Aug. 29, 1967 M. CUVELIER 3,338,569

CONVEYING MECHANISM FOR A TUNNEL KILN

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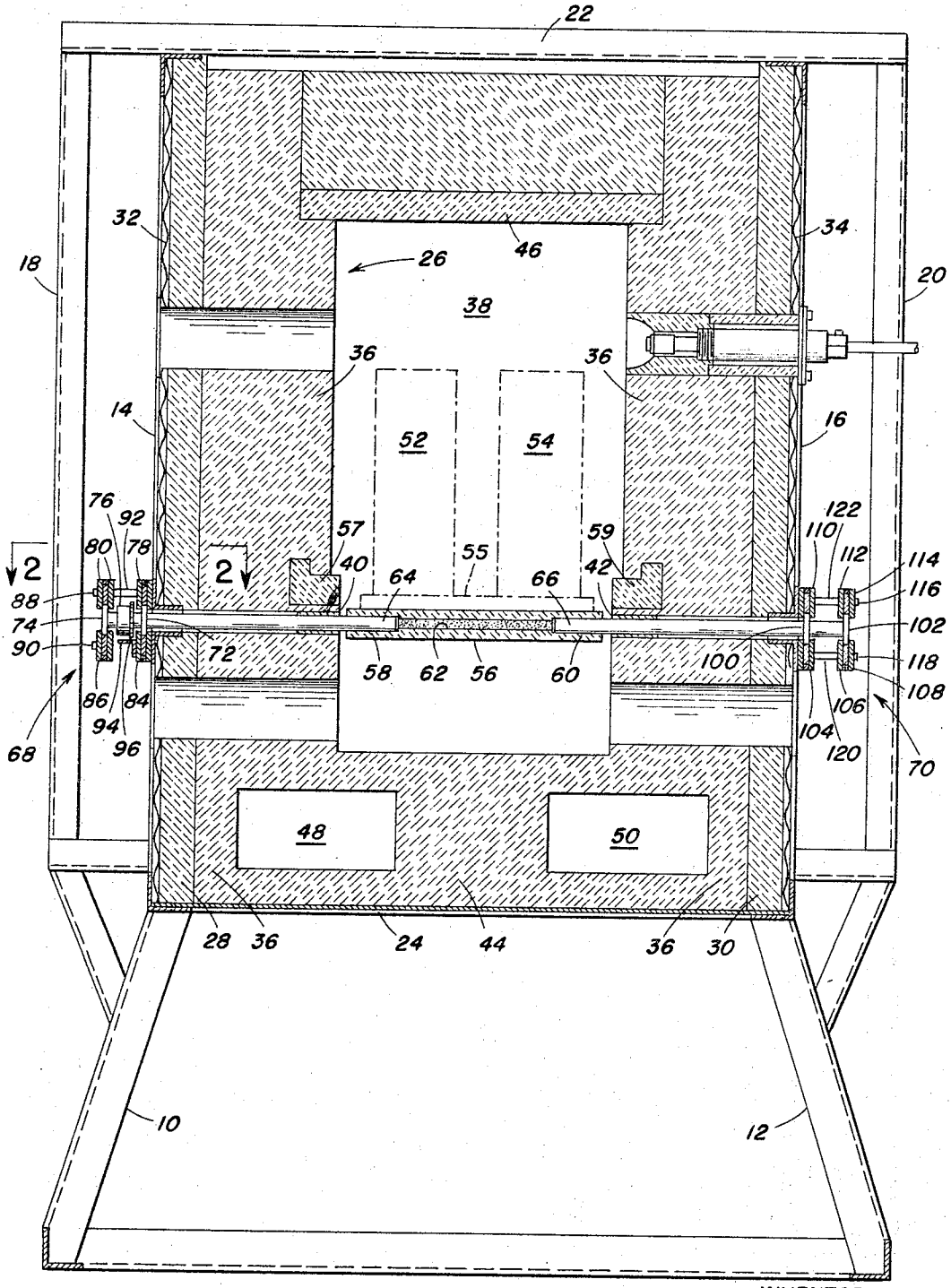


Fig. 1.

