Sept. 19, 1939. F. A. FAHRENWALD 2,173,682

FURNACE CONVEYER

Filed Oct. 27, 1938 4 Sheets-Sheet 1

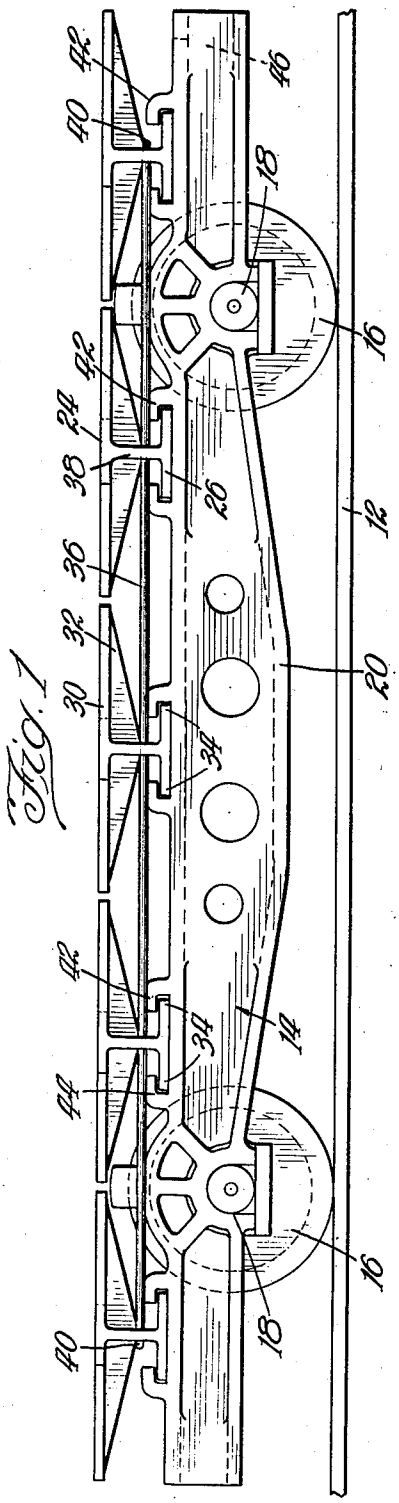


Fig. 1

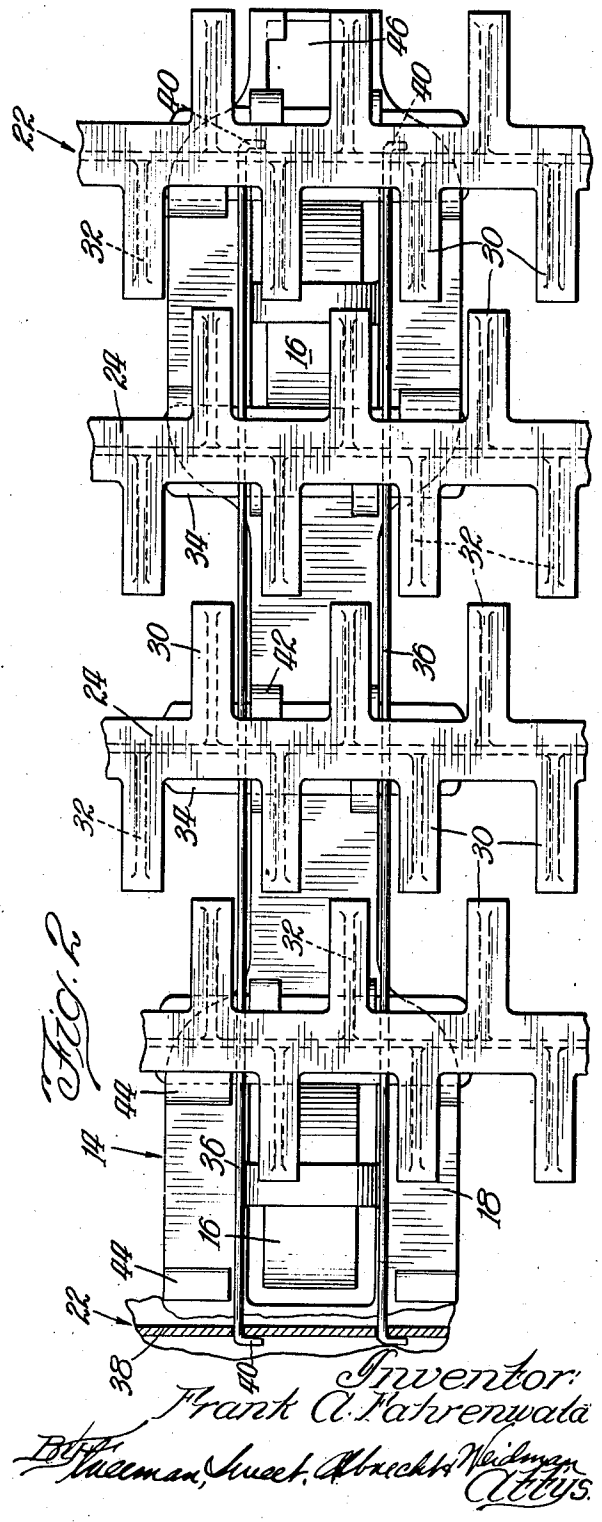


Fig. 2

Inventor:
Frank A. Fahrenwald
By Freeman, Sweet, Albrecht & Weidman
Attys.

