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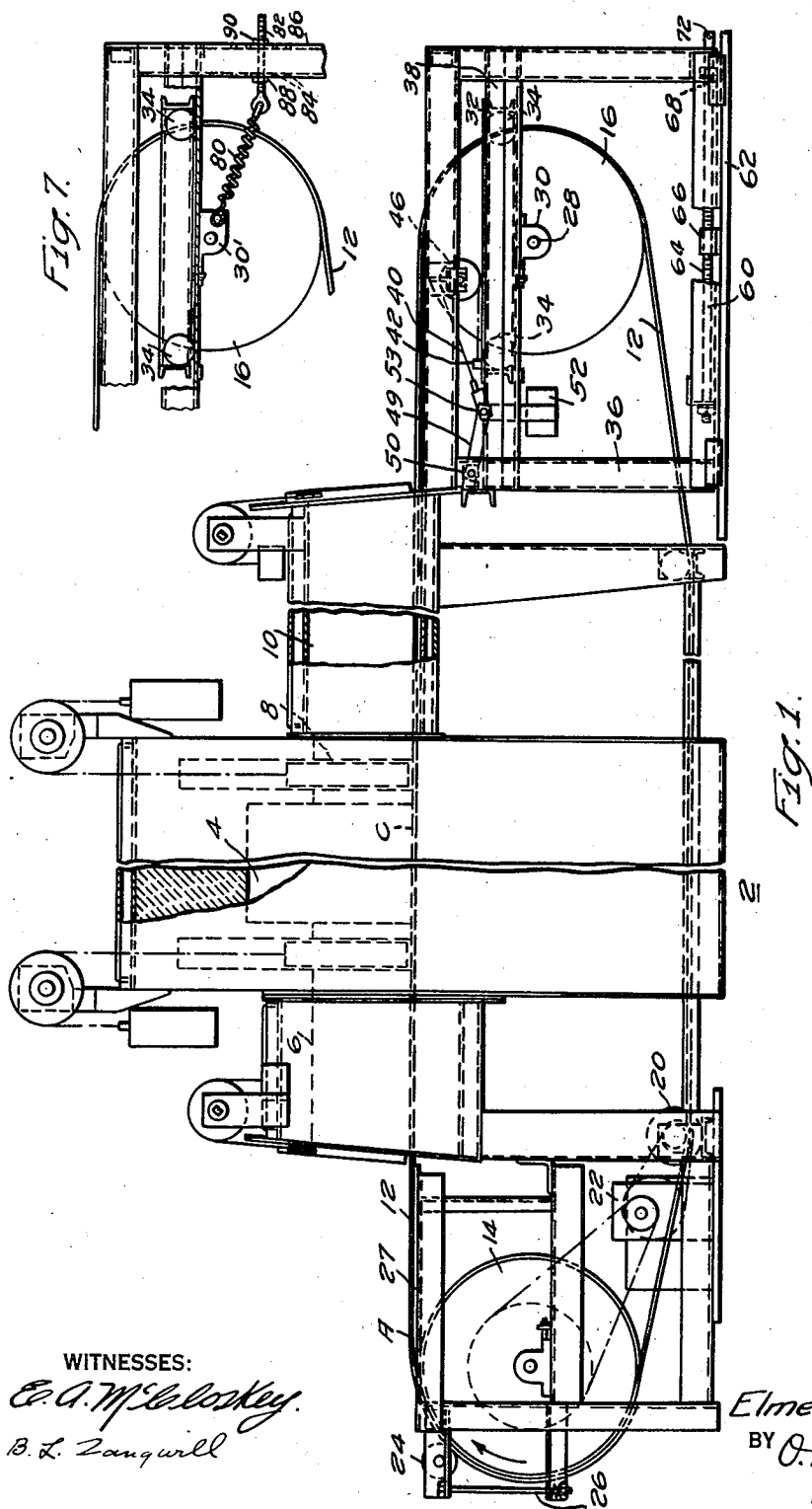
E. K. HANSEN

2,295,401

BELT-TENSION CONTROL DEVICE

Filed Feb. 20, 1940

2 Sheets-Sheet 1



WITNESSES:

E. A. McSherry
B. L. Zangwill

INVENTOR

Elmer K. Hansen

BY *O. B. Buchanan*

ATTORNEY

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2 Sheets-Sheet 2

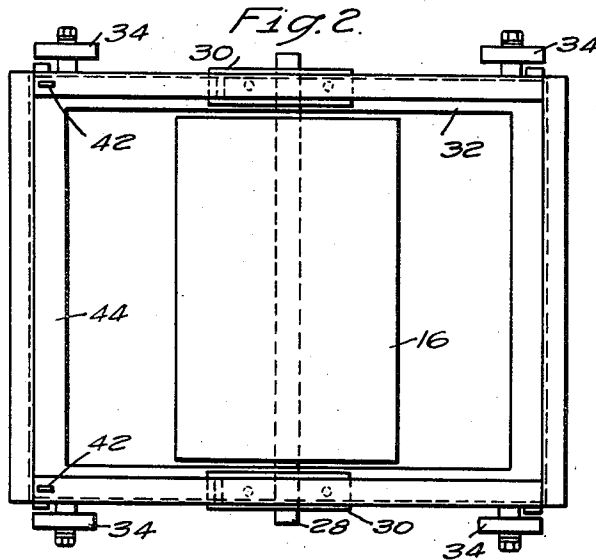
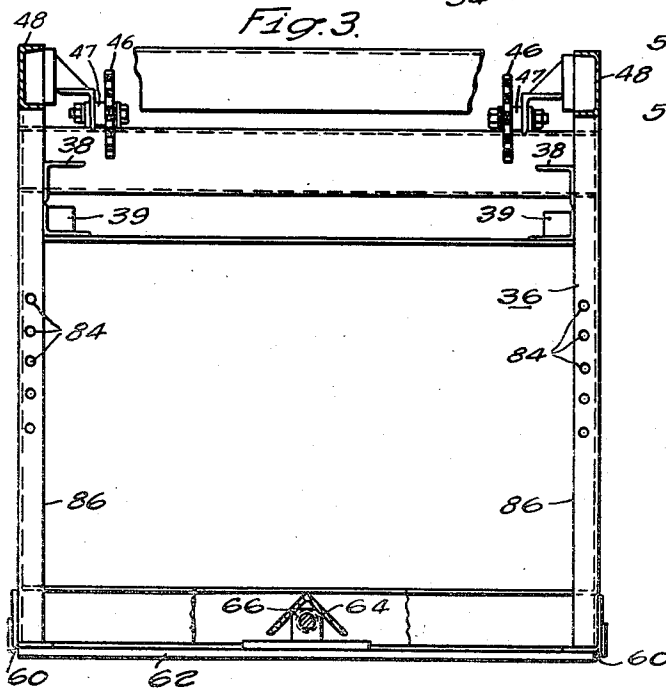
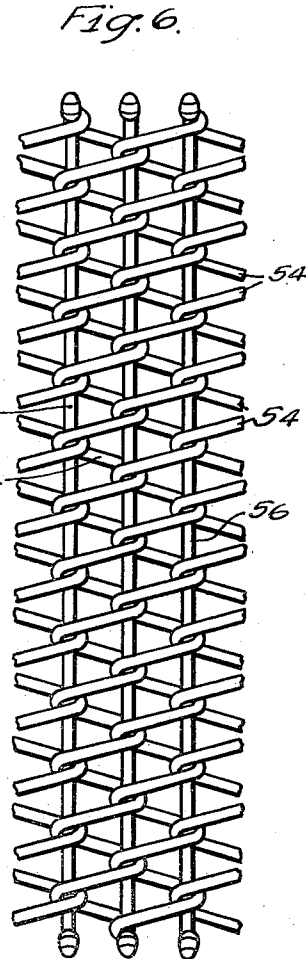


Fig. 4.

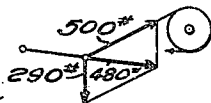
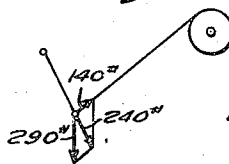


Fig. 5.



WITNESSES:

E. G. McLoskey.
B. L. Langwell

INVENTOR

Elmer K. Hansen.

BY

O. R. Buchanan

ATTORNEY

UNITED STATES PATENT OFFICE

2,295,401

BELT-TENSION CONTROL DEVICE

Elmer K. Hansen, Edgewood, Pa., assignor to
Westinghouse Electric & Manufacturing Com-
pany, East Pittsburgh, Pa., a corporation of
Pennsylvania

Application February 20, 1940, Serial No. 319,871

11 Claims. (Cl. 214—21)

My invention generally relates to the tensioning of loaded belt conveyors, and more particularly relates to the tensioning of endless mesh-belt conveyors for carrying charges through a high temperature furnace for heat-treatment.