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Fig. 2.

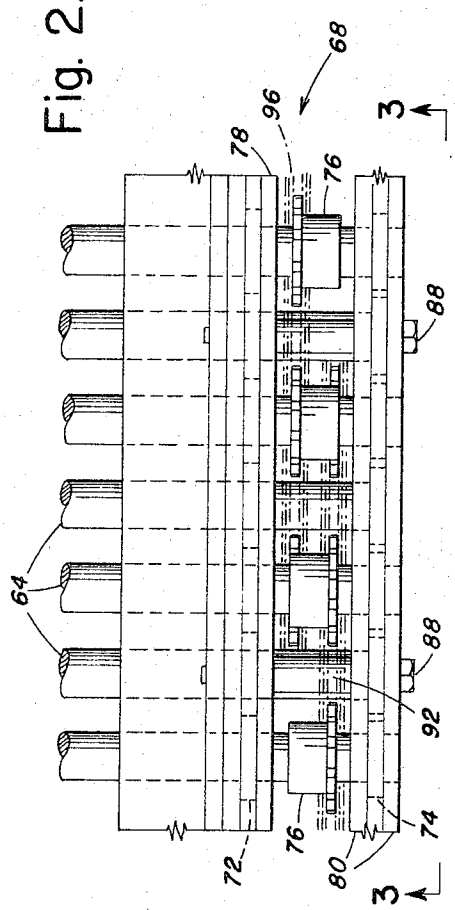


Fig. 3.

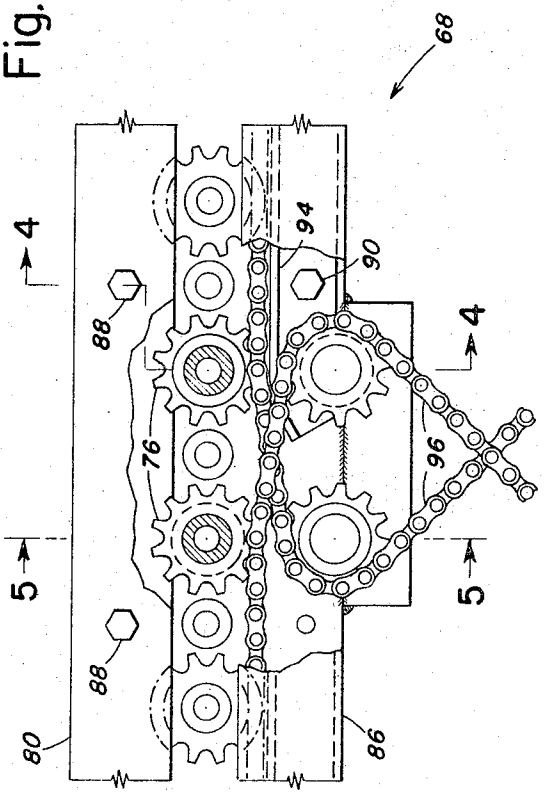


Fig. 5.

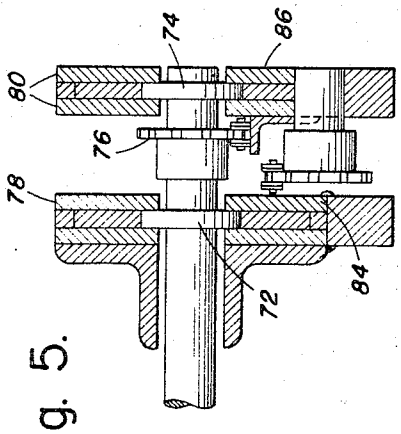
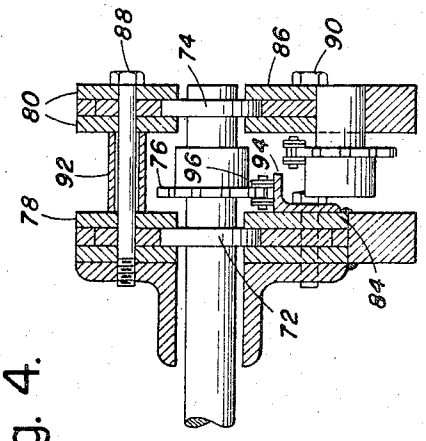


Fig. 4.