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FURNACE CONVEYER

Filed Oct. 27, 1938 4 Sheets-Sheet 2

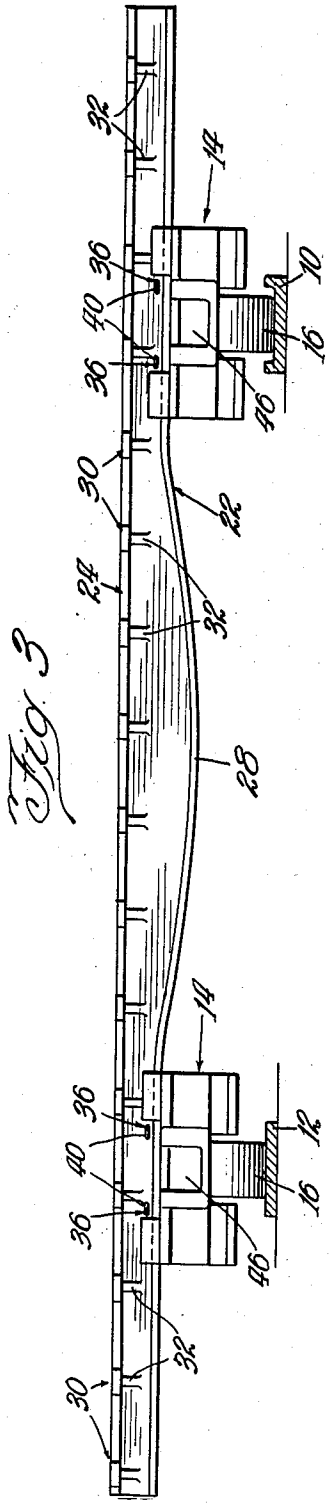


Fig. 3

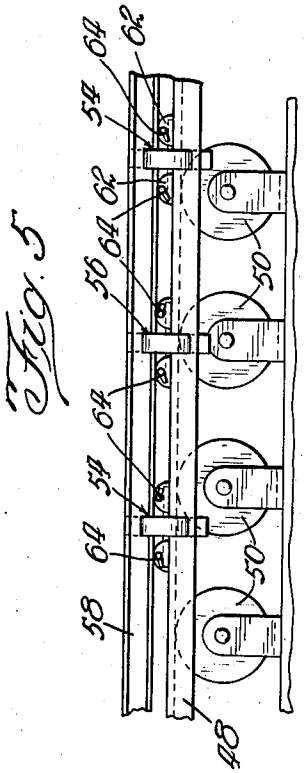


Fig. 5

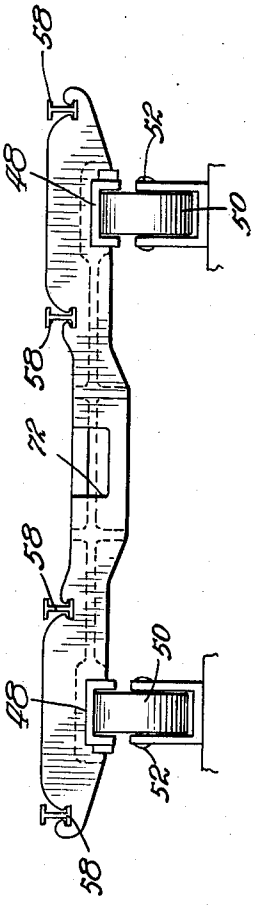


Fig. 6

Inventor:
Frank A. Fahrenwald
By Freeman, Mueller, Albrecht & Weidman
Attys.