Conveyors used in heat-treatment furnaces are customarily made of commercially-available heat-resistant metals or alloys, a nickel-chromium alloy being mostly employed, especially where the furnace is to be permeated by a controlled atmosphere for enveloping the charge. However, at the higher temperatures, which might range up to 2000° F., and even higher, such metals or alloys have only a small fraction of the strength which they possess at ordinary room temperatures, and are very sensitive to continually-applied forces, these forces being detrimental to the life of the belt, particularly if the belt is subjected to repeated heatings and coolings, as is usually the case with endless-belt conveyors for heat-treatment furnaces.

Under conventional methods of operating a conveyor belt for a heat-treating furnace, a constant tension is maintained on the belt whose value is computed or adjusted so that the heaviest load anticipated on the belt will be moved. No consideration has heretofore been given to the effect of this constant tension on the belt's life with loads less than that of the heaviest anticipated. Under such conditions the expected life of a mesh-belt is approximately 3,000 hours of operation. This means that a user will have to anticipate replacement of this costly item at fairly frequent intervals.

It is, accordingly, a primary purpose of my invention to increase the life of mesh-belt conveyors subject to varying temperature conditions, including high temperatures appreciably decreasing the strength of the conveyors; and this I accomplish by controlling the tension on the belt in accordance with its loading.

Consequently, it is a more specific object of my invention to provide a tensioning device for a belt conveyor of a heat-treating furnace, which will apply a tension to the belt generally in accordance with the variations of the loading of the belt, and, preferably, by decreasing the tension when the load decreases, and increasing the tension when the load increases.

Another object of my invention is to provide a tensioning device to be applied to an endless-belt conveyor for a heat-treatment furnace, which will adjust the pull on the belt in accordance with the maximum permissible stress at the point of highest temperature in the furnace whereby the ten-

sion thereat may be decreased when the load decreases so that the portion of the belt at this point of high temperature is subjected to lower stresses and strains with loads less than the permissible maximum. Thus, the pull on the belt, which is a prime factor in determining its life, is controlled so as to keep destructive effects on the belt to a minimum.

In accordance with my invention, the endless-belt is wrapped around a return tension drum or idler pulley which serves also to tension the belt just sufficiently to cause motion of the belt when a driving force is applied. To permit a force to act upon the idler pulley, and therefore, tension the belt, the pulley is rotatably mounted on a carriage slidably mounted in a relatively fixed frame, and an automatic tensioning device has one end secured to the carriage and the other end to the frame. This automatic tension device exerts varying forces on the carriage, depending on the position of the carriage with respect to the frame, and therefore, responds to the load on the belt. An adjusting device in the form of a screw is provided for the frame so that stretching of the belt, in the course of time, can be compensated for by simply turning the screw. Consequently, the function of the tensioning means is confined purely to tensioning the belt under load.

The aforesaid objects and features of my invention as well as other objectives and features, will be apparent from the following description, taken in connection with the accompanying drawings, of a preferred application thereof.

In these drawings:

Figure 1 is a schematic elevational view, partly in section, on a decreased scale, of a heat-treating furnace including an endless-belt conveyor for carrying the charge, and having my automatic tensioning device applied to the return pulley of the belt. This view shows the driving means for the belt at one end and the return pulley at the other end mounted on a slidable carriage riding in an adjustable fixed frame;

Fig. 2 is a plan view of the carriage which slidably supports the return pulley;

Fig. 3 is an end view of the carriage-supporting frame to more particularly show the manner in which it is supported upon a bed plate;

Fig. 4 is a diagram representing the balance of the forces and the relative position of the force members of the tensioning device when a belt has a relatively heavy loading;

Fig. 5 is a view similar to Fig. 4 but showing the distribution of forces and the force members when the loading of the belt is relatively lighter;

Fig. 6 is a top view, on an enlarged scale, of a fragment of a belt whose life has been extended by the use of my invention; and

Fig. 7 is a schematic fragmentary elevational view, on a decreased scale, of a modified form of my invention.

