April 16, 1957 E. W. LINDQUIST 2,788,957

REFRACTORY ROLLER FURNACE CONVEYOR SYSTEM

Filed March 30, 1953 2 Sheets-Sheet 1

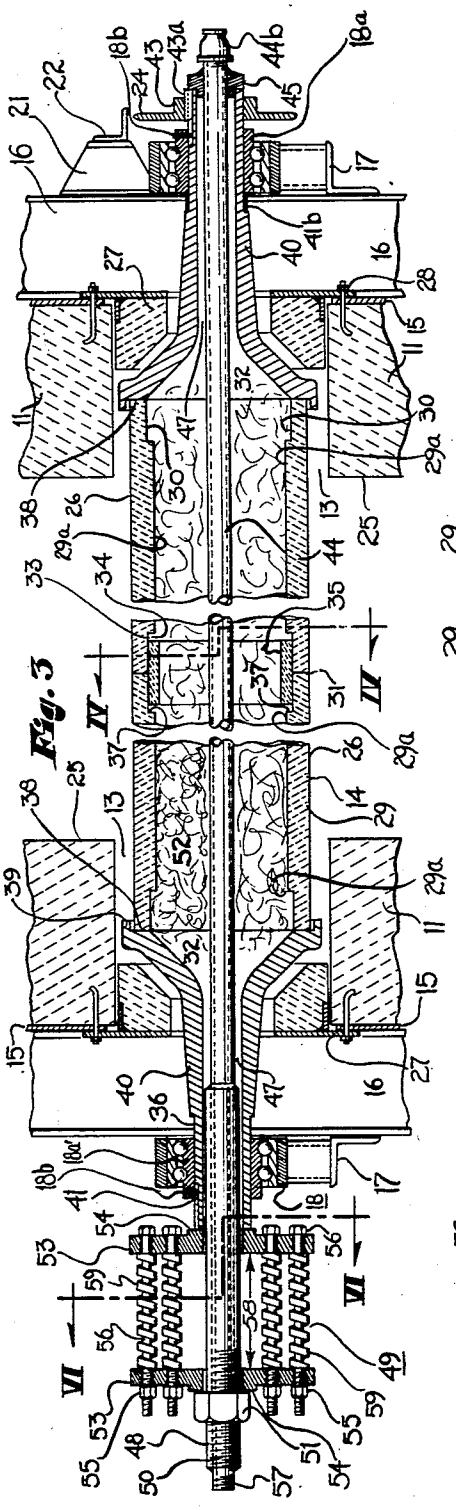


Fig. 3

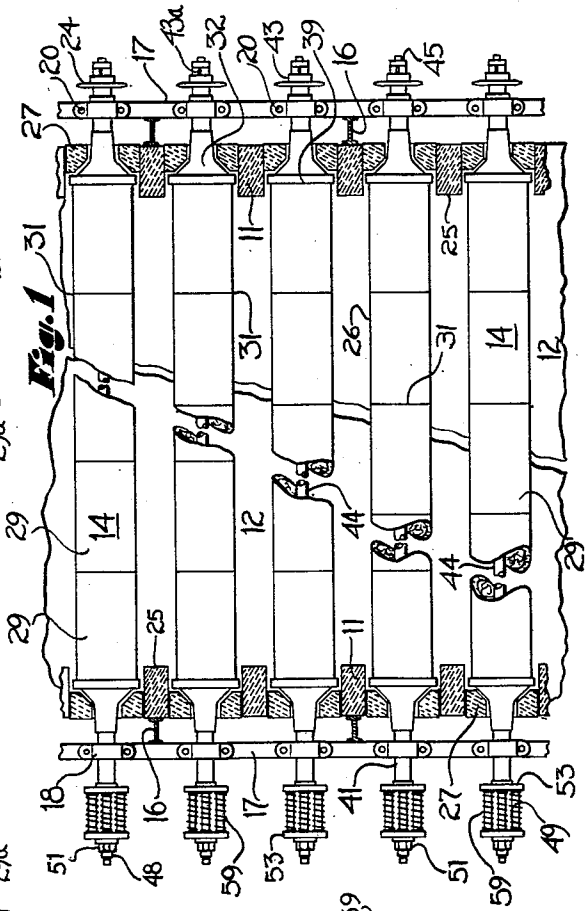


Fig. 1

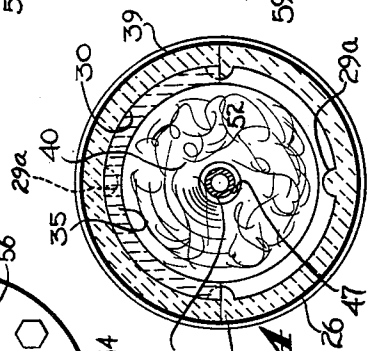


Fig. 4

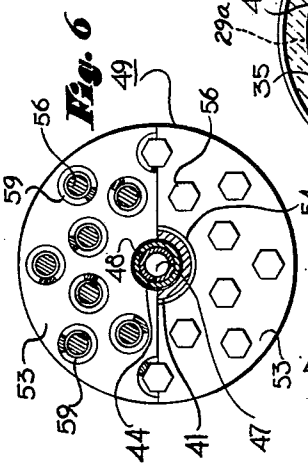


Fig. 6

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REFRACTORY ROLLER FURNACE CONVEYOR SYSTEM

Filed March 30, 1953 2 Sheets-Sheet 2

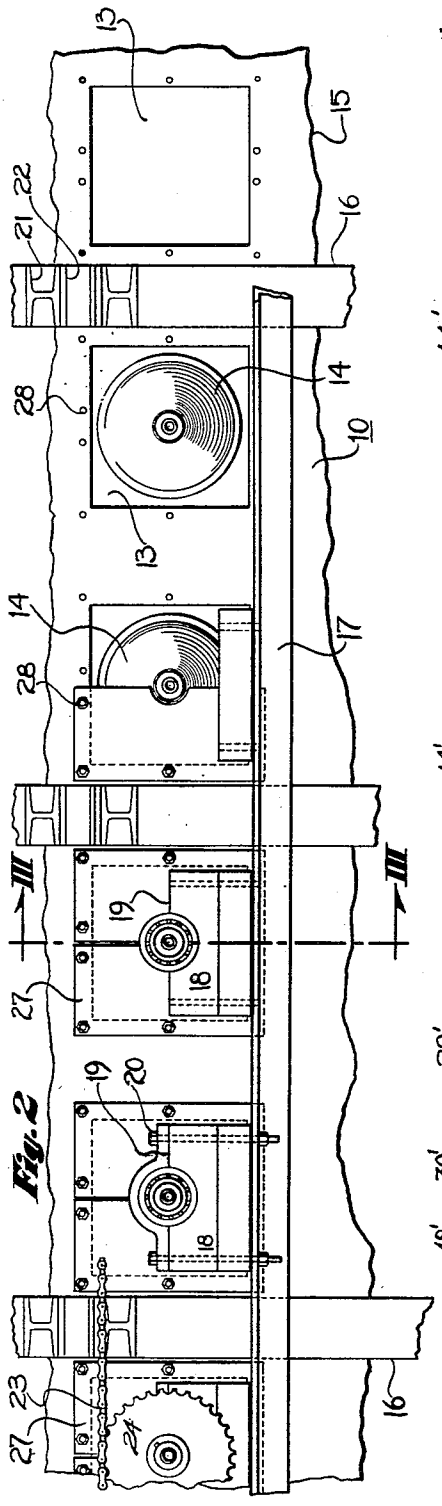


Fig. 2

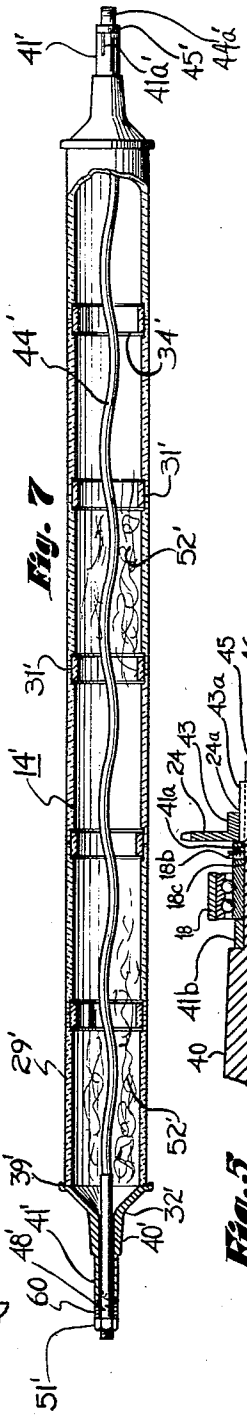


Fig. 7

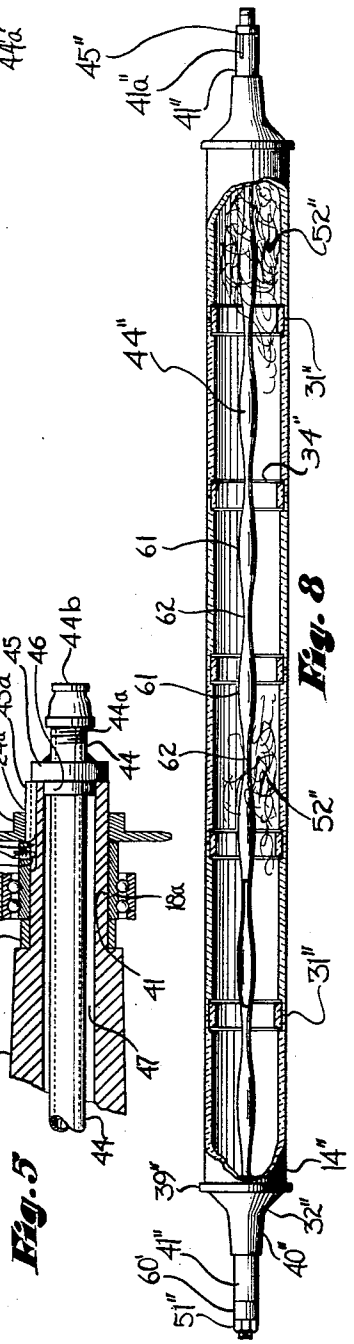


Fig. 5

Fig. 8

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REFRACTORY ROLLER FURNACE CONVEYOR SYSTEM

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Application March 30, 1953, Serial No. 345,473

15 Claims. (Cl. 263—6)

This invention relates to a new refractory roller and furnace conveyor system in which such rollers may be used. More particularly, this invention pertains to a new composite roller and roller furnace conveyor system in which hollow refractory sections under compression provide a work-engaging surface, the said sections being held under compression by a tension rod providing a new composite beam structure.