Sept. 19, 1939. F. A. FAHRENWALD 2,173,682

FURNACE CONVEYER

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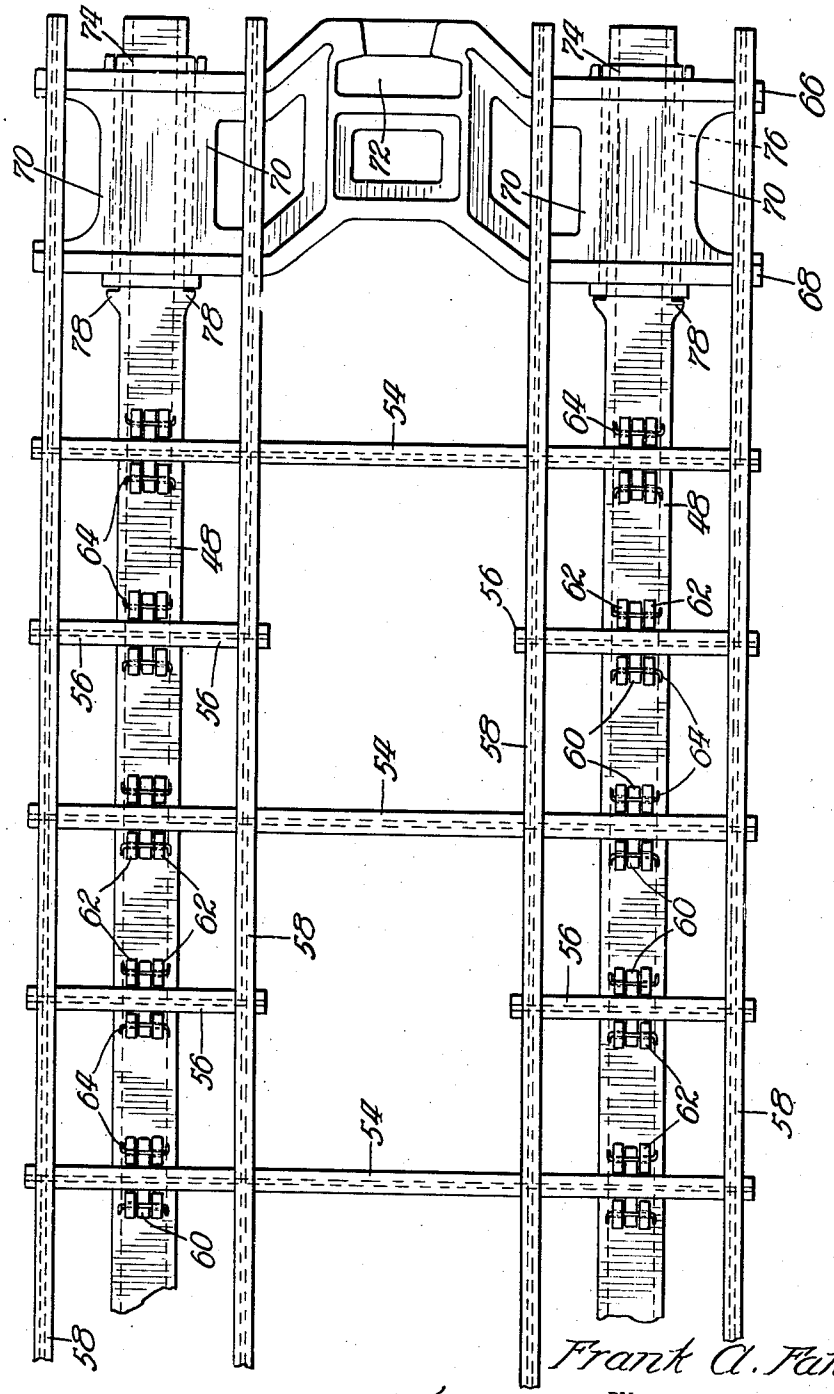


