May 14, 1929. W. W. LECK 1,713,136

APPARATUS FOR HEAT TREATING METALLIC ARTICLES

Filed June 7, 1926 2 Sheets-Sheet 1

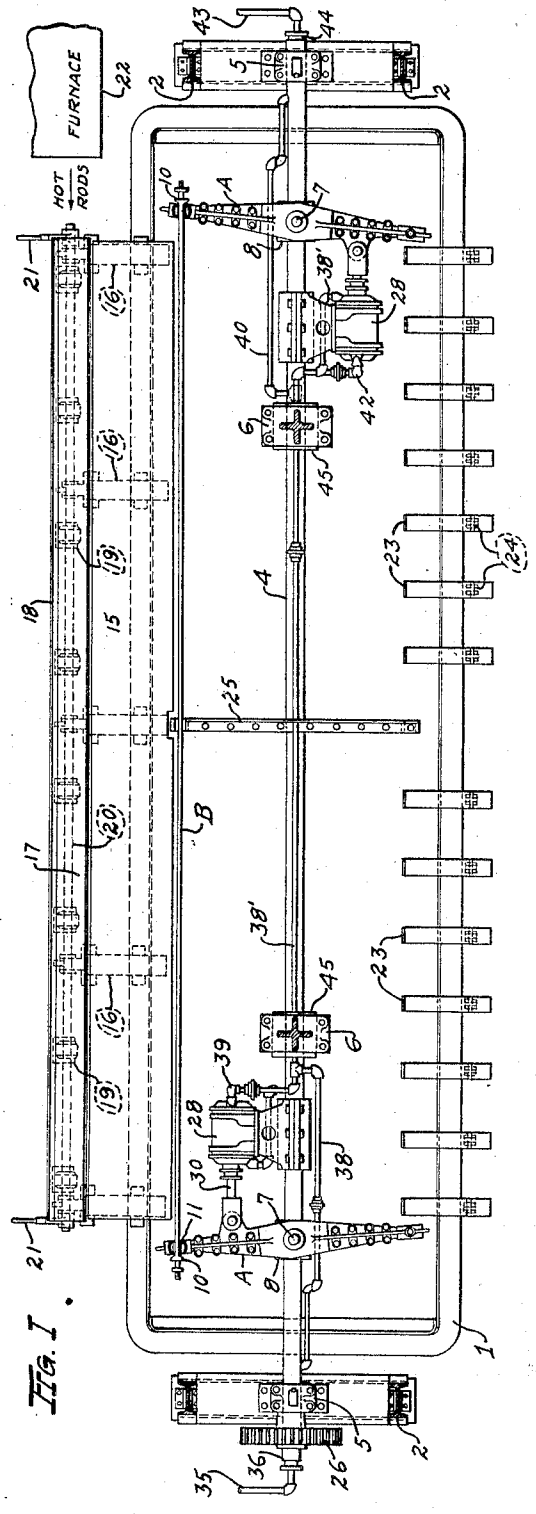


FIG. I.