There are many kinds of heat-treating furnaces in which means are provided to facilitate the passage of the work through such furnaces. One common kind employs rollers for such conveying of work which may be in the form of tubes, sheets, bars, castings, forgings and other forms made of metal and/or other material requiring heat treating. Possibly the kind of rollers most extensively used in such furnaces comprises metal rollers having a plain cylindrical work-engaging surface. Such rollers generally are mounted in parallel relation to one another and transversely of the direction of the movement of the work.

The roller furnace conveyor industry has also tried, and, in some cases, may have used other kinds of rollers in which the work-engaging surface has been made of refractory material. Even when a tension member has been employed in connection with such refractory rollers, a number of short-comings have existed. Thus, in some cases, the tension member was subjected to material transverse load thereby not only requiring a relatively large member but also at least partially restoring the inherent disadvantages of metal rollers for which such refractory rollers may have been substituted. In the case of other such refractory rollers, the heating and cooling of the tension member adversely affected the operation of the roller and augmented the problem of differential expansion caused by temperature both radially and axially between the refractory material and the metal. In still other cases, the refractory rollers were not unitary structures and hence could neither be moved into position in the furnace nor removed therefrom as a unit, which meant that a roller change could not be made when the furnace was hot. Again, many such refractory rollers had to be constructed with undue and impractical precision in respect of obtaining proper engagement of the respective parts and the relative positioning of the refractory and any such tension member. Still further, severe heat loss attended the construction of many prior refractory rollers as well as excessive force requirements for starting, stopping and sometimes for driving the rollers where such driving was specified.

The foregoing difficulties have been overcome by the provision of the new composite refractory roller and furnace conveyor system of this invention. Further objects and advantages thereof will be apparent from the following description and drawings which are illustrative only in which

Figure 1 is a schematic plan view of a roller conveyor furnace, with the portions above the rollers removed, employing a plurality of one embodiment of the new refractory roller of this invention;

Figure 2 is a somewhat enlarged view of the furnace shown in Figure 1, with certain parts removed for illustrative purposes, at the level of the rollers on the driving side thereof;

Figure 3 is a view of the structure shown in Figure 2 taken along line III—III thereof;

Figure 4 is a view in section through the new roller shown in Figure 3 taken along line IV—IV of Figure 3;

Figure 5 is an enlarged view in cross section of the drive end of the new roller shown in Figure 3;

Figure 6 is an enlarged view of the structure shown in Figure 3 taken along the broken line VI—VI of Figure 3;

Figure 7 is a further embodiment of the new refractory roller of this invention; and

Figure 8 is a still further embodiment of the new refractory roller of this invention.

Referring to the drawings, a roller conveyor furnace 10 for heat treating may be of a continuous type having refractory side walls 11, a refractory floor 12 extending between the bottoms of the side walls 11 and a refractory cover or roof (not illustrated) extending between the tops of the side walls 11. The side walls are pierced in registry to provide pairs of roller ports 13, each such pair providing ingress, egress and mounting openings for the new refractory rollers 14 of this invention. The furnace 10 may be covered on the outside thereof with metal plate 15 and a structural binder may be provided in the form of buckstays 16 and transverse and longitudinal structural ties respectively. In the illustrated furnace, the stringers 17 are provided at the proximate level of the lower edges of the ports 13 and may be in the form of an angle welded to the outside of the buckstays with one flange horizontal and outstanding where it may serve as a support on each side for pillow block ball bearings 18, which may be one-piece or split as at 19 for disconnection from journals 41. In a finished assembly, the bolts 20 hold the bearings 18 secured to the respective stringers 17. Brackets 21 are also fastened to the outsides of buckstays 16 and hold guide angles 22 which serve as a hold-down for a driving sprocket chain 23. Sprocket chain 23 in its movement meshes with the teeth of sprocket wheels 24 respectively keyed to the driving ends of the respective rollers 14. Any suitable motor or other prime mover may be used to cause sprocket chain 23 to travel at a predetermined speed to rotate the rollers 14 at the desired angular speed for progression of work engaging the outer surfaces of the rollers 14 between the insides 25 of furnace 10.

The rollers 14 are preferably arranged in parallel relation to one another and at a uniform height in furance 10 to provide a bed for a workpiece or workpieces passing therethrough in direct or indirect engagement with the outer or work-engaging flush surfaces 26 of the respective rollers 14. In the furnace shown, the axes of the rollers 14 are at right angles to the direction of travel of the work being heat treated or otherwise processed within furnace 10. In the course of operation, the respective ports 13 are closed by covers 27 which relatively closely fit around the respective ends of the respective rollers 14 without interfering with their rotation when mounted in the bearings 18. The covers 27 may be held in position by the bolts 28. For ease of manipulation, the covers 27 may be horizontally or vertically halved as shown more clearly in Figure 2. In the course of removing a roller 14 in furnace 10, the covers 27 at the respective ends of that roller are removed, the sprocket gear 24 attached to that roller is removed and bearings 18 are disconnected from stringers 17, the one on the drive end being removed whereupon the entire roller can be

removed as a unit endwise toward the end on which the spring compression unit 49 is mounted. Conversely, in inserting a roller 14, the end thereof away from its spring compression unit is first passed through the port 13 on the spring unit side of the furnace and then through the port 13 on the drive side of the furnace before the roller is reconnected to the supporting furnace structure. In that way, the springs in a compression unit 49 are not passed through the furnace and therefore are not subjected to the heat thereof which might adversely affect their temper. In the course of the insertion or removal of a roller 14, cantilever-handling equipment operating through a port 13 can be used whether furnace 10 is cold or still in a heated condition. The advantage of this last circumstance is that if one of the new rollers should meet with an accident in the course of operations, the removal and repair or replacement thereof will result in a temporary interruption of the work going through the furnace. In cases of prior devices, particularly where the furnace had to be cooled to remove a roller, a major interruption or complete cessation of operations was entailed. No such handicap exists with the new construction of the present invention.

