Jan. 17, 1956 E. A. SMITH 2,731,139

CONVEYOR MECHANISM

Filed Aug. 24, 1951 2 Sheets-Sheet 1

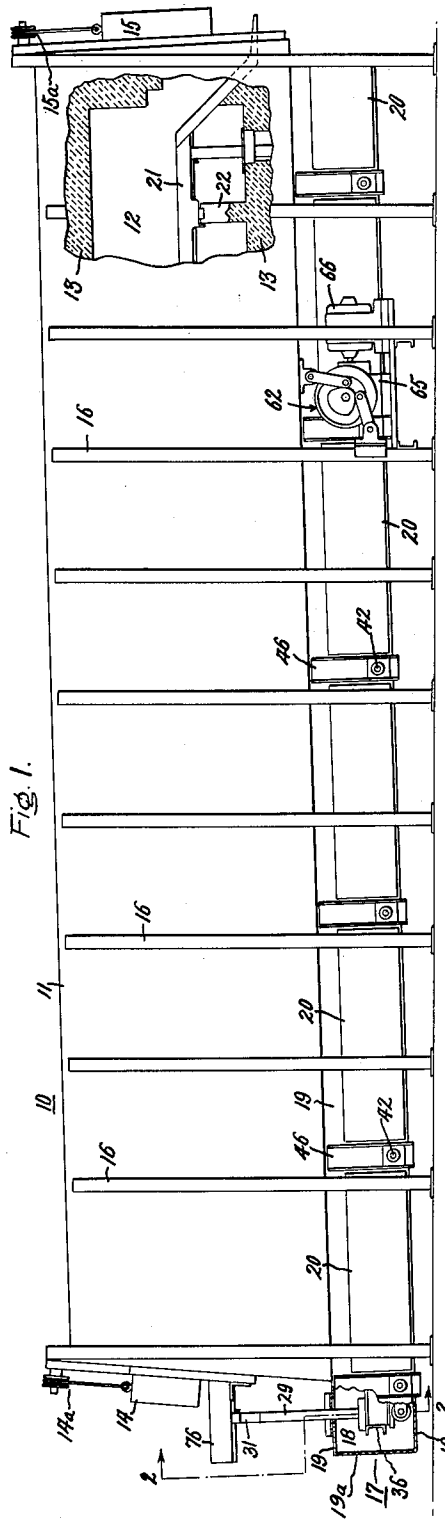


Fig. 1.

