
- (5) It is not required to form an aperture or slot in the ceramic roller 21. Therefore the rollers 21 are not damaged.

If the coil spring 60 wound around the external reduced-diameter portion 21d of the corresponding roller 21 has its peripheral speed different from that of the receiver rollers 36, a slippage occurs between the coil spring 60 and the receiver roller 36. A force associated with this slippage serves to clamp the coil spring 60 against the external reduced diameter portion 21d so that the ceramic roller 21 will be uniformly clamped by the coil spring 60. Thus, the external reduced-diameter portion 21d of each roller 21 will apparently be of a substantially uniform size through the coil spring 60. Therefore, all the rollers 21 will apparently have substantially the same external diameter. This can stabilize the speed of conveyance for articles to be heat treated.

If the receiver rollers 36 are made of a metal material having substantially the same hardness as that of the coil spring 60, abrasion can be reduced in either or both of the receiver rollers 36 and coil spring 60 to improve their durability. Even if any abrasion is much created in either of the coil spring 60 or receiver roller

36, a new component can replace the abraded component without the replacement of an expensive ceramic roller 21. Thus, all the ceramic roller 21 can be used in their prolonged service life, leading to reduction of cost.

FIGURE 7 shows the second embodiment of the present invention in which the connection between a rotary drive shaft and the corresponding connection pipe is improved.

In the second embodiment as shown in FIGURE 7, a roller connecting structure comprises a connection tube 65 having its external diameter smaller than the internal diameter of a roller 21 and a holder 67 having its internal diameter larger than the external diameter of the connection tube 65. The connection tube 65 has one end to be inserted into the internal diameter of the holder 67. This end of the connection tube 65 includes a rectangular positioning aperture 68 formed therein and extending axially in the end to be inserted. On the other end, the holder 67 includes an opening 69 formed therein at a position corresponding to the positioning aperture 68 of the connection tube 65. A leaf spring 70 is fastened on the holder 67 at one end as shown by 70a such that the other end of the leaf spring 70 can be received into the positioning aperture 68 through the opening 69 in the holder 67. The other end 70b of the leaf spring 70 is urged into the positioning aperture 68 under its own resiliency. When the side faces of the leaf spring 69 are engaged by the sidewalls of the positioning aperture 68, a rotational drive force can be transmitted therebetween. The leaf spring 70 is of such a configuration that it has a gently sloped angle at the mounting side while having a sharply sloped angle at the opposite side. Thus, the leaf spring 70 maintains its original position when the corresponding roller 21 is pulled rightward from such a position as shown in FIGURE 7. However, the leaf spring 70 will move its right-hand slope upward to disengage from the positioning aperture 68 by engagement with the right-hand edge of the positioning aperture 68 when the roller 21 is pressed leftward from such a position as shown in FIGURE 7.

At its other end, the tube 65 is connected to the roller 21 by a bolt 66, as shown in Fig. 7.

In the second embodiment of the present invention, when it is required to remove a roller 21 for replacement or repair, the roller 21 is pressed toward the corresponding rotary drive shaft 27 to shift the folded portion 70b of the leaf spring 70 in the radial and outward direction out and then to be brought out of engagement with the positioning opening 69. The connection tube 65 is then rotated clockwise or counter-clockwise, relative to the holder 67 such that the folded portion 70b of the leaf spring 70 will slide on the outer wall of the connection tube 65. As a result, the roller 21 connected with this connection tube 65 can be drawn out from the holder 67. In such a man-

ner, the separation of the roller 21 from the holder 67 can be carried out easily according to the present invention.

Since the external diameter of the connection tube 65 is smaller than the internal diameter of the roller 21, it does not prevent the roller 21 from being removed from contact with any ambient matter such as a brick or the like when the roller 21 is drawn out from the hearth wall 1. The connection tube 65 also will not interfere with the grinding operation of the roller 21 since the external diameter of the connection tube 65 is smaller than the internal diameter of the roller 21.

FIGURES 8 and 9 show the third embodiment of the present invention in which the connection between a connection tube and a roller is improved.

In the third embodiment, parts similar to those of the embodiment shown in FIGURES 1 and 3 are denoted by similar reference numerals and will not further be described. The end of the roller 21 adjacent to the drive includes an external reduced-diameter portion 21c continuing to the annular step 21e. The axial length of the external reduced-diameter portion 21c is substantially equal to the distance from the open end 32a of the connection tube 32 to an opening 51 formed through the sidewall of the connection tube 32.