A roller 14 may comprise one or more hollow sections 29 in the form of right cylinders having an outer surface 26 and an inside surface 30. The sections 29 may be molded or otherwise fabricated of suitable refractory material having strength and having temperature resistance characteristics of the desired kind, such as the characteristics found in some silicon carbide and binder compositions, in which the silicon carbide is protected against oxidation. Each of the sections 29 is provided with a planar meeting face 31 at each end so that the sections can be placed in end-to-end relation to each other in a particular one of the new rollers 14 as well as in compressive engagement with an opposed pair of clamping plates 32. By means of the compression effected by clamping plates 32, the integral circular refractory sections 29 constitute an arch-like or bridging work-engaging portion which acts as a rigid beam in supporting the work.

If desired, the respective sections 29 may be molded at 33 inwardly from the respective meeting faces 31 adjoining another refractory section so as to form recesses 34 for unbroken refractory rings 35 extending across each of the refractory-to-refractory joints between the longitudinal ribs 29*a* of the respective sections 29. In the joint recesses 34, rings 35 which may be of a suitable refractory material, are placed. Preferably, when rings 35 are made of refractory material, they should have the same coefficient of expansion as the refractory material of which the sections 29 are made. The ends 37 of each recess 34 are spaced from the edges of the respective rings 35 for expansion and contraction purposes but yet so placed that the rings 35 cannot move out of position across the meeting face joints between the sections 29. In those cases in which the new rollers of this invention are employed without such rings 35 the recesses 34 may be omitted. In general, for ease of assembly and uniformity in the distribution of stresses, a cementitious material may be applied to the meeting faces 31 in the refractory-to-refractory joints.

The clamping plates 32 are provided with opposed meeting faces 38 which compressively engage the outermost end meeting faces of the axially outermost refractory sections 29. Clamping plates 32 may, if desired, be provided also with axially and inwardly extending circular flanges 39, to prevent radial displacement of refractory sections 29 at meeting faces 38 in the course of service of the new rollers. The body of the clamping plates 32 may be tapered outwardly at the respective ends in the form of a hollow cone, the apex of which may be continued as a hollow hub 40. The outermost ends 41 of the two hubs 40 are turned as true cylinders for true running support by the frictionless or other bearings provided as a part of the assembly of the respective bearings 18. A ball bearing may be a part of each pillow block bearing 18 and be provided with inner races 18*a* and 18*a'*, each having a portion thereof extending outwardly relative to the respective ends 41 of the clamping plates 32. Each such extension may be radially drilled and tapped for the reception of a set screw 18*b* having a dog point 18*c* which projects into a longitudinally keyway 41*a* in the journals 41. Hence, as the journals 41 are turned by a sprocket 24, set screws 18*b* insure that the inner races 18*a* and 18*a'* will also rotate, thereby avoiding any chance that inner races 18*a*, 18*a'* might bind and be held from turning under the conditions present around a furnace. Sprocket 24 may be provided with an integral hub 43 and a keyway 24*a* extending both through the sprocket and the hub. Keyway 24*a* is in radial and longitudinal alignment with keyway 41*a* at the end of roller 14. A key 43*a* extends into the registering keyways 24*a* and 41*a* to fasten sprocket 24 to journal 41. Although the sprocket drive for roller 14 is shown at the end illustrated in the drawings, it may instead be placed at the other end. At the drive end of the rollers 14, illustrated, a spacing collar 41*b* abuts adjacent hub 40 and the inner end of the adjacent inner race 18*a*. However, there is no such collar in the space 36 between the outer end of hub 40, at the spring unit end of roller 14, and the inner end of the adjacent inner race 18*a'*, so that the adjacent journal 41 may slide longitudinally relative to race 18*a'* at that end thereby permitting axial expansion and contraction to take place under the conditions under which a roller 14 might function.