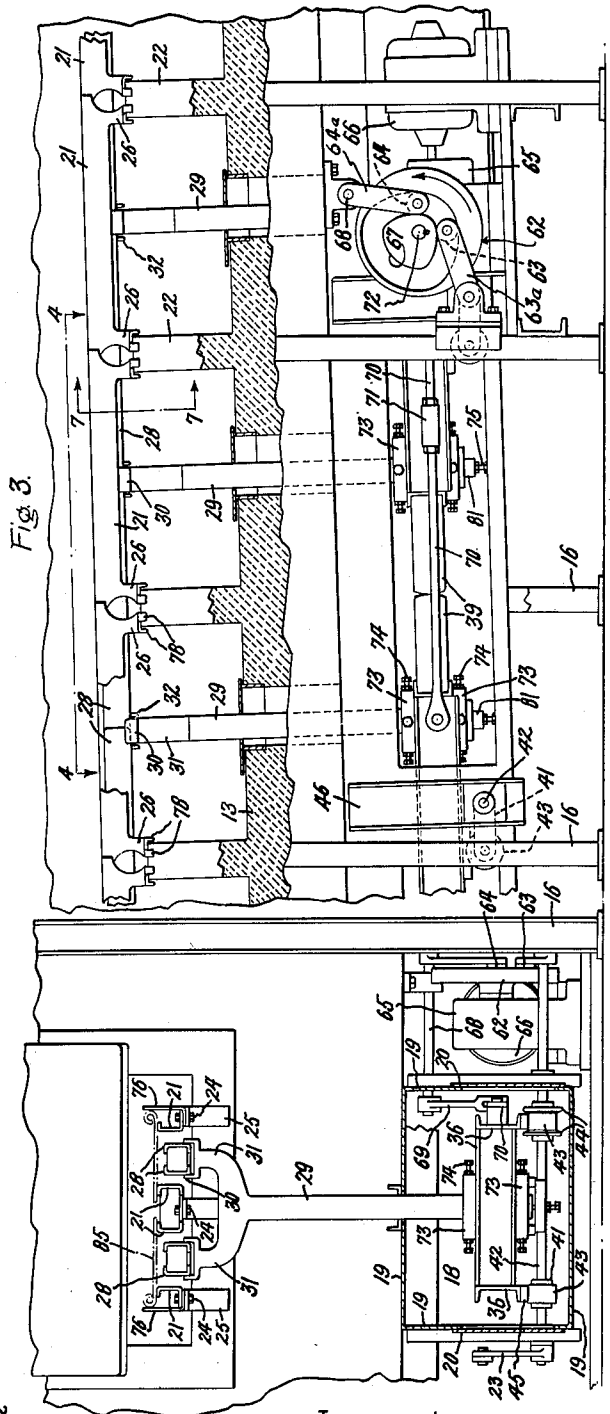


Fig. 3.

Fig. 2.

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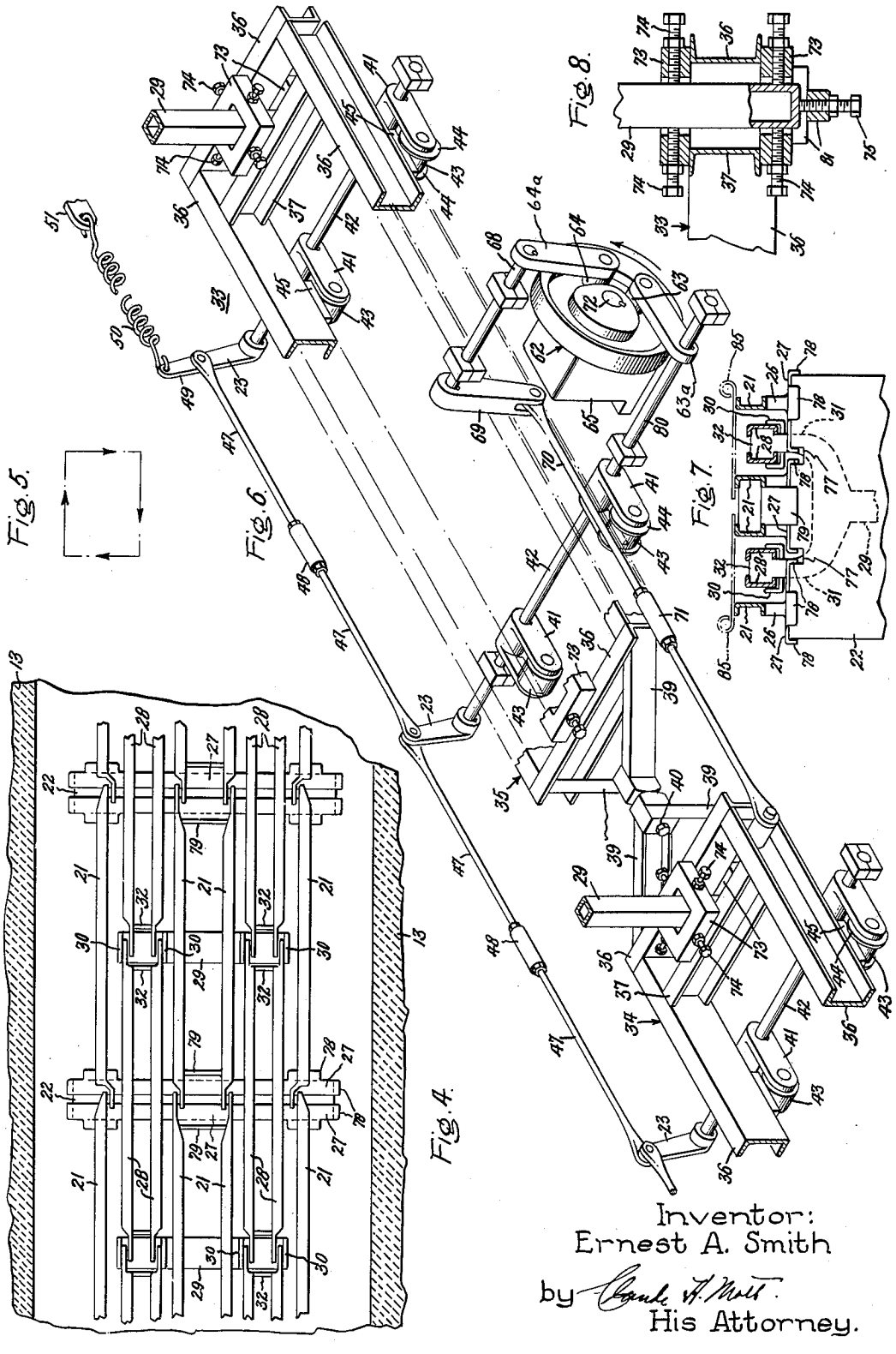