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Fig. 6.

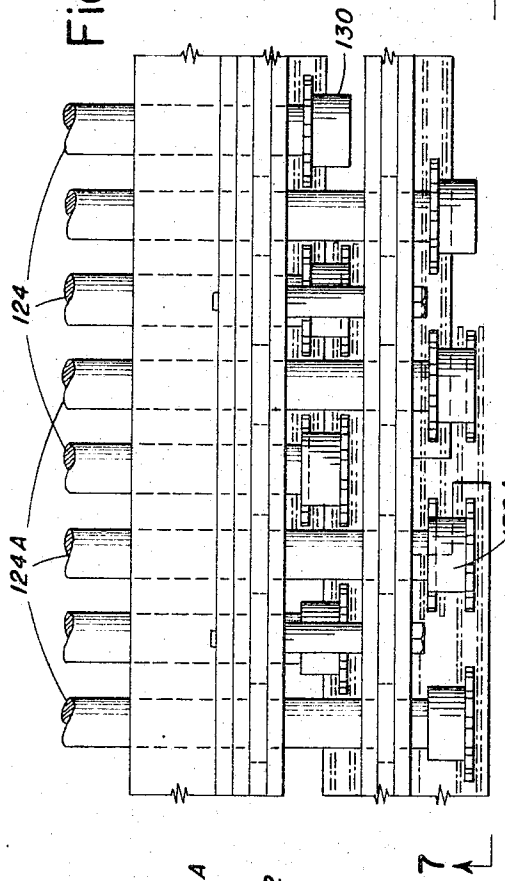


Fig. 7.

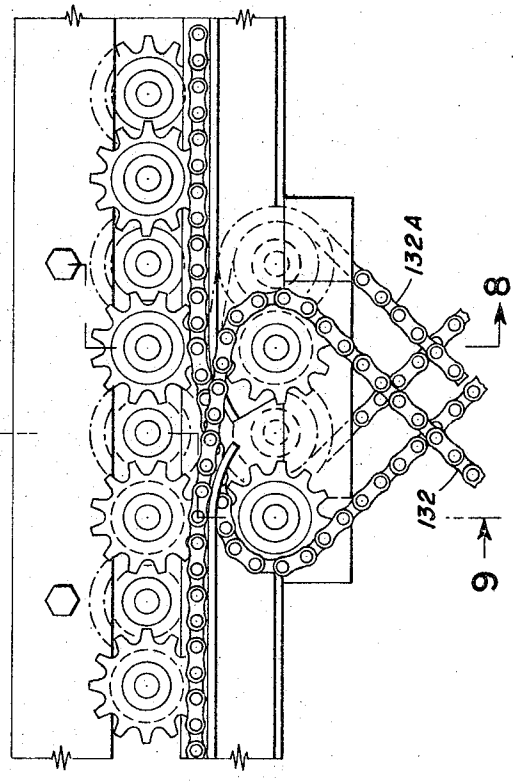


Fig. 9.