In the embodiment of this invention shown as rollers 14, a tubular rod 44 exceeds through the center of the sections 29 and through the clamping plates 32. In general, the axis of rod 44 is coincident with the axis of the sections 29 and of the clamping plates 32, although by virtue of the improvement made by this invention some eccentricity may exist without material impairment of the operation of the new roller 14. Rod 44 is preferably relatively small in diameter relative to the internal diameter and external diameter of the sections 29. The drive end of tubular rod 44 may be provided with a collar 45 welded to it as shown in Figure 5. The outer side of collar 45 constitutes a discoidal flange abutting the outer end of the adjacent journal 41 and locks key 43*a* in place. A reduced cylindrical portion 46 on collar 45 may act as a concentric spacer around tube 44 between it and the core 47 of adjacent journal 41. A reducing fitting 44*b* engaging a threaded portion 44*a* on rod 44 may be employed at that end for connection to a source of cooling fluid. After removal of a roller 14 from the furnace as described, removal of a nut 51 and a spring compression mechanism 49 at the other end will enable rod 44 to be removed endwise in the direction of the welded collar 45 after which the balance of the new roller may be taken apart if desired. On the other hand, rod 44 adjacent the drive end of roller 14 may be provided with a threaded sleeve like sleeve 48 and a nut in place of collar 45 may be used on that sleeve to hold the new roller assembly together at the drive end. The total mass of each new roller 14 is materially lessened by the substantial space existing between rod 44 and the inside surface 30 of the sections 29. In that space, there are no radial or circumferential supporting members extending between rod 44 and sections 29, a feature which also assists in maintaining a uniform insulating characteristic between the axis and outside of the new roller. The interior of each roller 14 is preferably filled with a lightweight insulating material 52 like mineral wool or other lightweight material, whether fibrous or granular, of suitable high temperature insulating qualities. As an example, fibrous alumina and silica may be used to fill the space between rod 44 and the insides of refractory sections 29 and clamping plates 32. The insulating material should be relatively uniformly packed in the space for evenness of thermal conductivity and in the packing,

the insulating material should be made sufficiently dense to minimize or avoid any transfer of radiant heat to rod 44 and in those services in which the work-engaging surface of the new rollers 14 is incandescent.

At the end of rod 44 opposite to the drive end, a sleeve 48 may be provided and welded to the outside of rod 44. Sleeve 48 may serve as a centering spindle for a resilient compression mechanism 49 and as a surface on which threads 50 may be cut to cooperate with a nut 51 in adjusting mechanism 49. The sleeve 48 preferably extends inside hub 40 but not into the interior of roller 14 axially inwardly, at least to any material extent, of the refractory sections 29 with the result that maximum effectiveness is obtained from the cooling fluid usually circulated through the interior of rod 44 by any conventional means, and the weight of the new roller is also reduced. Rod 44 with sleeve 48 thereon is movable axially to a limited extent in the course of elastically straining rod 44 while placing it under the appropriate tension to move the clamping plates 32 toward each other and compress the refractory sections 29. In stressing rod 44 elastically, if made of steel, for example, the elastic limit of that metal is not exceeded either when the new roller 14 is cold or when rod 44 has reached a higher temperature under the furnace conditions in which the roller 14 and rod 44 must work. However, the circulation of cooling fluid through the interior of rod 44 may keep the entire rod 44 at a temperature hundreds of degrees below the working temperature of as much as 2000° F. or more which the refractory sections 29 may attain.

Adjustment mechanism 49 comprises retainer plates 53, each of which may have an outwardly facing boss 54. The inner plate abuts the outer end of the adjacent journal 41 of clamping plate 32 at the non-driving end in the embodiment of the new rollers 14 which are illustrated. Axially extending spring guides in the form of through bolts 56 are provided. The spring guides 56 are circumferentially arranged around sleeve 48 and provide any desired initial holding or compression of springs 59 surrounding guides 56 respectively between retainer plates 53 in accordance with the axial distance between the heads of such bolts 56 and nuts 55 thereon. In that way, the spring compression unit 49 may be handled as a unit and inserted over the spring unit end of rod 44 and sleeve 48 for further compression of spring unit 49 by rotation of nut 51 in a tightening direction which moves plates 53 toward one another and thereby places sufficient compression upon the springs 59 to prestress the rod 44 and, hence, the sections 29, to an extent sufficient for their intended conveying function. The plates 53 are axially movable relative to sleeve 48 and the outer plate 53 which is borne against by nut 51 is also movable relative to the other retainer plate 53 and the clamping plates 32. When nut 51 is backed off toward the end 57 of rod 44, the axial distance between the retainer plates 53 lengthens under the influence of coiled springs 59 urging the retainer plates 53 apart with a relatively tremendous force. Conversely, when nut 51 is rotated to move toward the other end of rod 44, the distance 58 between the retainer plates 53 is diminished, which diminution may continue until the springs 59 exert their greatest force. Although the inner boss 54 on the inner retainer plate 53 and flange 45 bear against the outer edges of the respective clamping plates 32 in a frictional manner, if desired, anti-friction bearings may be interposed in which event the rotation of the clamping plates 32 and the refractory sections 29 would enable rod 44 to avoid rotation in the event that non-rotary joint connections for the fluid to be passed through tube 44, were to be employed. In the embodiment shown, the compressive force exerted by the straining of rod 44 due to the tightening of nut 51 creates enough friction generally to rotate rod 44 and mechanism 49 with the rotation of the balance of roller 14 under the influence of sprocket chain 23 and wheel 24.