Fig. 4

INVENTOR.
Frank A. Fahrenwald
BY
Freeman, Sweet, Albrecht & Weidman
ATTORNEYS

Sept. 19, 1939. F. A. FAHRENWALD 2,173,682

FURNACE CONVEYER

Filed Oct. 27, 1938 4 Sheets-Sheet 4

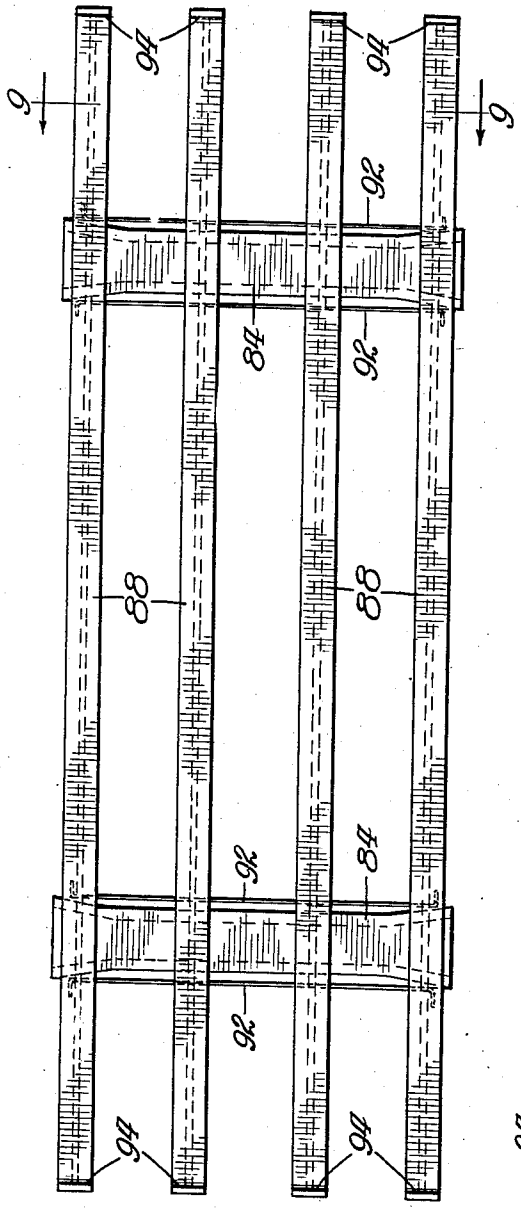


Fig. 7

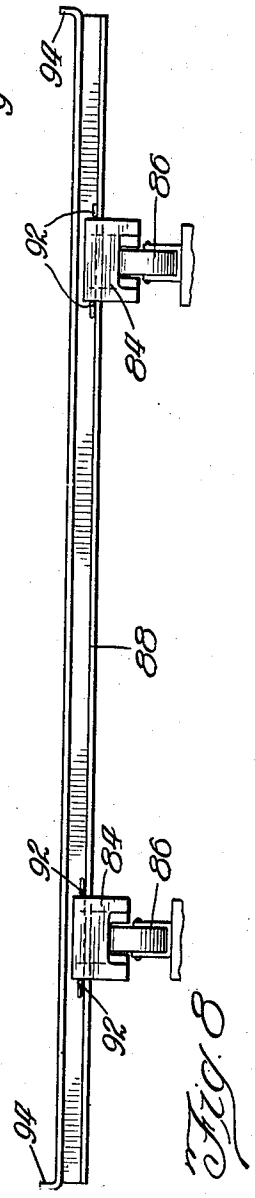


Fig. 8

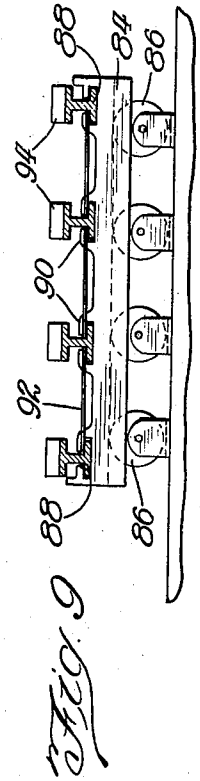


Fig. 9

INVENTOR.
Frank A. Fahrenwald
BY
Freeman, Sweet, Albrecht & Weidman
ATTORNEYS

Patented Sept. 19, 1939

2,173,682

UNITED STATES PATENT OFFICE

2,173,682

FURNACE CONVEYER

Frank A. Fahrenwald, Chicago, Ill.

Application October 27, 1938, Serial No. 237,298

23 Claims. (Cl. 263—28)

My invention relates to the heat treatment of materials, and includes among its objects and advantages an improvement in means for conveying material to be treated through a hot chamber or space, particularly with reference to strength, durability, and freedom from warping, buckling, and cracking.

In the expansion of the field of service in the heat treating of metal castings, forgings, and the like, as well as bricks and a wide variety of ceramic products, where the heat treatment usually has a baking action, one of the main obstacles is the weakness and warping of the instrumentalities used to support and transport the articles through the heated zone in which the treatment takes place.

It has been common heretofore to employ more or less rigid devices, usually of one piece, and not infrequently in the nature of a simple flat tray with or without stiffening walls or flanges, upon which the material is placed while the device is pushed or pulled through the heated chamber. Such devices are necessarily subjected to the same heat treatment as the articles themselves, and the continued repetition of the heat treatment time after time results in rapid deterioration, of which the most annoying feature is the buckling, warping, and even cracking open of the supporting device, due to the combined action of temperature gradients, loss of strength at high temperatures, and the weaving and warping due to track irregularities. This last item of track irregularity is thought of as negligible in conveyers operating at ordinary temperatures, but becomes highly significant at temperatures where it becomes impossible to employ springs of any sort, because the high temperature would draw the temper of any spring, and where it becomes impracticable to maintain in the track a degree of smoothness that could easily be maintained at ordinary temperatures.