Fig. 4.

Fig. 5.

Fig. 6.

Fig. 7.

Fig. 8.

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CONVEYOR MECHANISM

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2 Claims. (Cl. 198—219)

This invention relates to conveyor mechanisms, and more particularly to conveyor mechanisms for use in conveying work through heat-treating furnaces and the like.

An object of my invention is to provide a mechanism suitable for the simultaneous conveyance of work-pieces of assorted sizes and shapes.

Another object of the invention is to provide a mechanism which will convey such assorted pieces and at the same time maintain all work-pieces in the alignment in which they are placed initially on the mechanism.

A further object of the invention is to provide a conveyor mechanism which handles work-pieces of assorted sizes and shapes and maintains them in alignment, and which is suitable for use at high temperatures in a furnace or the like.

A still further object of the invention is the provision of a conveyor mechanism suitable for use in a furnace which provides maximum exposure of the pieces being conveyed to the heat of the furnace.

Other objects and advantages of my invention will become apparent from the subsequent description of a preferred embodiment thereof, while the scope of the invention is defined in the appended claims.

In one form of my conveyor mechanism, I provide fixed means forming a substantially horizontal support, and conveying means for raising vertically a work-piece resting on the horizontal fixed support, moving the work-piece a predetermined distance substantially parallel with the horizontal support and then lowering the work-piece vertically on to the horizontal support again. The conveying means comprises movable support means, a rotatable cam, means operated by the cam for raising and lowering the movable support means vertically, and separate means operated by the cam for operating the movable support means back and forth horizontally.

For a clearer and more complete understanding of my invention, reference should be had to the accompanying drawing, in which Fig. 1 is a side elevational view having two small portions in section of a furnace embodying the conveyor mechanism of this invention; Fig. 2 is an enlarged partial end view along 2—2 of the furnace of Fig. 1 with the walls of an auxiliary enclosure near the bottom thereof in section; Fig. 3 is an enlarged partial view showing a part of the same side of the furnace as Fig. 1 with a portion of the furnace in section and with a cover plate removed from the auxiliary enclosure; Fig. 4 is an enlarged partial top view of the furnace in section, along the line 4—4 of Fig. 3; Fig. 5 is a diagram illustrating the operation of my conveyor mechanism; Fig. 6 is an enlarged partial view in perspective showing some of the construction details of the conveyor mechanism; Fig. 7 is an enlarged partial view in section along the line 7—7 of Fig. 3 illustrating other details of the conveyor mechanism; and Fig. 8 is an enlarged fragmentary view partially in section of a part of the conveyor mechanism showing the details thereof.