Each of the slits 48 formed in the connection tube 32 includes an enlarged aperture 48d of circular configuration formed therein at the closed end, the diameter of this aperture 48d being larger than the width of the corresponding slit 48. The aperture 48d serves to avoid stress concentration at the closed slit end on bolt fastening and to promote resilient flexure in the sidewall of the connection tube 32 at the opened end 48b of the slit 48.

The opening 51 is adapted to receive a bolt 52, and the bolt head 52a is located in a recess 58 formed in the connection tube 32. In other words, the bolt head 52a is located at a position offset radially and inwardly from the outer periphery of the connection pipe 32. The opposite threaded end of the bolt 52 is screwed into a female threaded hole which is tapped in a recess 60 diametrically opposite to the recess 58.

When a roller 21 is removed from the hearth wall, the folded portion 44b of the leaf spring 44, is pressed to disengage the connection tube 32 from the holder 30. In such a situation, the connection tube 32 and the roller 21 is drawn out toward the support device 23. Thus the roller 21 and the connection tube 32 can be drawn out easily through the roller insert opening 1a. In such a case, the connection tube 32 will not be brought into contact with the sidewall of the roller insert opening 1a, which might damage heat-resistant insulating materials, since the external diameter of the connection tube 32 is equal to or smaller than that of the roller 21.

In addition to the aforementioned advantages,

the third embodiment of the present invention provides the following advantage: Since the open end 32a of the connection tube 32 is located radially and inwardly from the external diameter of the corresponding roller 21, the open end 32a of the connection tube 32 will not be brought into contact with the hearth wall when the combination of the connection pipe 32 with the roller 21 is removed from the hearth wall. Thus, the hearth wall and other components associated therewith will not be damaged by this combination being removed.

Although the first to third embodiments have been described with the bolt-nut type fastening means used at the connection between each of the rollers and the corresponding connection tube, the fastening means may be of any suitable type other than the bolt-nut type. The leaf springs 44 and 70 may be replaced by any other suitable resilient means. Furthermore, the external reduced-diameter portion 21d of the roller 21 may not be required when each of the rollers has its external diameter increased in precision.

The aforementioned numeral values for the external diameter D_1 of each roller 21, the external diameter D_2 of the external reduced-diameter 21d, the axial length l of the same external reduced-diameter 21d and the line diameter of each coil spring 60 are not intended to limit the invention and may be selected suitably depending on the particular case.

In the roller driving structure of the present invention, each of the ceramic rollers is connected with the corresponding one of the metallic rotary drive shafts through an appropriate resilient means such that a drive power can be positively transmitted to the rollers. Furthermore, each of the rollers can be rapidly and easily mounted or demounted in the roller hearth kiln. In addition, there are provided many advantages in that the roller will not be accidentally removed from the associated connection when the kiln is running, that the roller driving structure may be simplified and manufactured more inexpensively, that each of the rollers may be easily ground and easily drawn out from the hearth wall since the external diameter of the connection tube can be smaller than that of the rollers. Since the leaf spring is mounted on the holder adjacent to the drive shaft, the roller may be drawn out from the interior of the roller hearth kiln without the associated leaf spring being passed through the kiln at its high temperature. Therefore, the leaf springs will not be degraded due to heat.

In the illustrated roller supporting device of the present invention, the driven end of the ceramic roller is supported on the pair of metallic receiver rollers through a metallic coil spring. Thus, slippage occurred between the conveying roller and the associated receiver rollers may be absorbed through the coil spring. This results in reduction of abrasion and provides a stabilized speed of the conveying rollers to im-

prove the characteristics of conveyance.