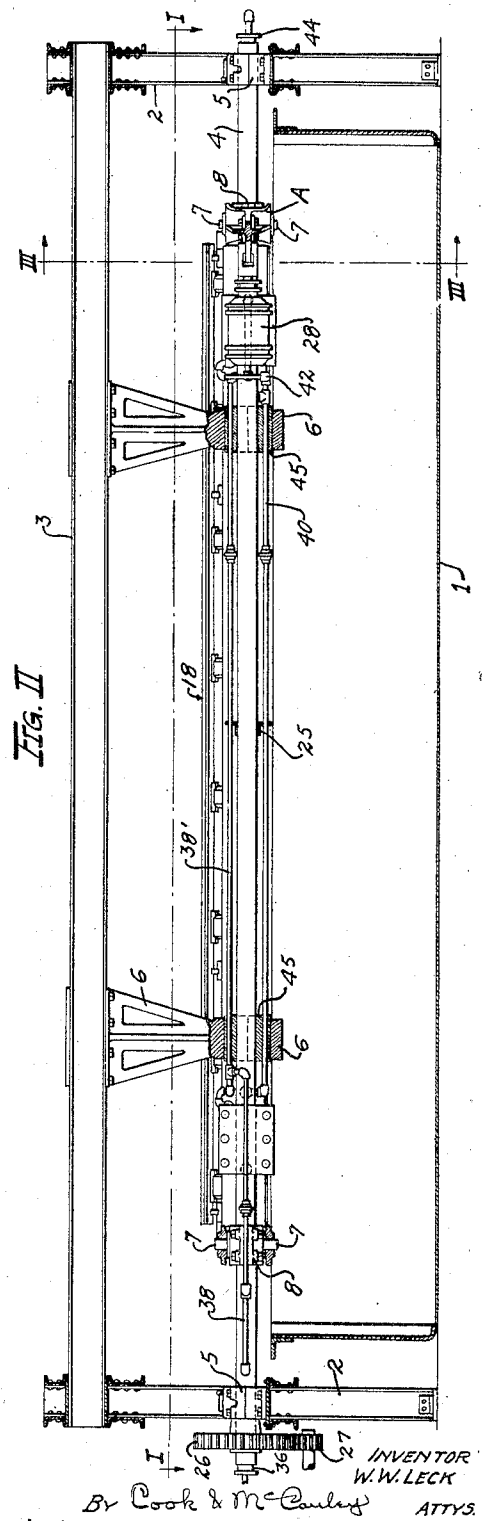


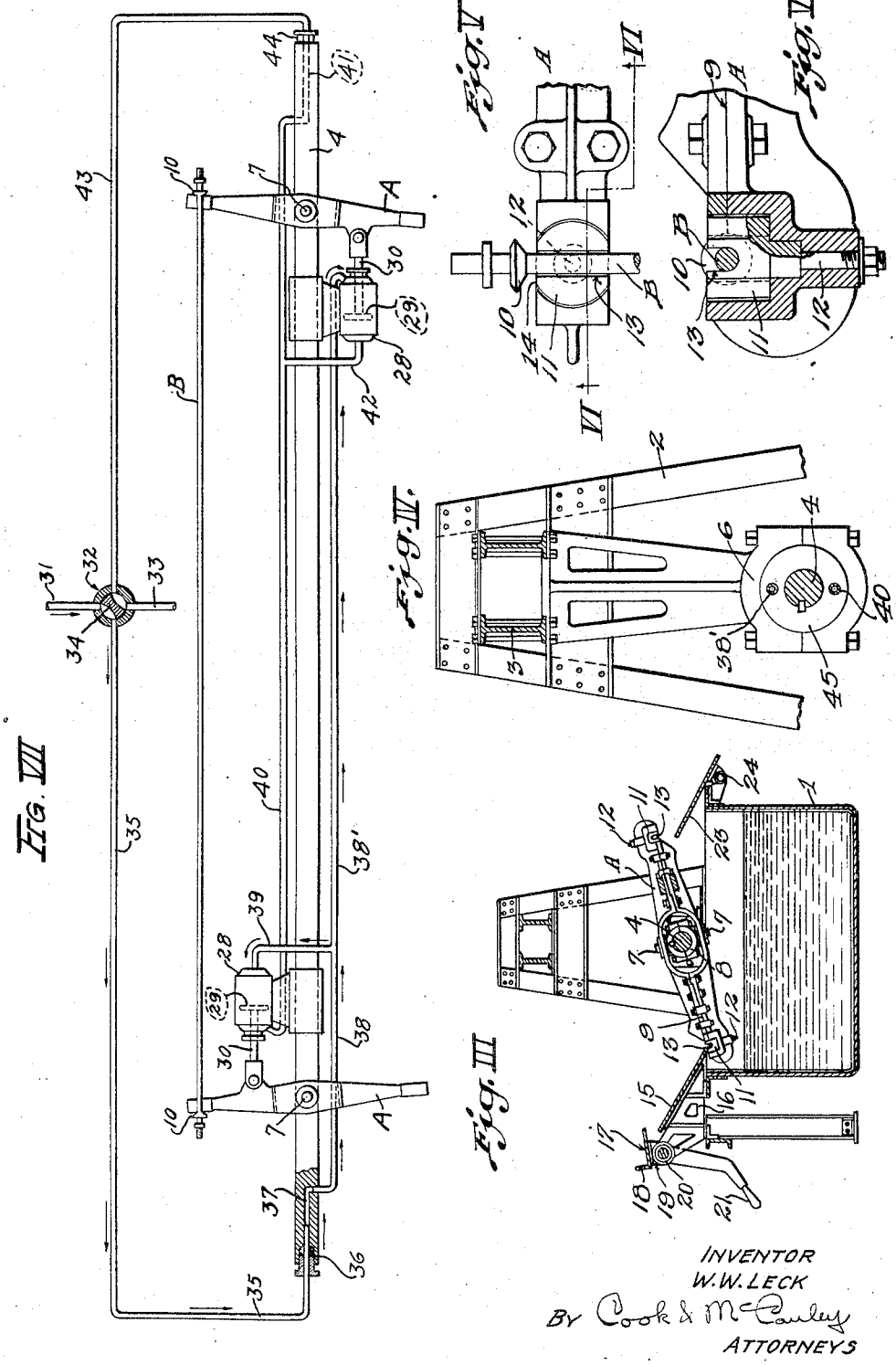
FIG. II.