Increasing the weight and over-all rigidity of the device itself is a step in the wrong direction. Such an increase not only multiplies the heat losses involved in treating the device, as well as its load, but it also increases the forces caused by temperature differences, to such an extent that the heavier and more rigid device destroys itself all the sooner.

In the accompanying drawings:

Figure 1 is a side elevation of a support according to the invention;

Figure 2 is a fragmentary plan view of the same device looking down from above;

Figure 3 is a section as on line 3—3 of Figure 1;

Figure 4 is a fragmentary plan view of a modified construction;

Figure 5 is a partial side elevation and Figure 6 an end elevation of the structure of Figure 4;

Figure 7 is a plan view of a simplified construction;

Figure 8 is an end view of the device of Figure 7; and

Figure 9 is a section on line 9—9 of Figure 7.

According to the invention, I employ the principle of multiple point contact with the supporting rails, utilizing points spaced widely enough apart to secure stability of the device and its load under the action of gravity. This necessarily implies not less than three points of support, but stability is greatly increased by the use of four points, and I have selected for illustration an embodiment providing for four points of support.

Proceeding upwardly from these points of support, I provide a plurality of intermediate supporting structures, each composed of a plurality of independent members, no one of which is of large dimensions in more than one direction. And each set or series of supportnig members is connected to the set or series below it by lost motion connections such that no twisting or warping action can be transmitted in any direction.

Referring first to Figures 1 to 3, the track 10 has flanges, and the track 12 is flat. Duplicate longitudinal truck members 14 each lie over one of the tracks and each carries spaced wheels 16 mounted in suitable bearings at 18. The bearings at 18 are located with approximately 60% of the length of the truck members between them, to secure substantially maximum efficiency in the use of material. Each truck member is of substantially hollow box section throughout, and intermediate the bearings 16 the vertical dimension of the section is increased as clearly indicated at 20 in Figure 1. In general, the section is designed to secure approximately uniform stress in the material when the beam is subjected to approximately uniform loading throughout its length.

In the embodiment selected for illustration in Figures 1 to 3, the next series of supporting members comprises five spanning members 22, each of I-beam cross section with an upper flange 24 and a lower flange 26, which lower flange rests under the action of gravity on the upper surface of the truck member 14. As in the case of truck members 14, the spanning members 22 are supported at points to secure maximum efficiency

in the use of material, and the lower flange 26 of each spanning member is curved downwardly as best indicated at 28 in Figure 3 to secure approximately uniform stress with approximately uniform loading along the length of the spanning member.

In the embodiment of Figures 1 to 3, the spaces between the spanning members 22 are further filled in by a plurality of fingers 30 projecting alternately in opposite directions from the upper flanges 24, and each reinforced by an underlying tapered web 32. It will be apparent that the supporting surface defined by the flanges 24 and fingers 30 is supported at ten points, so located that if the diagonally opposite wheels of the device happen to be elevated, the front spanning members may be tipped with their right ends uppermost, and the rear spanning members with their left ends uppermost, while the central spanning member still lies level, but no harmful twisting or binding action is developed on either the spanning members or the truck members 14.

I have provided lost motion connections adequate to prevent complete separation of the parts, but still leaving the parts free to warp as indicated, or to shift materially due to differences in temperature. The upper web of the truck member 14 where it underlies each bottom flange 26 of the spanning member is provided with curved lugs cast integral with the truck member itself. As clearly indicated in Figure 1, these lugs extend up and then inwardly over the adjacent edges of the flanges 26 but spaced therefrom. Accordingly, the spanning members may be assembled with the truck member by sliding them endwise to engage the flanges 26 in the positions indicated in Figure 1. The flanges 26 are widened at 34 to secure additional bearing surface on the truck members 14. To restrain the spanning member from permanent displacement parallel to its length, I have provided suitable stop means, in the form of rods 36. The rods 36 pass through holes in the webs 38 of the spanning members 22, and have their ends bent over at 40. In the narrower portions of the truck members 14, the lugs 42 engaging the webs of the spanning members are located between the rods 36. Adjacent each wheel 16 the truck member is widened to provide the bearings 18 for the wheel 16, and in the widened portions the lugs 44 are positioned with the rods 36 between the lugs. But at every point the clearances between the rods and lugs are ample to allow more than the maximum displacement that could result from differences in temperature of the different beams, so that the thermal expansion and contraction of the spanning members can not twist or distort the truck members or vice versa. The ends of the truck members 14 are provided with sockets at 46 to receive the end of any suitable pulling instrumentality, such as a yoke or harness for coupling the individual truck to another truck or to a pulling device.