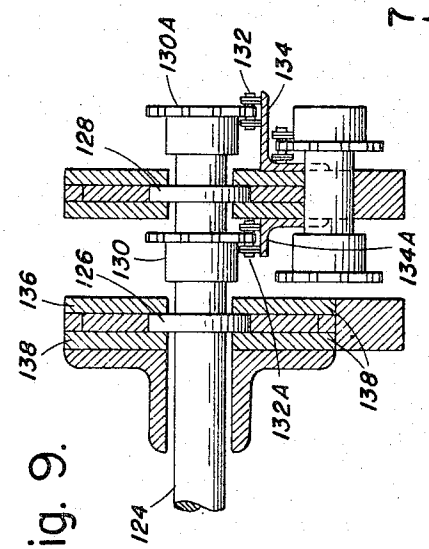
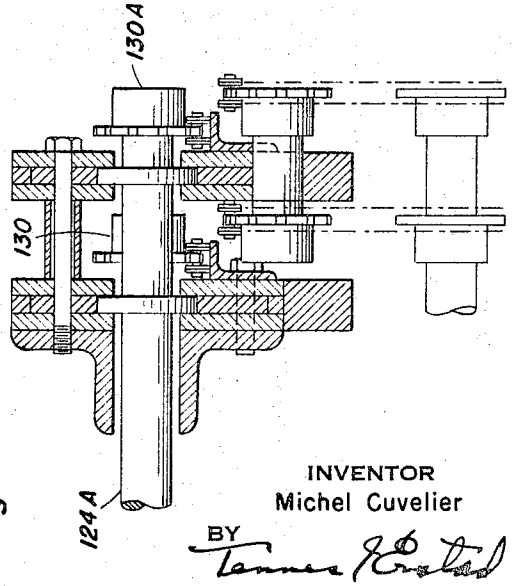


Fig. 8.



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3,338,569

CONVEYING MECHANISM FOR A TUNNEL KILN

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10 Claims. (Cl. 263—6)

ABSTRACT OF THE DISCLOSURE

A conveyor mechanism for moving ceramic ware through a kiln tunnel utilizing banks of ceramic rollers arranged side by side to form a conveying bed inside the kiln. Rotary motion is imparted to the ceramic rollers by means of shafts extending from opposite sides of the tunnel through the walls of the kiln. A sufficient clearance is provided between the shafts and the rollers to compensate for thermal expansion while preventing the ends of the rollers from touching the side walls of the kiln tunnel. The ends of the shafts include sprockets and a chain drive to synchronize the rotation of the rollers as the ceramic ware passes through the tunnel.

This invention relates to an improved conveying method and mechanism for conveying material to be heat treated through a tunnel kiln and is particularly well suited for conveying ceramic ware through such a kiln.

In a slow fire tunnel kiln, the conveying cycle for ceramic ware through the kiln usually lasts from 14 to 36 hours and in a fast fire kiln, the cycle is usually less than 4 hours. The temperature along the length of the kiln varies between approximately 70° F. and 2000° F. Refractory conveying mechanism for moving ware through the tunnel is therefore subjected to stresses and strains due to the variations in temperature which can cause it to become fractured.

It is an object of this invention to provide an improved conveyor mechanism which will be reliable in operation for moving ceramic ware through a tunnel kiln by providing a moving support for advancing ceramic slabs carrying ware to be fired through the kiln.

Another object of this invention is to provide refractory conveying rollers arranged so they will allow for slippage to occur in the event of a jam-up in the tunnel to prevent the rollers from becoming broken.

An object of this invention is to support refractory rollers on their axis between the projecting ends of a pair of driving and supporting pintles.

A further object is to provide a drive and support for refractory conveying rollers which will cause the rollers to be self-centering with respect to the side walls of the tunnel kiln.

Other objects and features of the invention will appear as the description of the particular embodiment selected to illustrate the invention progresses. In the accompanying drawings, which form a part of this specification, like characters of reference have been applied to corresponding parts throughout the several views which make up the drawings.

FIGURE 1 is a vertical cross section of a kiln showing how my improved refractory conveying roller mechanism may be employed therein.

FIGURE 2 is a plan view taken on line 2—2 of FIGURE 1 showing a sprocket and sprocket support structure wherein adjacent rollers are alternately driven from different ends.

FIGURE 3 is an elevation of the drive taken on line 3—3 of FIGURE 2.