There is illustrated in Fig. 1 of the drawing an elongated furnace 10 of the continuous type customarily used for the heat-treating of small metal parts. The furnace includes an outer metal casing 11 enclosing a long, rectangular heating chamber 12 on the ends and on four sides (i. e., the top, bottom and two vertical sides). Inside the outer casing 11 is located a layer 13 of thermal insulating material which also surrounds the heating chamber 12. Externally of the casing 11, the furnace may be provided with vertical supports 16 upon which the furnace rests. As shown in Fig. 1, the furnace 10 is provided with a door 14 and an operating mechanism 14*a* therefor on the left end of the furnace which provides for the admission into the furnace of pieces to be heated. On the opposite or right end of the furnace as illustrated in Fig. 1, it includes an exit door 15 and an operating mechanism 15*a* for this door. The furnace may be heated by any conventional means (not shown), such as electric heating units, gas flames or oil flames.

The conveyor mechanism for the furnace which I have designated generally by the numeral 17 extends entirely through the furnace and is housed in part within the furnace chamber 12 and in part within an auxiliary enclosure 18 which extends the length of the furnace below the lower wall of the heating chamber. The supplementary enclosure 18 which is rectangular in cross section is formed by four walls 19 of metal plus end portions 19*a* of the same material, as seen in Figs. 1 and 2 of the drawing. The side walls of supplementary enclosure 18, as shown in Figs. 1 and 2, are provided with a plurality of openings which are covered by cover plates 20; these cover plates may be removed to expose portions of the conveyor mechanism.

As illustrated in the drawing, particularly in Figs. 1–4 and 7, the conveyor mechanism includes a plurality of fixed support members 21 arranged in four rows which provide a substantially horizontal support extending longitudinally through the heating chamber 12 of the furnace. The support members 21 rest on pillars 22 of insulating material which extend upwardly from the insulating material 13 on the floor of the heating chamber, as seen best in Figs. 1, 3 and 7. The support members 21 are preferably formed of a metal with good heat resisting qualities, such as alloy steel, and may be in the form of channels in accordance with Figs. 2 and 7. Portions of the supporting members 21 extending beyond the left end of the furnace may be bolted to the outside of the furnace enclosure by means of nuts and bolts 24 and brackets 25, as shown best in Fig. 2. This external portion of the fixed support means also includes loading guides 76 along the sides of the two outermost members 21. The fixed support members 21 within the heating chamber, however, are preferably provided at each end with a downwardly disposed projection 26, as seen best in Figs. 3 and 7. Each of the projections 26 on the fixed members on the outer two rows has a base portion 27 having a plurality of depending projections 78 fitting loosely over a portion of a pillar 22. These depending projections are positioned along portions of the end and side surfaces of the pillars and in grooves 77 which extend longitudinally of the furnace across the upper surfaces of pillars 22. The fixed support members 21 making up the center two rows may have adjacent ends joined by a cross piece 79 (Figs. 4 and 7) if desired so that a common supporting base 27 is provided for the ends of two such members. This arrangement, as will be readily understood, provides for expansion and contraction of fixed support members 21 as the temperature in the heating chamber is increased and decreased.

The conveying portion of the conveyor mechanism comprises movable support means including a plurality of longitudinally disposed members 28 which are positioned in pairs between the spaced rows of fixed support mem-

bers 21, as illustrated in Fig. 4. These members 28 may be made from alloy steel channels similar to fixed support members 21. Members 28 are supported by a plurality of vertically disposed supporting members 29 each having a bifurcated portion at the upper end thereof comprising a pair of arms 31. Each of the arms 31 supports the ends of two pairs of members 28 and is provided with a pair of upward projections 30 (Figs. 2, 4 and 7) to retain the members 28 in position. Members 28 are loosely supported on arms 31, and as shown in Figs. 3, 4 and 7 each pair of members 28 is provided near each end with a depending cross piece 32 to maintain members 28 in the proper position on arms 31 and at the same time allow for expansion and contraction of members 28.