Referring now to Figures 4, 5, and 6, I have illustrated a similar truck in which three superposed sets of beams are provided. The truck members in this embodiment are simple channels 48 with downwardly directed flanges which roll along over the supporting wheels 50 mounted on stationary pivots at 52. The next set of beams includes spanning members 54 which go all the way across the truck and spanning members 56 which extend across under only two of the uppermost longitudinal beams 58. The spanning members 54 and 56 are I-shaped in cross section, and where they overlie the truck members 48 they have laterally projecting lugs at 60. Each lug 60 lies between spaced lugs 62 projecting upward from the truck member 48 and pins 64 pass through aligned holes in lugs 62 and overlie lugs 60. The pins 64 are of materially smaller diameter than the holes in which they fit, and the lugs 60 are materially narrower than the clearances between the lugs 62. Also the lugs 62 on opposite sides of a spanning member 54 or 56 are spaced apart materially farther than the width of the flange of the spanning member between them. These clearances permit relative movement and material warping in all directions between the truck members 48 and the spanning members 54 and 56. The extreme front spanning member 66 and the one next beyond it and 68 are interconnected by bracing webs 70 into a single piece, the center of which is shaped to provide a socket at 72 for receiving a coupling member by means of which the entire truck can be pulled through the furnace. In other words, the two front spanning members 66 and 68 also constitute the pulling yoke. To transmit the pull from the yoke back to the truck members 48, each truck member has a flange at 74 abutting downwardly extending flanges at 76, which flanges 76 are integral with the web 70. These flanges also are formed with sufficient clearance between themselves and the parts against which they abut to prevent any harmful warping action. Any movement of the yoke in the opposite direction is similarly restrained by shoulders at 78 on the truck member 14.

The third set of beams comprises four duplicate I-beams 58, each overlying all the spanning members 54, 56, 66, and 68, and connected to all of them as best indicated in Figure 6, with the same ample clearances between the lower flanges of the beams and the lugs at 62 to prevent any harmful binding between the second and third sets of beams.

Referring now to Figures 7, 8, and 9, in which my invention is shown in a simpler embodiment, the truck members 84 are of channel cross section with downwardly turned legs, and ride on the rows of supporting wheels 86. At each end the truck member 84 is extended upwardly to form a contact abutment at 88 by means of which, when the conditions of service make such procedure desirable, a series of such trucks can be pushed through the furnace. The spanning members 88 are of I-beam cross section and slide under the lugs 90 as in the embodiment of Figure 1, and the retaining rods 92 are outside the lugs on the truck members throughout their length. The spanning members 88, taken together, define a flexible grid on which the material to be subjected to heat can be supported. The upper flanges of the spanning members are turned up at 94 at both ends to facilitate loading the truck without letting part of the load work off the side of the truck as the truck goes through the furnace.

It will be noted that in Figures 1, 2, and 3 the wheels are on the truck structure, but in the other embodiments the wheels are on the track structure.

Without further elaboration, the foregoing will so fully explain my invention that others may, by applying knowledge current at the time of application, readily adapt the same for use under various conditions of service.

I claim:

1. In a furnace conveyer, in combination: a

pair of tracks; a pair of truck members each supported by said tracks at two spaced points; a plurality of spanning members each supported at two spaced points by said truck members; said spanning members collectively defining a gridlike structure adapted to receive and support an object to be conveyed; connections between said spanning members and said truck members for supporting each spanning member independently of the others; said connections permitting free shifting or rotary displacements between said spanning members and said truck members, largely in excess of any distortion that might be caused by thermal conditions, and normal loads, and track unevenness, but restraining complete separation of the parts; and roller means carried by said truck members and operating between said truck members and said tracks for supporting said truck members and spanning members and load, and permitting the whole to roll along over said tracks; said truck members extending parallel to said tracks.

2. In a furnace conveyer, in combination: a pair of tracks; a pair of truck members each supported by said tracks at two spaced points; a plurality of spanning members each supported at two spaced points by said truck members; said spanning members collectively defining a gridlike structure adapted to receive and support an object to be conveyed; connections between said spanning members and said truck members for supporting each spanning member independently of the others; said connections permitting free shifting or rotary displacements between said spanning members and said truck members, largely in excess of any distortion that might be caused by thermal conditions, and normal loads, and track unevenness, but restraining complete separation of the parts; and roller means carried by said truck members and operating between said truck members and said tracks for supporting said truck members and spanning members and load, and permitting the whole to roll along over said tracks.

3. In a furnace conveyer, in combination: a pair of tracks; a pair of truck members each supported by said tracks at spaced points; a plurality of spanning members each supported at spaced points by said truck members; said spanning members collectively defining a gridlike structure adapted to receive and support an object to be conveyed; connections between said spanning members and said truck members for supporting each spanning member independently of the others; said connections permitting free shifting or rotary displacements between said spanning members and said truck members, largely in excess of any distortion that might be caused by thermal conditions and normal loads, and track unevenness, but restraining complete separation of the parts.