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May 14, 1929. W. W. LECK 1,713,136

APPARATUS FOR HEAT TREATING METALLIC ARTICLES

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UNITED STATES PATENT OFFICE.

WALTER W. LECK, OF WEBSTER GROVES, MISSOURI, ASSIGNOR, BY MESNE ASSIGNMENTS, TO SCULLIN STEEL CO., OF ST. LOUIS, MISSOURI, A CORPORATION OF DELAWARE.

APPARATUS FOR HEAT TREATING METALLIC ARTICLES.

Application filed June 7, 1926. Serial No. 114,059.

This invention relates to apparatus of the kind that are used to heat-treat metallic articles.

The main object of the invention is to provide a practicable apparatus by which a sucker rod, tie rod or other long metallic member of relatively small cross-sectional area, can be heated and then quenched without liability of the rod being bent or buckled out of shape at the completion of the quenching operation.

Another object is to provide an apparatus in which relatively long rods and similar articles can be heat-treated rapidly and in such a way as to insure substantially straight articles that are tempered substantially uniformly throughout their entire length. Other objects and desirable features of my invention will be hereinafter pointed out.

I have herein illustrated my invention embodied in an apparatus that is intended to be used for practising the method described in my pending application for patent Serial No. 115,729, filed June 14, 1926, and which is designed for use in the heat treatment of sucker rods of the kind that are used to operate deep well pumps. I wish it to be understood, however, that the apparatus herein described can be used for quenching various kinds of hot, metal articles and that various changes can be made in the construction of the apparatus without departing from the spirit of my invention.

The complete apparatus comprises any suitable means for heating a rod or other article of relatively great length and small cross-sectional area, a quenching bath composed of oil or any other suitable quenching liquid, and a means by which the heated rods can be immersed in the quenching bath and held under longitudinal tension during the quenching operation. Preferably, the apparatus is constructed so as to stretch or exert an endwise pull on each rod at the completion of the heating operation so as to remove any kinks or bends in the rod before it is quenched, and the means that is used to immerse the rods in the quenching bath is so constructed that it will cause all portions of each rod to be submerged simultaneously and to be withdrawn from the quenching bath simultaneously, thereby insuring each rod being tempered substantially uniformly throughout its entire length.

Fig. I is a top view of an apparatus embodying the features of this invention, some of the parts being in section taken approximately on the line I—I in Fig. II.

Fig. II is a vertical longitudinal section of the apparatus.

Fig. III is a transverse section taken approximately on the line III—III in Fig. II.

Fig. IV is an enlarged section, partly in elevation, showing one of the bearings which support the rotary carrier.

Fig. V is an enlarged top plan view showing a portion of one of the tensioning members and a portion of a sucker rod to be held thereby.

Fig. VI is a vertical, longitudinal sectional view of one of the tensioning members taken approximately on the line VI—VI in Fig. V.

Fig. VII is a diagrammatical view illustrating a means that can be used for actuating the tensioning members.

1 designates a quenching receptacle adapted to contain a quenching liquid, preferably oil, as shown in Fig. III. The articles to be quenched are held under longitudinal tension in a rotary carrier supported partly by end frames 2 and partly by a top frame 3 located over the quenching receptacle and connected to the end frames. These frames may be built of commercial beams and plates, as suggested in the drawings.