While my invention has more general use, it is especially adapted to be used with mesh-belt conveyors which are subjected to temperatures at which they can stand relatively little stress, as for example, belt conveyors for heat-treatment furnaces operating at high temperatures, of which a brazing furnace is a more specific example. Consequently, in Fig. 1, I schematically show a heat-treatment furnace 2 comprising a well-insulated heating chamber 4 having a door-controlled entrance opening 6 and an exit opening 8 which also is an entrance opening to a cooling chamber 10 forming part of the heat-treatment furnace. The charge is moved through the furnace by means of an endless-belt 12 wrapped over a drive drum 14 at the front end of the furnace and return wrapped over a return tensioning drum or idler pulley 16 at the back end of the furnace. The heating chamber is heated by any suitable means, such as electrical resistor units, while the cooling chamber may have a water-jacket about it so that the charge may be quickly cooled while it traverses this chamber. An endless-belt passing through the furnace will have its top run or upper portion subjected to high temperatures while passing through the heating chamber, which will be cooled considerably when passing through the cooling chamber of the furnace, while the bottom run or lower portion of the belt will be approximately at room temperature since it passes below the bottom of the main structure of the furnace. It will be at once perceived, therefore, that the maximum permissible stress on the belt will be determined by the portion which happens to be in the heating chamber and which reaches the highest temperature.

The driving drum 14 is preferably driven by a motor 20 through a suitable power transmitting means 22 which includes speed adjusting means so that the rate of travel of the belt may be suitably adjusted. The drum 14 is preferably rubber covered and a pinch roller 24 contacts the outside of the belt for pinching the belt to the drive drum. This pinch roller is also preferably rubber covered, and an adjusting means 26 may be employed to control the force with which the pinch roller bears against the belt.

The drive drum is preferably located somewhat outward from the entrance to the furnace to provide a length of belt on the top run or flight upon which charges can be loaded prior to their entry into the furnace, and to provide a length of belt closer to the drive drum which is slack and enables the tensioning device to function. An apron plate 27 is disposed below the front portion of the top flight of the belt, and serves to support this part of the belt, and also to peel the belt from the drive drum.

The idler pulley includes a central shaft 28 journaled in suitable bearings and housings 30 at each end of the shaft, the bearing housings being secured to a carriage 32 having wheels 34 at each of its corners. The carriage rides in a frame, represented in its entirety by the reference character 36, comprising a skeleton framework having horizontal track channels 38 in which the wheels 34 ride so that the idler pulley is slidably mounted with respect to the frame 36. Removable stop lugs 39 may be provided at

the ends of the track channels as a safety measure to prevent the carriage from riding off its tracks.

At each lateral side of the frame and carriage, a tensioning device is provided, each comprising a sprocket chain 40, one end of which is secured to a lug 42 secured to a cross member 44 of the carriage 32. The chain 40 is wrapped around a rotatably mounted sprocket wheel 46 journaled in a bearing 47 secured by any suitable rigid supporting structure to a longitudinally-directed side channel 48 of the frame 36 so as to be relatively stationary with respect to it. The other end of the chain is secured by any suitable means to one end of a link 49 whose other end is pivotally secured to the frame 36, the mounting being represented by the reference character 50. The link 49 is preferably rigid, and at the end to which the chain 40 is secured a weight 52 is pivotally attached, as at 53, to exert a pull on the carriage 32 and consequently control the tension on the belt 12. Preferably, a single extended bar is employed as the weight 52 for both tensioning devices, the bar extending across the frame and being supported at each end from the pivot point 53 at each side of the frame.

The belt I prefer to employ is this embodiment comprises a plurality of flattened helically-wound heat-resistant alloy wires. A fragment of such a belt is shown in Fig. 6 and comprises the helices 54, with adjacent helices meshed with each other, and rods 56 passing through their meshing portions with the ends of the rods securely welded to the far ends of the helices. This type of mesh belt is well known and, by itself, forms no part of my invention except as it enters into a combination with the remaining features thereof.

In order to take up the stretching of the belt and to initially adjust the tension thereon, the frame 36 is slidably mounted in guide angles 59 secured to each side of a base plate 62, in turn fixedly secured to the floor or foundation for the furnace. Consequently, the frame 36 may be slid or adjusted in a direction parallel to the primary direction of movement of the belt. Any suitable means may be provided to hold the frame adjustably stationary with respect to the base plate. For example, the frame may be adjustably secured to the base plate by means of a long screw 64 passing through a threaded sleeve 65 which is fixed to the base plate 62, the ends of the screw cooperating, of course, with any suitable means fixed to the frame so that the frame will slide on the base plate when the screw is turned. One end of the screw is provided with an aperture 72, or other appropriate means, for receiving a wrench or lever for turning the screw in the sleeve 65, and consequently moving the frame.