FIGURE 4 is a vertical cross section taken on line 4—4 of FIGURE 3.

FIGURE 5 is a vertical cross section take on line 5—5 of FIGURE 3.

FIGURE 6 is a plan view, similar to FIGURE 2, but showing a modification of FIGURE 2 wherein each of the rollers may be synchronistically driven from opposite ends.

FIGURE 7 is an elevation view taken on line 7—7 of FIGURE 6 showing the drive sprocket and chain.

FIGURE 8 is a vertical cross section taken on line 8—8 of FIGURE 7.

FIGURE 9 is a vertical cross section taken on line 9—9 of FIGURE 7.

My improved technique and apparatus for conveying articles to be heat treated through a kiln tunnel can best be illustrated by showing my conveyor mechanism used in connection with a heat treating kiln tunnel.

The section of the tunnel kiln shown in FIGURE 1 which I have used to illustrate my improved conveying mechanism is known as the firing section of the tunnel kiln. The tunnel kiln framework is constructed from angle iron comprising supporting legs **10** and **12** and angle iron wall supports **14**, **16**, **18**, **20**, **22** and **24** which surrounds and supports the ceramic refractory and insulating fibre material **26**.

The insulating fibre material **26** may consist of plates of insulating material **28** and **30** such as rockwool or asbestos which can be assembled within the framework, **14**, **16**, and **24**. On the outside surfaces of such insulating material may be placed a reflecting aluminum sheet **32** and **34** to further reduce the heat loss. The inside and bottom walls of the tunnel **38** consists of suitable cast refractory walls **36** such as refractory concrete or fire brick. Here again the refractory material or fire brick **36** may be either cast integrally in place or in the form blocks, so as to form the inside wall of the tunnel kiln.

The top of the kiln is covered by suitable slab similar refractory concrete or fire brick material **46** such as refractory concrete as shown in FIGURE 1. In the bottom refractory wall portion of the kiln there is formed, two longitudinally extending ducts **48** and **50** for conveying heated air back to the dryer. The heat conducted through ducts **48** and **50** is picked up from the cooling section of the kiln.

The ceramic material **52** and **54** which is to be conveyed through the kiln **38** for firing is supported on heat resistant refractory slabs **54A** which are supported on refractory conveyors **56** which are moved to advance the slabs **54A** and the ware **52**, **54**, they support through the kiln tunnel **20**.

One way of doing this is by refractory rollers **56**, which are arranged side by side to form a bed extending through the tunnel kiln **38**. These rollers **56** are of tube or pipe shaped construction and may be formed with larger holes **58** and **60** at their ends than the hole **62** at their center portion. Projecting into the ends of the rollers **56** are spaced shafts **64** and **66** which support the rollers **56**. The refractory rollers may be made from ceramic or metallic material.

Shafts **64** and **66** are supported on the outside of the kiln in suitable cantilever bearing bracket supports **68** and **70**. The ceramic shaft support **64** consists of a hollow pipe like cylinder which rotates in the sleeve or disk bearings **72**, **74** and has mounted thereon a sprocket **76**. The sleeve or disc bearings **72** and **74** are clamped and held tight by conventional washers **78**, **80**, **84** and **86** by means of suitable bolts **88** and **90**. A conventional tubular spacer sleeve **92** is positioned between each pair of inside washers **78** and **80**.

It will thus be evident that when the bolts **88** and **90**, which are threaded into the framework **14**, are screwed up tight, they will clamp the disc bearings **72** and **74** holding them tightly in place. Thus the shafts **64** are free

to rotate in their cantilever supporting discs **72** and **74**. Supporting sleeves **40** and **42** may be mounted in the sidewalls of refractory **36** to support the ends **64** and **66** of the ceramic rollers adjacent to the ends of tunnel **38**.