Each of the members 29 is movably supported upon a carriage which is designated generally by the numeral 33. This carriage is best seen in Figs. 2, 3 and 6, particularly the latter figure. As shown in the drawing, the carriage comprises two sections 34 and 35 for convenience of assembly. However, it will be understood that any number of sections, one, two or more, may be used depending upon the length of the furnace and the maximum size section which can be handled conveniently. As shown particularly in Fig. 6, each of the sections of the carriage is formed of channel members 36 along the sides and ends, with additional cross members 37 being provided as needed for rigidity of the carriage and to provide supporting means for the members 29. It will be readily understood that the sections of the carriage 33 may be braced in any conventional manner such as by diagonal channel members, if desired, to make certain that the carriage is rigid. As illustrated, the sections 34 and 35 of the carriage are joined by means of a structure comprising suitable channel members 39 and a nut and bolt 40.

The carriage 33 is supported on a plurality of substantially horizontally disposed levers 41 which are affixed in pairs to a plurality of transverse shafts 42. Each of the levers 41 is provided with a roller 43 on the free end thereof so that the shafts 42 may be turned, clockwise as seen in Fig. 6, to raise the carriage, and counterclockwise to lower it again. Certain of the rollers 43 are provided with flanges 44 to maintain alignment of the carriage, while the various side structural members 36 of the carriage may, if desired, be provided with bearing blocks 45 for engagement with the rollers. The shafts 42 may be journaled in suitable structural members such as angle members 46 (see Fig. 1).

Each of the shafts 42 is provided on one end with an upwardly disposed lever or rocker arm 23. The rocker arms 23 are rigidly secured to their respective shafts 42 and are positioned in substantially parallel relation with each other in order to provide for the simultaneous operation of all of the rocker arms. Connecting the rocker arms 23 are a plurality of connecting or tie rods 47 having turnbuckles 48 for adjusting the lengths thereof. As illustrated in Fig. 6, the shaft 42 at one end of the carriage is provided a longer rocker arm 23 having an extension 49; a tension spring 50 is connected between extension 49 and a fixed support such as 51. The spring 50 tends to rotate rocker arms 23 and all the shafts 42 in the clockwise direction, as will be readily apparent from the drawing. The purpose of this arrangement is explained subsequently.

In order to operate the conveyor mechanism 17 in the desired manner, there is provided a cam mechanism which includes a cam 62 mounted on a shaft 72 and a pair of cam followers 63 and 64 mounted respectively on levers 63*a* and 64*a*, and disposed approximately 90° apart about the axis of the shaft 72. As shown in Fig. 6, cam follower 63 is connected through its lever 63*a* to an extension 80 of one of shafts 42, and since all the shafts 42 are connected together through rocker arms 23 and tie rods 47 on the back side of the mechanism, cam follower 63 operates all of the shafts 42. The cam 62 is arranged so that when cam follower 63 is in the up position illustrated in Fig. 6, shafts 42 maintain all levers 41 in a substantially horizontal position as illustrated and this maintains carriage 33 in a lowered position. The cam 62 may be rotated continuously by means of a gear speed reducer 65 and a suitable driving means such as an electric motor 66.

As illustrated, the cam 62 comprises two portions, one portion having inner and outer cylindrical surfaces concentrically disposed with respect to the axis of rotation of the cam to form a passageway extending over a sector of approximately 90°, and the other portion having similarly disposed inner and outer cylindrical surfaces forming a passageway extending over a sector of approximately 90° diametrically opposite from the first portion. The inner and outer surfaces of the first portion are of a different radius than the corresponding inner and outer surfaces of the second portion, and, of course, surfaces join the inner and outer surfaces of the first portion with the corresponding surfaces of the second portion to form a continuous passageway around the axis of rotation of the cam.

If the cam 62 is rotated counterclockwise from the position illustrated in Fig. 6, cam follower 63 is depressed and moved away from cam shaft 72 which causes all of the levers 41 to rise and raise carriage 33. In the cam mechanism illustrated in the drawing, approximately a quarter of a complete cam revolution or 90 degrees is required for this operation. During this first 90 degrees of cam rotation cam follower 64 maintains its initial radial position, i. e., it does not move away from shaft 72.