In designing a furnace of the type described, the loading and the rate of production are determined by the tension in the belt approximately at the point C in the heating chamber 4, the place of highest temperature, and is limited to approximately 85 pounds per foot of belt width, at 2000° F. for an 80% nickel, 20% chromium alloy. This means that the weight of the load carried by the belt and the belt from the point C to the point A, the charge-loading point of the belt, multiplied by a friction factor must not exceed 85 pounds per foot of belt width. If the weight 52 should be properly adjusted to a value just sufficiently large to cause motion of the belt, in the direction of the arrow shown on the drive drum, when the entire belt is carrying a maxi-

imum permissible load to be heat-treated, there will be just the required tension at the point C.

If, however, all of the load to be heat-treated were removed from the belt, point C would still be under this tension with the conventional constant-tensioning means of the prior art, and there would be considerable tension in the belt at point A. The same would also be true if the belt were carrying lighter loads. Thus, under such prior constructions, the pull on the belt at point C would be greater than that required for actually moving lighter loads through the furnace. Consequently, by far the greater part of the belt in the heating chamber would be subjected to more tension than required to move the lighter loads with the result that, ultimately, the belt would fail sooner than it would have if the tension on the belt in the heating chamber had been decreased while the belt carried such lighter loads.

By means of my tensioning expedient the tension on the belt at point C is always kept just enough to move the loaded portion between the points A and C so that the stresses in the belt at its weakest portions in the heating chamber are at all times kept to a minimum, with the result that the life of the belt is increased in furnaces in which the load to heat-treated varies from time to time. Stated differently, the tensioning means of my invention is such that there is practically no tension on the belt before the point A under all operating conditions.

In the operation of my automatic tensioning means, the screw 64 is employed for moving the entire frame to compensate for belt expansion from cold to operating temperature, or with inherent stretching of the belt with continued use. The tension on the belt during use is maintained by means of the weight 52 acting upon the chains 40 through different angles determined by the rigid links 49. This is represented in Figs. 4 and 5.

With reference to Fig. 4, assuming that the belt is to move its maximum load, the carriage will tend to travel toward the left, whereby the lugs 42 on the carriage will pull on the chains 40 to turn the wheels 46 and raise the weight 52. Assuming a 290 pound weight and a suitable length of links 49, the angles between the links 49 and the chains 40 extending from the links to the wheels 46 approach a horizontal straight angle, and the pull on the chains by the vertical weight increases, thereby increasing the tension on the belt. As a representative figure, I have been able to get a 500 pound pull on the belt under the assumed conditions, a drive-disconnecting expedient being employed when the carriage is moved to the left on the frame 36 to a point where the pull on the belt would be greater.

In Fig. 5, I show the resulting force diagram obtained when the load to be moved by the belt is decreased so that the carriage 32 moves to the right. Under this condition, the chains 40 unwrap over the wheels 46 permitting the weight to drop, and the angle between the vertical force of the weight and the chains increases so that the component of pull on the chains is considerably reduced, thereby lowering the tension on the belt, the pull in this case being 140 pounds in the specific example described. At intermediate positions of the carriage representing intermediate loads to be moved by the belt, the pull on the belt will correspondingly vary.

Movement of the carriage 32 away from the furnace carries with it, of course, the idler pulley 16, and this requires a change in the stretched

length of the top flight of the belt. This is obtained from the slack provided between the pinch roller 24 and the point A, the slack varying with varying load.

In Fig. 7, I schematically show a modified form of tensioning means using tension springs at each side of the carriage. In this case the lugs 42, the wheels 46 and their mounting means, the links 49, and all other related appurtenances for the variable linkage mechanism of the prior embodiment, are dispensed with. In the modification shown in Fig. 7, each bearing housing 30' has secured thereto one end of a tension spring 80, the other end of the spring being held in an eye of an eyebolt 82 passing through aligned holes 84 in an upright channel 86 of the frame 36.