As appears, particularly from a consideration of Figure 3, the movement of nut 51 along rod 44 toward flange 45 elastically strains the rod and conversely exerts an equal and opposite compressive force against the outer ends of clamping plates 32 through the springs 59. The resulting compressive engagement of the clamping plates 32 presses the refractory sections 29 together in end-to-end relation and the area of the meeting faces 31 is comparatively such a minor proportion of the entire cross-sectional area of a new roller like roller 14, that uniform and sound bearing around the meeting face joints both between the refractory sections 29 and between the meeting faces 38 on the clamping plates 32 is readily obtained. This is so whether or not the rings 35 are employed. In some cases split heat-resistant metal rings may be used in place of refractory rings 35 in the recesses 34, care being taken in the selection of any such metal rings to insure that a circumferential sufficient gap at the split is provided to permit such differential expansion and contraction to take place in accordance with the expansion coefficients of the respective materials. In general, the assembling of a new roller will take place when it is relatively cold compared to the operating temperature it will encounter in a furnace such as furnace 10. Nevertheless, the prestressing of the refractory sections 29 by the clamping action of the clamping plates 32 when the new roller is relatively cold is adequate to maintain sufficient compression and beam strength. Such prestressing is obtained in an assembly of a new roller like the new roller shown in Figure 3 by tightening up on nut 51 to compress the springs 59 until the desired new rigid hollow beam strength action provided as set forth hereunder, is attained. When the new roller has been installed in a furnace and subjected to the higher temperatures to be found there, the resulting expansion of the respective materials in the roller subjected to the heat imposes greater compression on the refractory sections 29 and greater beam strength is derived therefrom. At all times, either when the roller is heating up or in service at a higher temperature or when it is cooling down, differential expansion both axially, radially and otherwise is permitted to take place without such expansion being blocked which, in the case of the refractory sections 29, might chip or fracture them locally at least. The very much higher temperature of the refractory sections 29 under operating conditions relative to the temperature of rod 44 will generally mean that the refractory will have an aggregate expansion much greater than the expansion of rod 44. Indeed, the new roller constitutes a unitary beam of relatively high strength because of the compressive forces exerted in the manner shown upon the sections and other elements therein. Usually, there will be sufficient play between the interior of the clamping hubs 40 and the rod 44 so that even if there is some eccentricity between the axis of the rod 44 and the sections 29 in the final assembly, it will not affect either the assembly or the strength and operation of the new roller and, as mentioned above, such a new roller may be inserted in a furnace and removed therefrom whether the furnace is hot or cold as an entire roller unit. In operation, in addition to prior described advantages, it has been found that the new roller exhibits a remarkably small heat loss thereby materially increasing the furnaec efficiency. Even in the case of an impact on the work-engaging surface of a new roller or rollers, the compressive bearing of the respective sections against one another is not destroyed, a circumstance which facilitates the true running and load-carrying abilities of the new construction of this invention.

Various modifications may be made in the new construction of this invention without departing from the principle thereof. Thus, in Figure 7, a new roller is shown, the parts of which generally corresponding in nature and function to the construction of a new roller 14, are correspondingly numbered with the addition of a prime factor. In the modified embodiment of Figure 7,

tubular rod 44' is helically coiled like spring 59 but with a pitch of materially greater length. Thereby, nut 51' may bear either directly against the outer end of the nearer hub 40' or against a cylindrical spacer 60 which in turn bears against the end of hub 40' as shown in Figure 7. The coiling of rod 44' acts in the nature of a resilient means so that it can be prestressed by tightening nut 51' in assembling roller 14' while relatively cold, providing for moderate expansion of the sections 29' when roller 14' has been elevated to a higher operating temperature in a furnace. The further embodiment of this invention shown in Figure 8 is similar in nature and operation to the embodiment shown in Figure 7 and the parts are correspondingly numbered with a double prime factor. Rod 44'', however, has a straight axis, unlike rod 44', and is also hollow having a wall thickness that is relatively uniform. The walls of rod 44'' are corrugated presenting a sinusoidal or nodular appearance. The loop portions 61 of greater diameter between the node portions 62 of lesser diameter provide an elastic characteristic in rod 44'', which, as in the case of rod 44', eliminates the need in either the Figure 7 or Figure 8 embodiments for any spring mechanism like mechanism 49. It may also be noted that in the embodiments of Figures 7 and 8 the recesses 34' and 34'' are in the nature of molded counterbores extending in from the ends of the respective meeting sections 29' and 29''.

Departures in various details may be made in the respective embodiments shown without departing from the spirit of this invention or the scope of the appended claims.

I claim:

1. A roller for a roller bed heat treating furnace or the like, comprising in combination, at least one hollow refractory right cylinder, said cylinder having an outside surface providing a work-engaging surface, means including opposed clamping plates to exert a compressive force on said cylinder at the respective outer ends thereof, said cylinder and clamping plates having single meeting faces, each meeting face being generally normal to the axis of said cylinder, a rod extending through the interior of said cylinder, said rod being radially spaced from the inside of said cylinder a distance which is substantial relative to the thickness of said cylinder, opposed means extending between said rod and said clamping plates to exert a compressive force on said clamping plates, and means to place and maintain said rod in tension to press said opposed means toward each other to compress said cylinder sufficiently to maintain said cylinder as a beam to support work.

2. A roller for a roller bed heat treating furnace or the like, comprising in combination, a cylindrical beam having one or more hollow cylindrical relatively thin-walled refractory sections in end-to-end relation and providing a work-engaging circumferential portion, said sections having meeting faces lying in a plane normal to the axis of said sections, means including opposed clamping plates to exert a compressive force on said sections at the respective ends thereof, a rod extending through the inside of said sections, said rod being radially spaced from the inside of said sections a distance which is substantial relative to the thickness of said sections, relatively lighter insulating material positioned between the said inside of said sections and said rod, and opposed means connected to said rod to exert a compressive force against said clamping plates, at least one of said last-mentioned means being adjustable to elastically strain said rod and thereby press said clamping plates to compress said sections sufficiently to support work.