Claims

1. A roller hearth kiln, comprising at least one ceramic roller (21) arranged across the path of articles being heated in the kiln for conveying the articles and extending through a side-wall (1) of the kiln, a rotatable drive shaft (27) for driving the ceramic roller (21), a holder (30,67) fixed on one end of the shaft (27) and a metal connection tube (32,65) attached at its ends respectively to the holder (30,67) and the roller (21), wherein the attachment of the connection tube (32,65) at at least one of its ends is a detachable connection having resilient connecting means (44,70).
2. A roller hearth kiln according to claim 1 wherein said connection tube (32,65) has a positioning aperture (46,68) extending longitudinally of said tube (32,65), and said resilient connecting means (44,70) is fixed at one end on said holder (30,67) and has another part (44b,70b) which projects radially and engages in said positioning aperture (46,68).
3. A roller hearth kiln according to claim 2 wherein said connection tube (32) is fitted to an outer peripheral wall of said holder (30).
4. A roller hearth kiln according to claim 2 wherein said connection tube (65) is fitted to an interior wall of said holder (67).
5. A roller hearth kiln according to any one of claims 2 to 4 wherein said resilient means is a leaf spring (44,70).
6. A roller hearth kiln according to claim 1 wherein said connection tube (32) has, at its end attached to the ceramic roller (21), at least one axial slit (48) open at one end at the end of the tube (32) and openings (50) through its wall at a position between the closed and open ends of said slit or slits (48), and there are fastening means (52) extending through said openings (50) for resiliently engaging said connection tube (32) onto the roller (21), which is inserted into that end of the connection tube (32), by contracting that end of the connection tube (32).
7. A roller hearth kiln according to claim 6 wherein said axial slit (48) has a wider portion (48d) adjacent its closed end.
8. A roller hearth kiln according to claim 6 or claim 7 wherein said connection tube (32) has an exter-

nal diameter equal to or smaller than the maximum external diameter of the ceramic roller (21).

9. A roller hearth kiln according to claim 8 wherein the ceramic roller (21) has a reduced-diameter portion (21c) on which the end of the connection tube is mounted.
10. A roller hearth kiln according to any one of the preceding claims, wherein the other end of the ceramic roller (21) from the end attached to said connection tube (32,65) is supported by a supporting device, there being a metallic coil spring (60) wound on the outer periphery of said other end of the roller (21) and a metallic roller (36) of said supporting device rotatably supporting said other end of the roller through said coil spring.
11. A roller hearth kiln according to claim 10 wherein said coil spring (60) is wound in such a direction that it provides a clamping force against said other end of said ceramic roller (21) when said ceramic roller is rotated while said metallic roller (36) is stopped.

Patentansprüche

1. Rollenherdofen, umfassend zumindest eine Keramikrolle (21), die quer zum Weg der im Ofen erwärmten Gegenstände angeordnet ist, um die Gegenstände zu befördern, und sich durch eine Seitenwand (1) des Ofens erstreckt, eine drehbare Antriebswelle (27) zum Antreiben der Keramikrolle (21), einen Halter (30,67), der an einem Ende der Welle (27) befestigt ist, und ein Metallverbindungsrohr (32, 65), das an seinen Enden am Halter (30, 67) bzw. an der Rolle (21) befestigt ist, worin die Befestigung des Verbindungsrohres (32,65) an zumindest einem seiner Enden eine lösbare Verbindung ist, die elastische Verbindungseinrichtungen (44,70) aufweist.
2. Rollenherdofen nach Anspruch 1, worin das genannte Verbindungsrohr (32,65) eine Positionierungsöffnung (46,68) aufweist, die sich in Längsrichtung zum genannten Rohr (32,65) erstreckt, wobei die genannte elastische Verbindungseinrichtung (44,70) an einem Ende am genannten Halter (30,67) befestigt ist und einen weiteren Teil (44b,70b) aufweist, der radial vorragt und in die genannte Positionierungsöffnung (46,68) eingreift.
3. Rollenherdofen nach Anspruch 2, worin das genannte Verbindungsrohr (32) in eine äußere periphere Wand des genannten Halters (30) eingepaßt ist.

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Claims

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2. A roller hearth kiln according to claim 1 wherein said connection tube (32,65) has a positioning aperture (46,68) extending longitudinally of said tube (32,65), and said resilient connecting means (44,70) is fixed at one end on said holder (30,67) and has another part (44b,70b) which projects radially and engages in said positioning aperture (46,68).
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7. A roller hearth kiln according to claim 6 wherein said axial slit (48) has a wider portion (48d) adjacent its closed end.
8. A roller hearth kiln according to claim 6 or claim 7 wherein said connection tube (32) has an exter-

nal diameter equal to or smaller than the maximum external diameter of the ceramic roller (21).