As rotation of the cam 62 is continued counterclockwise beyond the first 90-degree sector, the cam follower 63 rides on the portion 67 of the cam at a constant distance from the cam shaft 72, and carriage 33 is thereby maintained in the raised position for another approximately 90 degrees. During this second 90-degree interval, the cam follower 64 is moved away from the cam shaft to pivot counterclockwise a shaft 68 to which its lever 64*a* is connected and operate a linkage to which the shaft 68 is connected. This linkage includes a downwardly disposed lever or rocker arm 69 on the other end of shaft 68 which is connected through a connecting rod 70, having a turnbuckle 71 for adjusting the length thereof, to section 34 of the carriage 33. As cam follower 64 is pivoted counterclockwise away from the cam shaft 72 during the second approximately 90-degree interval of cam rotation, lever 69 is also pivoted counterclockwise which through tie rod 70 pulls carriage 33 to the right.

During a third approximately 90-degree sector on the cam 62, the follower 63 returns counterclockwise to its initial position adjacent cam shaft 72 while cam follower 64 remains turned to its extreme counterclockwise position. This lowers the carriage 33 again while maintaining it at its extreme right position. Then, during the fourth and final approximately 90-degree sector on the cam, follower 63 is maintained in its up position so that the carriage remains down, while follower 64 moves clockwise and moves carriage 33 back to the left again to the starting point.

As will be readily understood, this action produces motion of carriage 33 which can be illustrated schematically by the diagram of Fig. 5 in which the upwardly pointed arrow along the left side represents the first approximately one-quarter of a revolution of cam 62, the horizontal arrow to the right represents the second portion of the cam rotation, the downwardly pointed arrow on the right side represents the third portion of the cam rotation, and the horizontal arrow pointed to the left at the bottom of the rectangle represents the final section of a cam revolution which returns the carriage to its starting point. Continued rotation of the cam repeats this cycle. It will be understood that the 90-degree divisions of a complete cam revolution used herein for purposes of illustration are not critical and that one such revolution or cycle may be separated into other than 90-degree portions if desired.

As carriage 33 is moved, the support members 29, which are rigidly supported on the carriage, cause the movable support members 28 to be moved through the same cycle. The support members 29 and the movable support members 28 are so dimensioned, and the members 29 are so adjusted, that at the starting point of the upward vertical motion the upper surfaces of the movable support members 28 are just below the upper surfaces of fixed support members 21 as illustrated in Figs. 2 and 7. During the upward substantially vertical motion of the carriage and movable support members, the upper surfaces of movable support members 28 rise above the fixed support members 21. During the second portion of the cycle, the movable support members move horizontally parallel to the fixed support members; during the third portion, they are lowered again so that their upper surfaces are again below the upper surfaces of members 21; and during the fourth portion, they return horizontally to their starting point. It will be readily understood, therefore, that if work-pieces such as are illustrated by the dashed lines 35 in Figs. 2 and 7 are placed across pairs of fixed support members 21 on opposite sides of a parallel row of movable support members, they will be picked up substantially vertically by the motion of the movable support members, moved horizontally, and again lowered on to the fixed support members, and that this operation may be continued until the work-pieces have moved completely through the furnace.

In order to adjust the support members 29 during assembly so that the lower position of movable support members 28 is below fixed support members 21 and the upper position is above the fixed support members, an adjustment mechanism may be provided for support members 29 and one adjustment mechanism suitable for this purpose is illustrated in Figs. 6 and 8 of the drawing. This mechanism comprises a pair of substantially square pieces of metal 73 positioned respectively above and below carriage 33 with four set screws 74 being provided for each member 73 to secure it to vertical support member 29. A depending member 81 is secured to the lower clamp member 73 in a suitable manner, and portion 81 is provided with a set screw 75 by means of which vertical support member 29 can be adjusted vertically.