In the embodiment shown in FIGURE 1, the shafts **64** are all driven from one side of the tunnel kiln. Rotary movement is imparted to shafts **64** by means of sprockets **76** which are fixedly secured to the shafts **64**. An angle iron bracket **94** has a sprocket chain **96** slidably supported on the top thereof. This chain **96** engages with the teeth of the sprockets **76** and thereby imparts rotary movement to the shafts **64**. In view of the fact that the hollow roller **62** is telescopically mounted over the projecting end of shaft **64**, it will cause the roller **56** to rotate at the same speed as shaft **64**.

The other end of roller **56** is supported in a similar manner on the freely mounted shaft **66**. When shaft **64** is driven it causes roller **56** to rotate and this roller in turn causes shaft **66**, on which it is mounted to rotate. The weight of roller **56** and the weight of the material supported thereon is sufficient to transfer rotary movement from the shaft **64** to the conveying roller **56** on which the articles being conveyed are supported. Since the center axial hole of the ceramic pipe like roller **56** is of a smaller diameter than the shafts **64** and **66** on which they are supported, the ends of the center rollers **56** are prevented from touching the sides **36** of the tunnel kiln. It has been found that if the ends of the center rollers **56** come in contact with the sides **40**, **42** of the kiln wall there is a tendency for the center rollers to become broken, particularly at their ends.

The opposite ends of the cantilever shaft **66** is supported in disc bearings **100**, **102**. The disc bearings **100** and **102** are clamped in place by suitable washers **104**, **106**, **108**, **110**, **112** and **114**, by clamp bolts **116**, **118** which are threaded into the angle iron framework **16**. The end of the shaft **66** may be supported in a suitable ceramic sleeve bearing **42** which is mounted in the vicinity of the inside walls of the tunnel kiln **38**.

It will be evident from the foregoing description that if for any reason the ceramic ware **52** and **54** passing through the kiln tunnel should prevent the conveying rollers **56** from rotating because of a jam-up or for any other reason, there will be no breakage of the rollers **56** or the shafts **64** and **66** because the shafts **64** and **66** can slide or rotate relative to ceramic center rollers **56**.

While I have shown the described ceramic roller **56** which have a smaller diameter in the center than at the ends of the rollers to effect centering the ceramic rollers **56** between the side walls **36** of the kiln, the ceramic center rollers **56** may also be formed so they have a uniform inside diameter throughout their length. When the longitudinal axial center openings of the rollers **56** are of uniform diameter throughout their length, the center portion of the roller is filled and plugged with a heat resisting refractory material so as to limit the distance the roller **56** can slide over on its supporting pintle shafts **58** and **60**. This prevents the ends of the rollers **56** from touching or contacting the side walls **40** and **42** of the kiln.

The clamping discs **104** and **106** and **110** and **112** are spaced from each other by suitable spacers **120** and **122**.

In the embodiment shown in FIGURES 6 and 7, I have shown how both ends of the ceramic shafts may be driven. For brevity I have only shown the drive on one side of the kiln tunnel because the opposite side is substantially the same in construction as the side that has been shown and therefore a description of one side will suffice to disclose how the embodiment is constructed and operates.

The supporting shafts **124** are supported in bearings **126** and **128** in a manner similar to that shown and described in FIG. 1. The shafts **124** have drive sprockets **130** fixedly mounted thereon and are driven by sprocket chain **132** which slides on top of the angle iron brackets **134**.

The bearing **126** is clamped by suitable washers **136** and **138**. The alternate shafts **124A**, on which sprockets **130A** are fixedly mounted extend out further than the shafts **124** to provide for clearance. The sprockets **130A** are driven by sprocket chain **132A** which are supported on angle brackets **134A**.

The endless sprocket chains **132** and **132A** shown in FIGS. 6, 7, 8 and 9 are driven from a suitable gear reduction box in synchronism with each other. In order not to have too long a run on a sprocket chain, there are a series of chain drives similar to sprocket **132** and **132A** for driving banks or sections of rollers. The chains of adjoining sections are synchronized in time with each other in any suitable manner well known in the art, as per example, by driving all of the drive chains **132** and **132A** on opposite sides of the conveying tunnel, from a common shaft or drive, as shown in FIG. 8.