The rotary carrier comprises a long horizontal shaft 4 located over the quenching receptacle and supported partly by bearings 5 in the end frames and partly by bearings 6 hanging from the top frame, as shown in Figs. II and IV. To illustrate a suitable tensioning device I have shown a pair of levers A pivotally mounted on trunnions 7 carried by the shaft 4. As shown by Figs. I, II and III, the shaft 4 is provided with a pair of collars 8, and each collar is provided with a pair of the trunnions 7. Each collar 8 rotates with the shaft and it may be made of two sections bolted together and keyed to the shaft, as shown in Fig. III. It is therefore unnecessary to pass the collars over an end of the shaft in assembling the struc-

ture. For the same reason, each lever may be made of two sections which contact with each other at the line 9 which extends lengthwise of the lever, as shown in Figs. III and VI. These two sections of the lever are suitably connected together by means of bolts, or the like, as shown in the drawings.

Each lever A comprises a pair of arms extending in opposite directions from the shaft 4, as shown in Fig. I, and the outer end of each arm is adapted to receive an end portion of the article to be treated. As an illustration of an article to be treated, I have shown a sucker rod B in Figs. I, V and VI, said rod having integral enlargements including collars 10 at its ends. To hold the sucker rods and maintain them under tension during the quenching operation, each end of each lever A is provided with a holder 11 (Figs. I, III, V and VI) having an extension 12 whereby it is pivotally connected to the lever. Each holder 11 has a recess 13 in its outer face for the reception of the sucker rod B, and as shown in Fig. V, each of these holders has an abutment face 14 adapted to engage one of the collars 10 on the sucker rod. In Fig. V the abutment 14 is shown spaced away from the collar 10, but the lever A is adapted to be moved to force the abutment into firm engagement with the collar, so as to exert an endwise pull on the rod of sufficient force to remove kinks or bends in the rod and also to hold the rod under a slight longitudinal tension.

To provide for the delivery of hot sucker rods to the holders 11, an inlet runway 15 is located at one side of the quenching receptacle 1, as shown in Figs. I and III. This runway is a stationary inclined plate mounted on stationary brackets 16. Immediately before the rods are delivered to the runway 15 they are supported on a tiltable plate 17 (Figs. I and III) having an upwardly extending flange 18 at its outer edge. Brackets 19, extending from the bottom of the plate 17, are fixed to a shaft 20 mounted in the stationary members 16 and provided with operating handles 21 whereby the plate 17 can be tilted to drop the rods onto the inclined runway 15.

In Fig. I, 22 designates a portion of the furnace in which the rods are heated. Any suitable heating means may be employed to heat the rods, preferably while they are free of tension, and after being heated the rods are moved endwise, as suggested by an arrow in Fig. I, from the furnace 22 to the tiltable plate 17 at the top of runway 15. After leaving the bottom of the runway, the rods enter the recesses 13 (Fig. III) in the holders 11. At this time the holders 11 are separated from the abutment collars 10 on the hot sucker rod B, and the levers A are then moved as will be hereafter described to force said holders into engagement with said collars. The collars 10 at opposite ends of the sucker rod are thus subjected to pressure tending to force them away from each other, and this action places the rod under sufficient longitudinal tension to remove any kinks or bends in same, at the same time frictionally securing it to the levers so as to eliminate the necessity of using clamping jaws or the like to secure the rod to the rotary carrier.

The shaft 4 is then operated to carry the rod downwardly in the quenching liquid at one side of the receptacle 1, and then upwardly at the opposite side. The shaft is turned half of a revolution to carry the rod from the receiving position suggested by the recess 13 at the left of Fig. III to the discharge position suggested by the recess 13 at the right of Fig. III. It will be noted that the recess 13 at the bottom of runway 15 is open at the top to receive the rod, but the holder 11 is inverted in making half of a revolution, so the recess 13 at the right in Fig. III is open at the bottom to discharge the rod.

In the illustration given by the drawings (Fig. I), the levers A have arms located adjacent to the runway 15, and these arms are moved away from each other to exert an endwise pull on the rod and hold it under tension. When this occurs the other arms of the levers A move toward each other to release the rod that has been subjected to the quenching operation, and the recesses 13 are so formed at opposite sides of the levers that the released rod will drop from the levers and fall onto a discharge runway which may consist of several inclined members 23 (Figs. I and III). These members 23 are pivotally supported at 24 and they have free upper end portions which extend into the path of the quenched rod. As the rod moves upwardly above the quenching liquid, it will engage and tilt the members 23 so as to pass them and permit them to return by gravity to positions directly below the rod. Therefore, when the rod is released, it will fall onto the members 23 and roll downwardly on their inclined faces.