By means of nuts 88 and 90, the tension on the springs may be adjusted, and by placing the eyebolts in different holes 84, vertically-spaced in the channels 86, the angle of the springs with respect to the carriage may be varied. In this embodiment, movement of the carriage to the left with increasing load stretches the spring and therefore increases the tension on the belt, and, correspondingly, movement of the carriage to the right with decreasing load decreases the tension on the belt.

I claim as my invention:

1. A heat-treatment furnace of the type described, comprising a substantially horizontal relatively high-temperature heating chamber having a charge-entrance opening at one end and a charge-exit opening at the other end, a driving drum at said one end, a return drum at said other end, a heat-resistant, metallic, endless conveyor wrapped about said drums, said conveyor having one run passing through said chamber for carrying a charge through said chamber, and a return run outside said chamber, driving means for said driving drum, and means cooperating with said return drum for tensioning said one run and automatically increasing and decreasing the tension in said one run responsive to increased and decreased load carried by said one run.

2. A heat-treatment furnace of the type described, comprising a substantially horizontal relatively high-temperature heating chamber having a charge-entrance opening at one end and a charge-exit opening at the other end, a driving drum rotatably mounted at said one end, driving means for rotating said driving drum, a heat-resistant, metallic, endless conveyor having one run in said chamber for carrying a charge through said chamber, said conveyor being wrapped over said driving drum to be moved thereby, a return drum at said other end, said conveyor being wrapped over said return drum, said one run of said conveyor passing through said chamber in moving from said driving drum to said return drum, a frame, a slidable carriage means slidable with respect to said frame, said carriage means rotatably supporting said return drum, variable-force tensioning means mechanically connecting said carriage means and said frame for automatically variably tensioning said one run in accordance with the reaction of said one run on said return drum, and means for adjustably fixing the position of said frame with respect to said driving drum.

3. A heat-treatment furnace of the type described, comprising a substantially horizontal relatively high-temperature heating chamber having a charge-entrance opening at one end

and a charge-exit opening at the other end, a driving drum rotatably mounted at said one end, driving means for rotating said driving drum, a heat-resistant, metallic, endless conveyor having a run in said chamber for carrying a charge through said chamber, said conveyor being wrapped over said driving drum to be moved thereby, a return drum at said other end, said conveyor being wrapped over said return drum, a frame, a slidable carriage means slidable with respect to said frame, said carriage means rotatably supporting said return drum, a linkage system mechanically secured to said carriage means and to said frame, and a force producing means acting on said linkage system in accordance with the relative positions of said carriage means and frame for producing variable force-reactions of said linkage system on said carriage means.

4. A device of the character described, comprising a heat-resistant conveyor adapted to be repeatedly heated and cooled, a rotatable driving drum, a rotatable return drum, said conveyor being wrapped over said driving drum and said return drum, stationary power means geared to said driving drum for rotating said driving drum, a frame, means for fixing the position of said frame with respect to said driving drum, supporting means for said return drum for slidably mounting said return drum on said frame, and variable-force means for automatically controlling the tension in said conveyor, said variable force means comprising a linkage system secured to said frame and to said supporting means and also comprising a weight secured to said linkage system for providing forces in said linkage system varying with the position of said supporting means on said frame.

5. A device of the type described, comprising a conveyor, a rotatable driving drum, a rotatable return drum, said conveyor being wrapped over said driving drum and said return drum, stationary power means geared to said driving drum for rotating said driving drum, a frame, supporting means for said return drum for slidably mounting said return drum on said frame, a slidable carriage means slidable with respect to said frame, said carriage means rotatably supporting said return drum, a linkage system mechanically secured to said carriage and to said frame for tensioning said conveyor, and a force-producing means acting on said linkage system in accordance with the relative positions of said carriage means and frame for producing variable force-reactions of said linkage system on said carriage means, whereby to variably tension the conveyor.

6. A heat-treatment furnace of the type described, having a substantially horizontal relatively high-temperature heating chamber including a charge-entrance opening at one end and a charge-exit opening at the opposite end, a conveyor comprising an endless-belt comprising a heat-resistant metal, the strength of which is appreciably reduced at the operating temperature of said chamber, said belt having a load-carrying portion passing through said entrance opening, said chamber, and said exit opening in succession for carrying a charge through said chamber, and having a return portion outside said chamber, driving means for said belt including a driving drum for said belt, a movable idler pulley for said belt, the said load-carrying portion of said belt passing through said heating chamber in moving from said driving drum to said movable idler pulley, and means cooperating

with said movable idler pulley for tensioning the first said portion of said belt variably in response to variable loads to be moved by said belt.