The power shaft that drives the sprocket chains **132** and **132A** on one side of the kiln are mechanically interconnected in any suitable manner with a similar drive on the other side of the kiln. As previously mentioned, the sprocket drive arrangement shown in FIGURES 6 to 9 are the same on both sides of the kiln.

It will thus be evident that the ceramic supporting and driving rollers **124** and **124A** extending into the kiln tunnel are positively driven in synchronism with each other so that the center rollers (not shown), which are supported on the ends of the shafts **124** and **124A** in the manner shown in FIGURE 1, are all driven in unison. If there were any difference in the driving rate of opposed shafts supporting such a center roller, it would be possible for slippage to occur in the ends of the rollers, without causing any twisting torque to be exerted on the center roller which would cause it to either fracture or break. The center rollers employed with shafts **124** and **124A** are so designed that they do not ride along the axis of either pintle shaft and are maintained in the center of the tunnel due to the arrangement described in FIGURE 1.

If for any reason a slab **55** should move to one side or the other of the tunnel, as it is advanced through the kiln tunnel, it would come in contact with hardened ceramic rail edges **57** and **59** which take up any wear on account of this abrasion. Preferably the slab **55** should be of a slightly less hardness than the rails **57** and **59** to avoid wear on the rail surfaces **57** and **59**. This can be accomplished by making the slab **55** of a less dense refractory material than the rails **57** and **59**.

The slab **55** should be preferably of a length which is more than twice the distance of the center line of two adjoining roller supports **55** to avoid any bouncing movement of the slab as it moves through the kiln over the rollers **55**. While this is the minimum distance, it has been found that if the slab is of a length equal to the spacing of four (4) adjoining rollers **55**, it moves very satisfactorily through the kiln without any undesirable undulations.

The invention hereinabove described may, therefore, be varied in construction within the scope of the claims, for the particular device selected to illustrate the invention is but one of many possible embodiments of the same. The invention, therefore, is not to be restricted to the precise details of the structure shown and described.

What is claimed is:

1. An improved conveyor mechanism for a kiln tunnel comprising a plurality of substantially flat refractory slabs for supporting ceramic ware to be fired, a plurality of rotary ceramic members arranged to provide a substantially continuous bed supporting said slabs, means for moving said ceramic members to advance said slabs and the ware supported thereon through said tunnel, and pintle centering means to maintain said rotary ceramic members centered with respect to the sidewalls of said tunnel.

2. An improved conveyor mechanism for a kiln tunnel comprising pairs of supporting shafts made of cer-

amic refractory material having their ends extending from opposite directions into the kiln tunnel area, ceramic refractory rollers having axial openings formed in the ends thereof into which the ends of said shafts extend, and having sufficient clearance therebetween to allow for thermal expansion of the roller, the shafts and the supports therefor, and means for rotating said shafts to impart rotary movement to the ceramic conveying rollers supported thereon to advance material through said kiln tunnel and means for limiting the distance said rollers can ride in on either shaft.

3. The method of conveying articles through a kiln tunnel which comprises arranging a series of rollers made of ceramic refractory material side by side and transversely along the length of a kiln tunnel, supporting said rollers on the ends of pintles extending into the kiln tunnel, from opposite sides thereof, rotating said rollers by rotating said pintles, allowing sufficient space for slippage to occur between said rollers and said pintles when material is being conveyed through the kiln tunnel in the event the center ceramic roller is prevented from rotating and for limiting the distance said ceramic roller can move axially onto their supporting pintles.