The rotary shaft 4 is provided with an intermediate support 25 (Figs. I and II) comprising a pair of arms extending from the shaft to serve as a support for the flexible hot rods before they are placed under tension.

The means for rotating the shaft 4 (Figs. I and II) may include a gear wheel 26 fixed to the shaft and a driving pinion 27 meshing with said gear wheel. This gearing may be operated by any suitable mechanism to intermittently drive the shaft, with intervals of rest at the end of each half of a revolution to provide for the admission of a hot rod and the discharge of a quenched rod.

At least one of the tensioning members is moved to tension the hot rod and to release

the quenched rod. To illustrate a suitable means for operating the tensioning levers, I have shown a pair of cylinders 28 fixed to the shaft 4 so as to rotate therewith. Each cylinder 28 contains a piston 29 (Fig. VII) provided with a piston rod 30 pivotally connected to one of the levers A. The means for conducting air, or other fluid, to and from the cylinders 28 is shown diagrammatically in Fig. VII. It comprises a supply pipe 31 whereby air under pressure is conducted to a four-way valve 32, and an exhaust pipe 33 extending from said valve. When the rotary valve member 34 is positioned as shown in Fig. VII, air under pressure is admitted to a stationary pipe 35 which extends through a stuffing box 36 at one end of the shaft. This end of the shaft is provided with a longitudinal bore 37 forming a passageway which leads from the pipe 35 to a pipe 38 extending from said passageway to a shorter conductor 39, the latter being connected to one of the cylinders 28. The pipe 38 has an extension 38′ leading to one end of the other cylinder 28.

When the valve member 34 is positioned as shown in Fig. VII, air under pressure is conducted through the pipes just described to place the rod B under tension, the lever arms holding this rod being forced away from each other, while the other arms of the tensioning levers are forced toward each other. During this operation air is exhausted from the cylinders through the medium of a pipe 40 extending from one of the cylinders 28 to a longitudinal bore 41 in one end of the shaft. The pipe 40 is provided with a branch 42 connected to the other cylinder. 43 designates a stationary pipe connected to the housing of the four-way valve and extending through a stuffing box 44 so as to communicate with the longitudinal bore 41.

When the valve member 34 is positioned as shown in Fig. VII, the pipe 35 contains air under pressure, and both of the pistons 29 are forced to the left. It will be readily understood that the valve member 34 can be moved to conduct the air pressure through the pipe 43 and to cause the pipe 35 to serve as an exhaust pipe. In this event, the pistons 29 will be forced to the right for the purpose of releasing one rod B and tensioning another rod. After the valve 34 has been adjusted to the desired position, it is retained in that position while the shaft 4 makes half of a revolution, thereby causing one rod to be stretched endwise and held under longitudinal tension before it enters the quenching bath, while it is traveling through the quenching bath, and for a short period after it leaves the quenching bath.

The bearings 6 lie between the ends of the shaft 4 to prevent sagging or bending of this long shaft, and the pipe elements 38′ and 40 extend through these bearings, as shown in Figs. II and IV. To provide for this condition, collars 45 (Figs. II and IV) are fixed to the shaft 4, and the pipes 38′ and 40 extend through these collars. The collars rotate with the shaft and they are mounted in the bearings 6.

The operations will be briefly described as follows:

The rod may be heated while free of tension in a suitable furnace 22 (Fig. I) and then moved to the tilting plate 17 above the inlet runway 15. When the tensioning members are positioned as shown in Fig. III, the hot rod is dropped onto the runway and into the recesses 13 in the holders 11 near the lower edge of the runway. The rod is in a horizontal position and it is rather flexible, but the intermediate supporting arm 25 (Fig. I) prevents sagging of the middle portion of the rod. The rod is then subjected to an endwise pull and while it is under longitudinal tension, in a horizontal position, substantially parallel to the surface of the quenching bath, it is immersed in said bath, moved through the same and then withdrawn from the bath, thereby producing a substantially straight, heat-treated rod that is tempered substantially uniformly throughout its entire length.

I claim:

1. In a heat-treating apparatus, a quenching receptacle adapted to contain a quenching liquid, a rotary carrier provided with tensioning arms movable into and out of the quenching liquid, said arms being adapted to hold the ends of the article to be treated, operating means whereby one of said arms is moved away from the other to place the article under longitudinal tension, and means whereby said carrier is rotated to carry the tensioned article into and out of the quenching liquid.