9. A roller hearth kiln according to claim 8 wherein the ceramic roller (21) has a reduced-diameter portion (21c) on which the end of the connection tube is mounted.
10. A roller hearth kiln according to any one of the preceding claims, wherein the other end of the ceramic roller (21) from the end attached to said connection tube (32,65) is supported by a supporting device, there being a metallic coil spring (60) wound on the outer periphery of said other end of the roller (21) and a metallic roller (36) of said supporting device rotatably supporting said other end of the roller through said coil spring.
11. A roller hearth kiln according to claim 10 wherein said coil spring (60) is wound in such a direction that it provides a clamping force against said other end of said ceramic roller (21) when said ceramic roller is rotated while said metallic roller (36) is stopped.

Patentansprüche

1. Rollenherdofen, umfassend zumindest eine Keramikrolle (21), die quer zum Weg der im Ofen erwärmten Gegenstände angeordnet ist, um die Gegenstände zu befördern, und sich durch eine Seitenwand (1) des Ofens erstreckt, eine drehbare Antriebswelle (27) zum Antreiben der Keramikrolle (21), einen Halter (30,67), der an einem Ende der Welle (27) befestigt ist, und ein Metallverbindungsrohr (32, 65), das an seinen Enden am Halter (30, 67) bzw. an der Rolle (21) befestigt ist, worin die Befestigung des Verbindungsrohres (32,65) an zumindest einem seiner Enden eine lösbare Verbindung ist, die elastische Verbindungseinrichtungen (44,70) aufweist.
2. Rollenherdofen nach Anspruch 1, worin das genannte Verbindungsrohr (32,65) eine Positionierungsöffnung (46,68) aufweist, die sich in Längsrichtung zum genannten Rohr (32,65) erstreckt, wobei die genannte elastische Verbindungseinrichtung (44,70) an einem Ende am genannten Halter (30,67) befestigt ist und einen weiteren Teil (44b,70b) aufweist, der radial vorragt und in die genannte Positionierungsöffnung (46,68) eingreift.
3. Rollenherdofen nach Anspruch 2, worin das genannte Verbindungsrohr (32) in eine äußere periphere Wand des genannten Halters (30) eingepaßt ist.





4. Rollenherdofen nach Anspruch 2, worin das genannte Verbindungsrohr (65) an eine Innenwand des genannten Halters (67) angefügt ist.
5. Rollenherdofen nach einem de Ansprüche 2 bis 4, worin die genannte elastische Einrichtung eine Blattfeder (44,70) ist.
6. Rollenherdofen nach Anspruch 1, worin das genannte Verbindungsrohr (32) an seinem an der Keramikrolle (21) befestigten Ende zumindest einen axialen Schlitz (48) aufweist, der am Ende des Rohres (32) an einem Ende offen ist, sowie Öffnungen (50) durch seine Wand an einer Position zwischen dem geschlossenen und dem offenen Ende des/der genannten Schlitzes oder Schlitze (48), und Befestigungseinrichtungen (52) vorhanden sind, die sich durch die genannten Öffnungen (50) erstrecken, um das genannte Verbindungsrohr (32) elastisch an der in dieses Ende des Verbindungsrohres (32) eingefügten Rolle (21) in Eingriff zu bringen, indem das genannte Ende des Verbindungsrohres (32) zusammengezogen wird.
7. Rollenherdofen nach Anspruch 6, worin der genannte axiale Schlitz (48) in Nachbarschaft seines geschlossenen Endes einen breiteren Abschnitt (48d) aufweist.
8. Rollenherdofen nach Anspruch 6 oder 7, worin das genannte Verbindungsrohr (32) einen Außendurchmesser aufweist, der gleich dem oder kleiner als der maximale Außendurchmesser der Keramikrolle (21) ist.
9. Rollenherdofen nach Anspruch 8, worin die Keramikrolle (21) einen Abschnitt (21c) mit verringertem Durchmesser aufweist, an dem das Ende des Verbindungsrohres montiert ist.
10. Rollenherdofen nach einem der vorhergehenden Ansprüche, worin das andere Ende der Keramikrolle (21) vom am genannten Verbindungsrohr (32,65) befestigten Ende von einer Stützvorrichtung getragen wird, wobei eine metallische Schraubenfeder (60) um die äußere Peripherie des genannten anderen Endes der Rolle (21) gewickelt ist und eine metallische Rolle (36) der genannten Stützvorrichtung das genannte andere Ende der Rolle durch die genannte Schraubenfeder drehbar stützt.
11. Rollenherdofen nach Anspruch 10, worin die genannte Schraubenfeder (60) in eine solche Richtung gewickelt ist, daß sie eine Klemmkraft gegen das genannte andere Ende der genannten Keramikrolle (21) schafft, wenn die genannte Kera-

mikrolle gedreht wird, während die genannte metallische Rolle (36) angehalten wird.