3. A roller for a roller bed heat treating furnace or the like, comprising in combination, a cylindrical beam having one or more hollow refractory relatively thin-walled right cylinders having an outside surface providing a work-engaging portion, opposed clamping plates to exert a compressive engaging force against the ends of said cylinders, said cylinders and clamping plates having meeting faces generally normal to the axis of said cylinders, a rod extending through the interior of said cylinders, said rod being spaced from the inside of said cylinders a distance which is substantial relative to the thickness of said cylinders, insulating material positioned between the inside of said cylinder and said rod, means connected to said rod to exert a compressive force against said clamping plates, and resilient means to place said rod in tension and cause said last-mentioned means to press said clamping plates to compress said cylinders sufficiently to support work.

4. A roller for a roller bed heat treating furnace or the like, comprising in combination, one or more hollow cylindrical refractory sections in end-to-end beam relation and providing a work-engaging and supporting surface, said sections having meeting faces, each meeting face lying in a plane respectively normal to the axis of said sections, a plurality of rings positioned around the inside of said sections adjacent said meeting faces and overlying said planes respectively, said insides of said sections being circumferentially recessed adjacent said meeting faces to retain said rings in position respectively, opposed clamping plates to exert a compressive force against said sections at the respective ends thereof, the meeting faces at said respective ends of said sections and of said clamping plates lying in a plane respectively normal to the axis of said sections, said clamping plates having outwardly axially extending hubs, a rod extending through the interior of said sections and through said hubs generally coincident with the axis of said sections, said rod being radially spaced from the inside of said sections a distance which is substantial relative to the thickness of said sections, means engaging said rod and abutting said hubs to press said clamping plates into compressive engagement with said sections, and an elastically strained member interacting with said rod to hold said last-mentioned means in compressive engagement with said hubs.

5. A roller for a roller bed heat treating furnace or the like, in combination, a plurality of hollow cylindrical relatively thin-walled refractory sections abutting in end-to-end relation and providing a work-engaging surface, said sections having meeting faces lying in a plane normal to the axis of said sections, opposed clamping plates compressively engaging said sections at the respective ends thereof, a rod extending through the interior of said sections and beyond the outermost edges thereof, said rod being radially spaced from the inside of said sections a distance which is substantial relative to the thickness of said sections, a flange on said rod abutting said hub to prevent the separation of the two by movement of said rod toward the other end of said sections, a clamping plate abutting the other end of said sections in opposed relation to the first-mentioned clamping plate, a thread and nut assembly extending between said rod and said last-mentioned clamping plate to elastically strain said rod and thereby place said sections under compression sufficiently to maintain them in compression in service to support work thereon.

6. A roller for a roller bed heat treating furnace or the like, in combination, a plurality of hollow cylindrical relatively thin-walled refractory sections abutting in end-to-end relation and providing a roller surface, said sections having meeting faces lying in a plane normal to the axis of said sections, an elastically strained rod extending through the interior of said sections and beyond the outermost edges thereof, said rod being radially spaced from the inside of said sections a distance which is substantial relative to the thickness of said sections, the axis of said rod generally coinciding with the axis of said sections, a clamping plate abutting one end of said sections and said rod in opposed directions, a clamping plate adjacent the other end thereof and abutting the other end of said sections and said rod in reversed opposed directions, said last-mentioned clamping plate be-

ing axially movable relative to said rod, relatively lightweight insulation positioned between the interior of said sections and the exterior of said rod, and means for simultaneously stressing said rod to move said clamping plates toward one another to compress said sections sufficiently to maintain them in compression substantially throughout the entire cross section thereof and support work.

7. A roller for a roller bed heat treating furnace or the like, comprising in combination, one or more hollow cylindrical relatively thin-walled refractory sections in end-to-end relation providing a work-engaging surface, said sections having meeting faces lying in a plane normal to the axis of said sections, opposed clamping plates compressively engaging said sections at the respective ends thereof, the meeting faces at said respective ends of said sections and of said clamping plates lying in a plane normal to the axis of said sections, said clamping plates having outwardly axially extending hubs, a tubular rod extending through the interior of said sections and through said hubs generally coincident with the axis of said sections, said rod being radially spaced from the inside of said sections a distance which is substantial relative to the thickness of said sections, insulation material positioned between the inside of said sections and said rod, means engaging said rod and abutting said hubs to press said clamping plates into compressive engagement with said sections, said means being axially movable relative to one another, at least one spring cooperating with said rod to press at least one of said last-mentioned means into abutment with its respective hub, a collar to adjust the force of said spring, said rod being threaded adjacent said collar, and a nut to engage said thread to adjust said collar.