4. An improved ceramic conveying apparatus for conveying ceramic ware through a kiln tunnel comprising a pair of spaced pintles axially aligned with each other and extending into said tunnel from opposite sides thereof, a heat resistant ceramic roller pivotally mounted at its ends on said spaced pintles, and having clearance therebetween when said rollers and pintles are subjected to their maximum temperature, and means to rotate at least one of said pintles to impart rotary movement to said center roller to convey material being fired through said kiln tunnel.

5. In a kiln tunnel, a series of ceramic rollers arranged side by side for conveying materials through said kiln tunnel, pintle shafts extending into said tunnel and projecting into the ends of said ceramic rollers for supporting the same and means for rotating said pintle shafts to rotate said ceramic conveying rollers to convey materials to be heat treated through said kiln tunnel the ends of said rollers having sufficient clearance with said pintles to allow for expansion during operation of the kiln.

6. In a kiln tunnel for heat treating material, a horizontal bed of rollers made of ceramic refractory material for conveying materials to be heat treated through said kiln tunnel on substantially flat ceramic slabs, stud shafts extending into the ends of said ceramic refractory rollers and means for rotating at least one of the stud shafts supporting each roller to impart rotary movement to said ceramic refractory rollers to cause said rollers to advance ceramic ware supported thereon through said tunnel on said slabs, the depth of the opening in each roller being adequate to allow for thermal expansion of the stud shafts and rollers when the kiln is operating and to limit the longitudinal movement of the axial movement of the rollers relative to the stud shafts to prevent the center rollers from touching the sidewalls of the kiln.

7. A conveying mechanism adapted for use in conveying material to be heat treated through a kiln tunnel comprising aligned heat resistant shafts having one end extending into said tunnel from opposite sides of the tunnel, drives mounted on the outside of said tunnel for driving said heat resistant shafts at at least one end, ceramic rollers axially mounted over the ends of said shafts for supporting and conveying material to be heat treated through said tunnel and means for imparting rotary movement to the shafts to rotate said center rollers to convey material to be heat treated through said tunnel, said rollers having sufficient clearance to allow for thermal expansion while simultaneously limiting the rollers' axial movement relative to said shaft to center said roller relative to said kiln tunnel.

8. A conveyor for advancing ceramic ware to be fired through a kiln tunnel comprising shafts extending from opposite sides into said kiln tunnel, conveying rollers arranged side by side and having axial holes formed in the ends of said rollers and supported on the ends of said shafts, means for alternately driving said shafts from opposite sides to impart rotary movement to said rollers to convey, on a substantially flat surface mounted on said rollers, ceramic ware supported thereon through said tunnel, the axial holes in said rollers having clearance between the rollers and the shafts to allow for heat expansion to prevent said rollers from touching the side of said kiln.

9. A conveyor mechanism for advancing ceramic ware through a kiln tunnel, said mechanism comprising banks of ceramic conveying rollers, shafts having one of their ends extending axially from opposite sides of the tunnel into the ends of said ceramic conveying rollers, there being sufficient clearance to allow for thermal expansion and to prevent the ends of the ceramic rollers from touching the sides of said kiln tunnel, a drive mechanism for each bank for imparting rotary movement to the shafts of each bank to rotate said ceramic conveying rollers, a common drive synchronizer for causing said drive mechanisms to operate in unison to advance said ceramic ware through said kiln tunnel.

10. A conveyor mechanism for advancing ceramic ware through a kiln tunnel comprising banks of ceramic rollers arranged side by side and forming a conveying bed inside of said tunnel kiln, shafts extending from opposite sides of the tunnel into the opposite ends of said ceramic rollers to impart rotary movement thereto, there being sufficient clearance between the shafts and the rollers to allow for thermal expansion but close enough to prevent the ends of the rollers from touching the sidewalls of the kiln tunnel, sprockets fixedly connected to said shafts on the outside of said tunnel, sprocket chains for driving the shaft of each bank in unison to impart rotary movement to said ceramic rollers, and means for synchronizing the timing of said sprocket chains to drive the banks of ceramic rollers in unison to move ceramic ware through said kiln tunnel.

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