The tension spring 50 assists cam follower 63 in raising the carriage in order to lessen the stress on this cam follower. Spring 50 is provided with sufficient initial stress that it supports most of the weight of the carriage so that cam follower 63 need supply only a small portion of the necessary lifting force in order to operate the carriage in the manner explained above.

It will be readily apparent from the foregoing that my invention provides a "walking beam" conveyor mechanism which is suitable for use with work-pieces of a variety of sizes and shapes. Moreover, since all motions are substantially rectilinear, the conveyor mechanism will move pieces of any size and shape which can be accommodated in the heating chamber while maintaining their alignment the same as when they are initially placed on the conveyor. In this connection, it will be understood that the tie rod 70 should be made sufficiently long that any deviation from rectilinear motion produced thereby when the carriage is raised is negligible. In addition to the above-mentioned advantages, this conveyor mechanism provides for the exposure of almost all of the surface of the work-pieces being heated to the furnace atmosphere which promotes uniform heating.

In one typical installation in which my conveyor mechanism was used in which the furnace was approximately 32 feet long, the fixed support members 21 on opposite sides of a double row of movable support members were spaced approximately 3 inches apart. In this same mechanism, the movable support members had a vertical motion of 2 inches and a horizontal motion of 3 inches. It will be understood, however, that the dimensions may be varied to suit a particular installation. Other modifications may also be made without departing from my invention, and I therefore intend to cover, by the appended claims, any modifications which fall within the true spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. A conveyor mechanism comprising fixed means providing a substantially horizontal support, movable support means for raising a work-piece from said fixed support, moving it a predetermined distance substantially parallel with said fixed support and lowering it on to said fixed support again, a carriage movably supporting said movable support means, a plurality of levers supporting said carriage, a plurality of shafts to which said levers are connected, a rotatable cam, said cam comprising a first cylindrical surface concentrically disposed with respect to the axis of rotation of said cam and extending over a sector of approximately 90°, a second cylindrical surface concentrically disposed with respect to the axis of rotation of said cam and extending over a sector of approximately 90° diametrically opposite from said first surface, said second cylindrical surface being of a different radius than said first cylindrical surface, and surfaces connecting said first and second cylindrical surfaces to form a continuous cam surface extending around the axis of rotation of said cam, a first cam follower engaging said cam surface to operate said shafts and the levers thereon to raise and lower said carriage and said movable support means, a second cam follower engaging said cam surface approximately 90° from said first cam follower, means for urging said first and second cam followers into engagement with said cam surface, and a linkage connecting said second cam follower with said carriage for moving said carriage and said movable support means horizontally.

2. A conveyor mechanism comprising fixed means providing a substantially horizontal support, movable support means for raising a work-piece from said fixed support, moving it a predetermined distance substantially parallel with said fixed support and lowering it on to said fixed support again, a carriage movably supporting said movable support means, a plurality of levers supporting said carriage, a plurality of shafts to which said levers are connected, a rotatable cam, said cam comprising a first portion having inner and outer cylindrical surfaces concentrically disposed with respect to the axis of rotation of said cam and extending to form a passageway over a sector of approximately 90°, a second portion diametrically opposite from said first portion and having inner and outer cylindrical surfaces concentrically disposed with respect to the axis of rotation of said cam and extending to form a passageway over a sector of approximately 90°, the inner and outer surfaces of said first portion being of a different radius than the corresponding inner and outer surfaces of said second portion, and surfaces joining the inner and outer surfaces of said first portion with the corresponding inner and outer surfaces of said second portion to form a continuous passageway extending around the axis of rotation of said cam, a first cam follower cooperating with said continuous passageway to operate said shafts and the levers thereon to raise and lower said carriage and said movable support means, a second cam follower cooperating with said continuous passageway approximately 90° from said first cam follower, and a linkage connecting said second cam follower with said carriage for moving said carriage and said movable support means horizontally.

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