2. In an apparatus for quenching long metallic articles, a quenching receptacle, a pair of supporting members adapted to hold the ends of the articles to be quenched, means whereby said supporting members are moved in an arcuate path from a receiving position to a discharge position so as to carry the articles through the quenching bath, said supporting members being inverted in passing from one of said positions to the other, each of said members having a recess open at the top when the member lies in its receiving position and open at the bottom when in the discharge position, and the recesses being adapted to receive the article to be quenched.

3. In an apparatus for quenching long metallic articles, a quenching receptacle, a pair of tensioning arms adapted to hold the ends of the article to be quenched, means cooperating with said arms to maintain the article under tension during the quenching operation, means whereby said arms are simulta-

neously moved in an arcuate path from a receiving position to a discharge position, so as to carry the tensioned article through the quenching bath, each of said arms having a recess open at the top when the arm lies in its receiving position and open at the bottom in the discharge position, and the recesses being adapted to receive the articles to be quenched.

4. In an apparatus for quenching long metallic articles, a quenching receptacle adapted to contain the quenching liquid, a rotary carrier including tensioning members whereby the article is held during the quenching operation, said tensioning members being movable from a receiving position near one side of the receptacle to a discharge position near the other side, and tensioning means cooperating with said tensioning members to retain the article under tension while said tensioning members move from one of said positions to the other.

5. In an apparatus for quenching long metallic articles, a quenching receptacle adapted to contain the quenching liquid, a rotary carrier including tensioning members whereby the article is held during the quenching operation, said tensioning members being movable from a receiving position near one side of the receptacle to a discharge position near the other side, and tensioning means cooperating with said tensioning members to retain the article under tension while said tensioning members move from one of said positions to the other, each of said tensioning members being provided with a recess to receive the article to be quenched, and said recess being open at the top when the tensioning member occupies its receiving position and open at the bottom when the member occupies its discharge position.

6. In an apparatus for quenching long metallic articles, a quenching receptacle adapted to contain a quenching liquid, a rotary carrier including two pairs of tensioning members to hold the articles during the quenching operation, one pair of the tensioning members being located in a receiving position when the other pair lies in a discharge position, and tensioning means cooperating with said members to retain the articles under longitudinal tension while said members move from the receiving position to the discharge position.

7. In an apparatus for quenching long metallic articles, a quenching receptacle adapted to contain a quenching liquid, a rotary carrier including two pairs of tensioning members to hold the articles during the quenching operation, one pair of the tensioning members being located in a receiving position when the other pair lies in a discharge position, and tensioning means co-operating with said members to retain the articles under tension while said members move from the receiving position to the discharge position, said tensioning means including an operating device whereby the article at the receiving position is tensioned while the article at the discharge position is released.

8. In an apparatus for quenching long metallic articles, a quenching receptacle adapted to contain a quenching liquid, a rotary carrier including two pairs of tensioning members to hold the articles during the quenching operation, one pair of the tensioning members being located in a receiving position when the other pair lies in a discharge position, and tensioning means cooperating with said members to retain the articles under longitudinal tension while said members move from the receiving position to the discharge position, said tensioning means including a member whereby a tensioning member at the receiving position and a tensioning member at the discharge position are simultaneously moved in opposite directions to tension one article and release the other.

9. In an apparatus for quenching long metallic articles, a quenching receptacle adapted to contain a quenching liquid, a rotary carrier including two pairs of tensioning members to hold the articles during the quenching operation, one pair of the tensioning members being located in a receiving position when the other pair lies in a discharge position, a member of one pair being connected to a member of the other pair and the connection being pivotally supported to permit the last mentioned members to move in opposite directions, and means for moving said connected members so as to tension the article at the receiving position and release the article at the discharge position.

10. In an apparatus for quenching hot sucker rods having enlarged end portions, tensioning members adapted to lie between and adjacent to said enlarged end portions, and means whereby said tensioning members are caused to cooperate with said enlarged end portions to hold the sucker rod under tension during the quenching operation.

11. In an apparatus for quenching hot sucker rods having integral enlargements at their end portions, a pair of tensioning members having recesses to receive the rods and abutments to engage said enlargements, and means whereby one of said tensioning members is forced away from the other to hold the sucker rod under tension during the quenching operation.