4. In a furnace conveyer, in combination: a pair of tracks; a pair of truck members each supported by said tracks; a plurality of spanning members each supported at spaced points by said truck members; said spanning members collectively defining a gridlike structure adapted to receive and support an object to be conveyed; connections between said spanning members and said truck members for supporting each spanning member independently of the others; said connections permitting free shifting or rotary displacements between said spanning members and said truck members, largely in excess of any distortion that might be caused by thermal conditions and normal loads, and track unevenness, but restraining complete separation of the parts; and roller means operating between said truck members and said tracks for supporting said truck members and spanning members and load, and permitting the whole to roll along over said tracks; said truck members extending parallel to said tracks.

5. In a furnace conveyer, in combination: a pair of tracks; a pair of truck members; a plurality of spanning members each supported at two spaced intermediate points by said truck members; said spanning members collectively defining a gridlike structure adapted to receive and support an object to be conveyed; connections adjacent the points of support between said spanning members and said truck members for supporting each spanning member independently of the others; said connections permitting free shifting or rotary displacements between said spanning members and said truck members, largely in excess of any distortion that might be caused by thermal conditions and normal loads, and track unevenness, but restraining complete separation of the parts; and roller means carried by said truck members and operating between said truck members and said tracks for supporting said truck members and spanning members and load, and permitting the whole to roll along over said tracks.

6. In a furnace conveyer, in combination: a pair of tracks; a pair of truck members movably supported on said tracks; a plurality of spanning members each supported a spaced points by said truck members; said spanning members collectively defining a gridlike structure adapted to receive and support an object to be conveyed; and connections between said spanning members and said truck members for supporting each spanning member independently of the others.

7. In a furnace conveyer, in combination: tracks; parallel truck members supported by said tracks; parallel spanning members arranged transversely of said truck members and overlying the same; lost motion connections between said truck members and said spanning members permitting free warping of the whole; parallel floor members arranged transversely of said spanning members and overlying the same; and lost motion connections between said floor members and said spanning members permitting free warping of the whole.

8. In a furnace conveyer, in combination: tracks, parallel truck members supported by said tracks; parallel spanning members arranged transversely of said truck members and overlying the same; lost motion connections between said truck members and said spanning members permitting free warping of the whole; parallel floor members arranged transversely of said spanning members and overlying the same; lost motion connections between said floor members and said spanning members permitting free warping of the whole; and wheels supporting said truck members above said track.

9. In a furnace conveyer, in combination: tracks; parallel truck members supported by said tracks; parallel spanning members arranged transversely of said truck members and overlying the same; lost motion connections between said truck members and said spanning members permitting free warping of the whole; parallel floor members arranged transversely of said spanning members and overlying the same; lost motion connections between said floor members and said

spanning members permitting free warping of the whole.

10. In a furnace conveyer, in combination: tracks; truck members supported by said tracks; spanning members arranged at an angle to said truck members and overlying the same; and lost motion connections between said truck members and said spanning members peritting free warping of the whole.

11. In a furnace conveyer, in combination: tracks; parallel truck members supported by said tracks; parallel spanning members arranged transversely of said truck members and overlying the same; and lost motion connections between said truck members and said spanning members permitting free warping of the whole.

12. In a furnace conveyer, in combination: tracks; parallel truck members supported by said tracks; parallel spanning members arranged transversely of said truck members and overlying the same; lost motion connections between said truck members and said spanning members permitting free warping of the whole; and fingers projecting from the sides of said spanning members to define a gridlike structure with the space between two spanning members partially bridged by said fingers.

13. In a furnace conveyer, in combination: spaced parallel tracks, spaced contact means engaging said tracks at four points occupying substantially the corners of a rectangle; a plurality of first supports each overlying said contact means and having cross sectional dimensions amounting to a minor fraction of its length; a plurality of second supports each overlying said first supports and resting on said first supports, said second supports each having cross-sectional dimensions amounting to a minor fraction of its length; and a plurality of third supports each overlying said second supports and each having cross-sectional dimensions amounting to a minor fraction of its length; and stop means carried by each of said second and third supports allowing free movement on the underlying supports within predetermined limits; said first supports extending parallel to said tracks.

14. In a furnace conveyer, in combination: spaced parallel tracks, spaced contact means engaging said tracks at four points occupying substantially the corners of a rectangle; a plurality of first supports each overlying said contact means and having cross sectional dimensions amounting to a minor fraction of its length; a plurality of second supports each overlying said first supports and resting on said first supports, said second supports each having cross-sectional dimensions amounting to a minor fraction of its length; and a plurality of third supports each overlying said second supports and each having cross-sectional dimensions amounting to a minor fraction of its length; and stop means carried by each of said second and third supports allowing free movement on the underlying supports within predetermined limits.