8. A roller for a roller bed heat treating furnace or the like, comprising in combination, one or more hollow cylindrical refractory beam sections in end-to-end relation providing a work-engaging surface, said sections having meeting faces lying in a plane normal to the axis of said sections, a plurality of rings positioned around the inside of said sections adjacent said meeting faces and overlying said planes respectively, said insides of said sections being circumferentially recessed adjacent said meeting faces to retain said rings in position respectively, opposed clamping plates compressively engaging said sections at the respective ends thereof, the meeting faces at said respective ends of said sections and of said clamping plates lying in a plane normal to the axis of said sections, said clamping plates having outwardly axially extending hubs, a tubular rod extending through the interior of said sections and through said hubs generally coincident with the axis of said sections, said rod being radially spaced from the inside of said sections a distance which is substantial relative to the thickness of said sections, insulation material positioned between the inside of said sections and said rod, means engaging said rod and abutting said hubs to press said clamping plates into compressive engagement with said sections by interaction with said rod, said means being axially movable relative to one another, at least one spring to press at least one of said last-mentioned means into abutment with its respective hub, a collar to adjust the force of said spring, said rod being threaded adjacent said collar, and a nut to engage said thread to adjust said collar.

9. A roller for a roller bed heat treating furnace or the like, comprising in combination, one or more hollow cylindrical relatively thin-walled refractory sections in end-to-end relation, the outside of said sections providing a work-engaging surface, said sections having meeting faces lying in a plane normal to the axis of said sections, opposed clamping plates compressively engaging said sections at the respective ends thereof, a rod extending through the inside of said sections in radially spaced relation thereto and through said clamping plates, said rod being helically formed, and means for elastically straining said rod, said means engaging said clamping plates to compress said sections through interaction with said rod.

10. A roller for a roller bed heat treating furnace or the like, comprising in combination, one or more hollow cylindrical relatively thin-walled refractory sections in end-to-end relation, the outside of said sections providing a work-engaging surface, said sections having meeting faces lying in a plane normal to the axis of said sections, opposed clamping plates compressively engaging said sections at the respective ends thereof, a rod extending through the inside of said sections at radially spaced relation thereto and through said clamping plates, said rod being corrugated, and means for elastically straining said rod, said means engaging said clamping plates to compress said sections through interaction with said rod.

11. In a roller bed heat treating furnace or the like, in combination, a roller having a plurality of hollow cylindrical relatively thin-walled refractory sections in end-to-end relation providing a work-engaging surface, opposed clamping plates compressively engaging said sections at the respective ends thereof, a rod extending through the interior of said sections in radially spaced relation thereto, opposed means connected to said rod to exert a compressive force against said clamping plates, at least one of said means being adjustable to elastically strain said rod and move said clamping plates to compress said sections sufficiently to maintain them in compression in service through interaction with said rod, bearings for said roller, and means for directly driving said clamping plates and sections.

12. In a roller bed heat treating furnace or the like, in combination, a roller having one or more hollow cylindrical relatively thin-walled refractory sections in end-to-end relation providing a work-engaging surface, said sections further having meeting faces lying in a plane normal to the axis of said sections, opposed clamping plates to exert a compressive force against said sections at the respective ends thereof, a rod extending through the interior of said sections in radially spaced relation thereto, insulating material positioned between the inside of said sections and said rod, opposed means connected to said rod to exert a compressive engaging force against said clamping plates, at least one of said means being adjustable to elastically strain said rod and thereby move said clamping plates to compress said sections sufficiently to maintain them in compression in service, bearings for said roller, and means for directly driving said clamping plates and sections.

13. In a roller bed heat treating furnace or the like, in combination, a roller having at least one hollow right relatively thin-walled beam cylinder with the outside surface thereon providing a work-engaging surface, means compressively engaging said cylinder at the respective ends thereof, said cylinder and means having meeting faces generally normal to the axis of said cylinder, a rod extending through the interior of said cylinder in radially spaced relation thereto, opposed means extending between said rod and said first-mentioned means to exert a compressive force against said ends of said cylinder, resilient means to place said rod in tension and thereby press said opposed means together to compress said cylinder sufficiently to maintain its beam strength in service, and means for driving said roller directly through at least one of said first-mentioned means.

14. In a roller bed heat treating furnace or the like, in combination, a roller having one or more hollow right relatively thin-walled cylinders with the outside surface thereof providing a work-engaging surface, means compressively engaging said cylinders at the respective outer ends thereof, said cylinders and means having meeting faces lying in a plane normal to the axis of said cylinders, a rod extending through the interior of said cylinders, said rod being spaced from the inside of said cylinders a distance which is substantial relative to the thickness of said cylinders, opposed means extending between said rod and said first-mentioned means to exert a compres-

sive force against said ends of said cylinders, resilient means to place said rod in tension and thereby press said opposed means together to compress said cylinders sufficiently to maintain their beam strength in service, and means for driving said roller directly through at least one of said first-mentioned means.

15. In a roller bed heat treating furnace or the like, in combination, a roller having one or more hollow cylindrical relatively thin-walled refractory sections in end-to-end relation providing a work-engaging surface, said sections having meeting faces lying in a plane normal to the axis of said sections, a plurality of rings positioned around the inside of said sections adjacent said meeting faces and overlying said planes respectively, said insides of said sections being circumferentially recessed adjacent said meeting faces to retain said rings in position respectively, opposed clamping plates to exert a compressive force against said sections at the respective ends thereof, the meeting faces at said respective ends at said sections and of said clamping plates lying in a plane normal to the axis of said sections, said clamping plates having outwardly axially extending hubs, a tubular rod extending through the interior of said sections and through said hubs generally coincident with the axis of said sections, means engaging said rod and abutting said hubs to press said clamping plates into compressive engagement with said sections by interaction with said rod, an elastically strained member to hold said last-mentioned means in compressive engagement with said hubs, and means for journaling said hubs and directly driving at least one of them to turn said roller.

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