5 Revendications

1. Four à sole munie de rouleaux, du type comprenant au moins un rouleau en céramique (21) disposé en travers de la voie de passage d'articles qui sont chauffés dans le four pour convoyage d'articles et qui s'étendent au travers d'une paroi latérale (1) du four, un arbre d'entraînement rotatif (27) apte à entraîner le rouleau en céramique (21), un support (30,67) fixé à une extrémité de l'arbre (27) ainsi qu'un tube de connexion en métal (32, 65) attaché à ses extrémités respectivement au support (30, 67) et au rouleau (21), dans lequel l'attache du tube de connexion (32, 65) au niveau d'au moins l'une de ses extrémités est une connexion détachable possédant des moyens de connexion élastique (44, 70).
2. Four à sole munie de rouleaux selon la revendication 1, dans lequel ledit tube de connexion (32, 65) possède une ouverture de positionnement (46, 68) qui s'étend longitudinalement par rapport audit tube (32, 65), lesdits moyens de connexion élastique (44, 70) étant fixés à une extrémité sur ledit support (30, 67) et possèdent une autre partie (44b, 70b) qui se projette radialement et vient en prise dans ladite ouverture de positionnement (46, 68).
3. Four à sole munie de rouleaux selon la revendication 2, dans lequel le tube de connexion (32) est logé sur une paroi périphérique externe dudit support (30).
4. Four à sole munie de rouleaux selon la revendication 2 dans lequel le tube de connexion (65) est monté sur une paroi intérieure dudit support (67).
5. Four à sole munie de rouleaux selon l'une quelconque des revendications 2 à 4, dans lequel les moyens élastiques sont constitués par un ressort à lame (44, 70).
6. Four à sole munie de rouleaux selon la revendication 1, dans lequel ledit tube de connexion (32) possède au niveau de son extrémité attachée au rouleau en céramique (21), au moins une fente axiale (48) ouverte à une extrémité au niveau de l'extrémité du tube (32) et des ouvertures (50) au travers de ces parois au niveau d'une portion entre les extrémités ouverte et fermée ou de la fente (48) et en ce que des moyens de serrage (52) s'étendent au travers de ladite ouverture (50) pour venir en prise de manière élastique avec le-



dit tube de connexion (32) sur le rouleau (21), qui est inséré dans cette extrémité du tube de connexion (32), par le contact de cette extrémité du tube de connexion (32).

7. Four à sole munie de rouleaux selon la revendication 6, dans lequel la fente axiale précitée (48) possède une portion plus large (48d) adjacente à son extrémité fermée.

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8. Four à sole munie de rouleaux selon la revendication 6 ou 7, dans lequel le tube de connexion précitée (32) possède un diamètre externe égal ou inférieur au diamètre externe maximal du rouleau en céramique (21).

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9. Four à sole munie de rouleaux selon la revendication 8, dans lequel le rouleau en céramique (21) présente une portion à diamètre réduit (21c) sur laquelle l'extrémité du tube de connexion est montée.

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10. Four à sole munie de rouleaux selon l'une quelconque des revendications précédentes dans lequel l'autre extrémité du rouleau en céramique (21) depuis l'extrémité attachée au tube de connexion précité (32, 65) est supportée par un dispositif de support, un ressort hélicoïdal métallique (60) étant enroulé autour de la périphérie externe de l'autre extrémité du rouleau (21) et un rouleau métallique (36) dudit dispositif de support permettant le montage à rotation et le support de ladite autre extrémité du rouleau, par l'intermédiaire dudit ressort hélicoïdal.

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11. Four à sole munie de rouleaux selon la revendication 10, dans lequel ledit ressort hélicoïdal (60) est enroulé suivant une direction qui permet d'obtenir une force de prise à l'encontre de l'autre extrémité du rouleau en céramique (21) quand ce rouleau en céramique tourne et tandis que ledit rouleau métallique (36) est arrêté.

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