7. A device of the class described comprising: a conveyor comprising a heat-resistant endless belt of a material having materially less tensile-strength when hot; a driving drum and an idler pulley for the belt; heating-means, adapted to heat various loads adapted to be carried by a load-carrying portion of said belt, at least a part of said load-carrying portion being subjected to said heating-means and heated thereby to temperatures at which the strength of at least a part of said load-carrying portion is appreciably reduced, said load-carrying portion of said belt being in that part of the belt which moves from said driving drum to said idler pulley; and a variable-force tensioning-means for tensioning said load-carrying portion of said belt and automatically increasing and decreasing the tension in said load-carrying portion in order to automatically cause a tension in substantially the hottest portion of said belt, which will not be significantly more than that necessary to move the loaded part of the load-carrying portion of said belt, which extends substantially from the hottest point of said belt substantially back to the driving drum, and supporting means for supporting said loaded part of said load-carrying portion of said belt.

8. A device of the class described comprising; a conveyor comprising a heat-resistant endless belt; means operable for moving said belt, comprising a driving drum and an idler pulley for the belt, the axis of said idler pulley being displaceable; heating-means adapted to heat various loads adapted to be carried by a load-carrying portion of said belt, at least a part of said load-carrying portion being subjected to said heating-means and heated thereby to temperatures at which the strength of at least a part of said load-carrying portion is appreciably reduced in comparison to the strength of other cooler portions of the belt, such load-carrying portion of said belt being in that part of the belt which is operable to move from said driving drum to said idler pulley; tensioning means for said conveyor, associated with said idler pulley, said tensioning means comprising means for automatically tensioning said belt, by displacing the axis of said idler pulley, for producing a substantially slack portion in said belt in the part of the belt between said driving drum and said load-carrying portion; and supporting means for supporting a part of the belt which extends from said slack portion through the said part of the belt, the strength of which is reduced as aforesaid.

9. A heat-treating furnace means of a type described comprising: a relatively high temperature heating chamber including a charge-entrance at one end and a charge-exit at a second end; a conveyor comprising a heat-resistant metallic endless belt having a portion passing through said charge-entrance, said heating-chamber and said charge-exit in succession, having a loading portion before said charge-entrance, and having a return portion outside said heating-chamber; said heating chamber being operative to produce temperatures at which the strength of at least a part of said belt exposed to heating is materially reduced; driving means for said belt, comprising a driving drum somewhat before said loading portion of said belt, and a movable idler pulley; and means cooperating with said

movable idler pulley for automatically tensioning said belt so that it has substantially no tension in it at a point between said driving drum and said loading portion.

10. A heat-treatment device comprising: a 5 heat-resistant endless belt of a material having materially less tensile-strength when hot; a driving-drum and an idler pulley for the endless belt; the endless belt having an approximately horizontal load-carrying portion on top, and a return-portion underneath; means for applying a turning-torque to the driving-drum and tensioning 10 said belt, the direction of rotation being such that the load-carrying portion of the endless belt moves in the direction toward the idler pulley, and the load-carrying portion of the endless belt is not subjected to any tensile-stress other than 15 that necessary to move the load thereon, heating-means applicable to the load carried by the load-carrying portion of the endless belt, and subjecting 20 said load-carrying portion to heat; and supporting means for supporting said load-carrying portion of said belt.

11. A heat-treatment furnace of the type described, having a substantially horizontal rela- 25

tively high-temperature heating chamber including a charge-entrance opening at one end and a charge-exit opening at the opposite end, a conveyor comprising an endless-belt having a portion passing through said entrance opening, said chamber, and said exit opening in succession for carrying a charge through said chamber, and having a return portion outside said chamber, driving means for said belt including a driving drum for said belt, an idler pulley for said belt, the first said portion of said belt passing through said heating chamber in moving from said driving drum to said idler pulley, and means cooperating with said pulley for tensioning the first 15 said portion of said belt variably responsive to various loads to be moved by said belt, said belt comprising heat-resistant metal, serially-arranged, relatively small, helically-shaped wires arranged transversely of the direction of travel 20 of said belt, adjacent helices being meshed, and heat-resistant metal rods through the meshing portions of adjacent helices to permit flexing of the belt.

ELMER K. HANSEN.