12. In an apparatus for quenching hot sucker rods having integral enlargements at their end portions, a pair of tensioning members having recesses to receive the rods and abutments to engage said enlargements, means whereby one of said tensioning members is forced away from the other to hold the sucker rod under tension during the quenching operation, and means whereby

said tensioning members are simultaneously moved through the quenching bath.

13. In an apparatus for quenching long metallic articles having enlargements at their ends, a tensioning member movable in an arc of a circle to place the article under tension, said tensioning member being provided with a holder having an opening to receive an end portion of the article and an abutment to engage the enlargement at said end portion, and said holder being yieldable in response to the arcuate movement of said tensioning member.

14. In an apparatus for quenching long metallic articles, a rotary carrier adapted to carry the articles through the quenching bath, and a support to receive the articles discharged from said carrier, said support being movable into and out of the course of the articles in said carrier so as to occupy a position directly below the articles to be discharged.

15. In an apparatus for quenching elongated metallic articles, rotary supporting members adapted to carry the articles through the quenching bath, and a tiltable support adapted to receive the articles passing from said rotary members, said tiltable support being extended into the path of the articles carried by said rotary members and adapted to tilt as the articles pass the extended portion.

16. In an apparatus for quenching long metallic articles, a rotary carrier adapted to carry the articles through the quenching bath, a support including a bearing in which a portion of the carrier is rotatably mounted, tensioning means including members carried by the carrier to hold the articles under tension during the quenching operation, and means for transmitting power to said members, the last mentioned means including a piston and cylinder carried by said carrier and a conductor whereby fluid under pressure is transmitted to said cylinder.

17. In an apparatus for quenching hot rods, a quenching receptacle having an inlet runway at one side and a discharge runway at the other, a horizontal shaft rotatably mounted over said receptacle, a pair of tensioning levers pivotally connected to said shaft, each lever comprising a pair of arms extending in opposite directions from said shaft, the outer end of each arm being provided with a recess open at the top when the arm lies adjacent said inlet runway and open at the bottom when the arm lies adjacent said discharge runway, the recesses being adapted to receive the hot rods passing from said inlet runway and to discharge the rods onto said discharge runway, said discharge runway being extended into the course of the rods and being pivotally supported to permit the rods to pass said discharge runway, air-actuated pistons carried by said shaft and connected to the respective tensioning levers, said pistons being operable to move the lever arms on one side of the shaft toward each other to release a rod at the discharge runway while moving the other arms away from each other to tension a rod near said inlet runway, and means whereby the shaft is rotated to carry the tensioned rods from said inlet runway to said discharge runway.

18. An apparatus for heat-treating rods and similar articles, comprising a bath of quenching liquid, and mechanism for immersing all portions of a heated article in said bath simultaneously and holding said article under longitudinal tension during the quenching operation.

19. An apparatus for heat-treating rods and similar articles, comprising a bath of quenching liquid, and mechanism for subjecting a heated article to an endwise pull and thereafter submerging all portions of said article simultaneously in the quenching bath and maintaining said article under longitudinal tension while it is submerged.

20. An apparatus for heat-treating rods and similar articles, comprising a bath of quenching liquid, a means for holding a heated article under slight longitudinal tension, parallel to the surface of said bath, and means for introducing said article into the bath, cause it to remain therein for a while, and thereafter emerge from the bath.

21. An apparatus for heat-treating rods and similar articles, comprising a bath of quenching liquid, a carrier having provision for holding a heated article, means for subjecting the article in said carrier to an endwise pull and holding said article under longitudinal tension, and means for actuating said carrier to cause all portions of the article therein to be introduced into the bath simultaneously, moved through the bath and then withdrawn from the bath.

22. An apparatus for heat-treating rods and similar articles, comprising a bath of quenching liquid, a rotatable carrier provided with members disposed so as to receive and hold a heated rod substantially parallel to the surface of said bath, means for actuating the carrier to cause said rod to travel through the bath, the said members of the carrier having provision for receiving another heated rod after the quenched rod is withdrawn from the bath, and means for effecting the discharge of the quenched rod and simultaneously causing the heated rod to be stretched and held under longitudinal tension by said members.

In testimony that I claim the foregoing I hereunto affix my signature.

WALTER W. LECK.