15. In a furnace conveyer, in combination: spaced parallel tracks, spaced contact means engaging said tracks at four points occupying substantially the corners of a rectangle; a plurality of first supports each extending over at least two of said contact means and having cross sectional dimensions amounting to a minor fraction of its length; a plurality of second supports each extending over more than one of said first supports and resting on said first supports, said second supports each having cross-sectional dimensions amounting to a minor fraction of its length; and stop means carried by each of said second supports allowing free movement on the underlying supports within predetermined limits.

16. In a furnace conveyor, in combination: spaced parallel tracks, spaced contact wheels engaging said tracks at four points occupying substantially the corners of a rectangle; a plurality of first supports each extending over and carrying two of said wheels and having cross sectional dimensions amounting to a minor fraction of its length; a plurality of second supports each extending over more than one of said first supports and resting on said first supports, said second supports each having cross-sectional dimensions amounting to a minor fraction of its length; and stop means carried by said second supports allowing free movement on the underlying supports within predetermined limits.

17. In a furnace conveyer, in combination: spaced parallel tracks; two first supports overlying said tracks and having cross sectional dimensions amounting to a minor fraction of its length; spaced contact wheels overlying said tracks and underlying and supporting said first supports; a plurality of second supports each extending over both said first supports and resting on said first supports, said second supports each having cross-sectional dimensions amounting to a minor fraction of its length; and stop means carried by each of said second supports allowing free movement on the underlying supports within predetermined limits.

18. In a furnace conveyer, in combination: a truck chassis made up of members of length greatly exceeding their transverse dimensions; a set of spanning members each of length greatly exceeding its transverse dimensions; said set of spanning members overlying said chassis, and contacting the same at a plurality of points; lost motion connections between all said members preventing complete separation of said spanning members and chassis but permitting free warping of the whole; and track means supporting said chassis.

19. In a furnace conveyer, in combination: a truck chassis made up of members of length greatly exceeding their transverse dimensions; a set of spanning members each of length greatly exceeding its transverse dimensions; said set of spanning members overlying said chassis, and contacting the same at a plurality of points; lost motion connections between all said members preventing complete separation of said spanning members and chassis but permitting free warping of the whole; and track means supporting said chassis; each spanning member having supporting contact with said chassis at two spaced points only.

20. In a furnace conveyer, in combination: a pair of tracks; a pair of truck members each supported by said tracks; a plurality of spanning members each supported at spaced points by said truck members; said spanning members collectively defining a gridlike structure adapted to receive and support an object to be conveyed; connections between said spanning members and said truck members for supporting each spanning member independently of the others; said connections permitting free shifting or rotary displacements between said spanning members and said truck members, largely in excess of any distortion that might be caused by thermal conditions and normal loads, and track unevenness, but restraining complete separation of the parts.

21. In a furnace conveyer, in combination: parallel truck members extending in the direction of motion; means for supporting and guiding said truck members throughout their movement through the furnace; a work-carrying spanning member arranged transversely of said truck members and overlying the same; and lost motion connections between said truck members and said spanning member; said connections permitting free shifting or rotary displacements between said spanning member and said truck members, largely in excess of any distortion that might be caused by thermal conditions and normal loads, and track unevenness, but restraining complete separation of the parts.

22. In a furnace conveyer, in combination: parallel truck members extending in the direction of motion; means for supporting and guiding said truck members throughout their movement through the furnace; work-carrying spanning members arranged adjacent each other and collectively defined structure adapted to receive and support the work; and lost motion connections between said truck members and said spanning members; said connections permitting free shifting or rotary displacements between said spanning members and said truck members, largely in excess of any distortion that might be caused by thermal conditions and normal loads, and track unevenness, but restraining complete separation of the parts; said supporting and guiding means comprising stationary track means, said truck members having contact surfaces positioned and arranged to engage said track means and provide both vertical support and lateral guidance for the movement of said truck members.

23. In a furnace conveyer, in combination: tracks; parallel truck members supported by said tracks; parallel spanning members arranged transversely of said truck members and overlying the same; lost motion connections between said truck members and said spanning members permitting free warping of the whole; parallel floor members arranged transversely of said spanning members and overlying the same; and lost motion connections between said floor members and said spanning members permitting free warping of the whole; said truck members having contact surfaces positioned and arranged to engage said track means and provide both vertical support and lateral guidance for the movement of said truck members.

FRANK A. FAHRENWALD.