May 14, 1929. W. W. LECK 1,713,137

METHOD OF HEAT TREATING METALLIC ARTICLES

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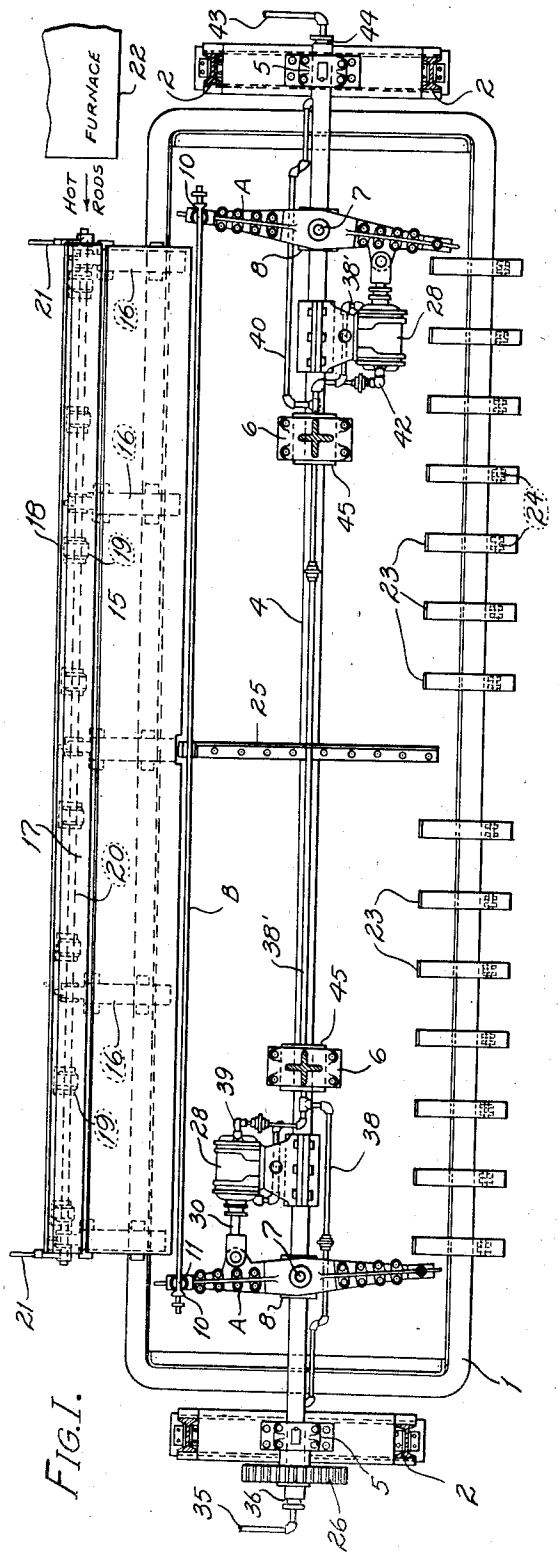


FIG. I.

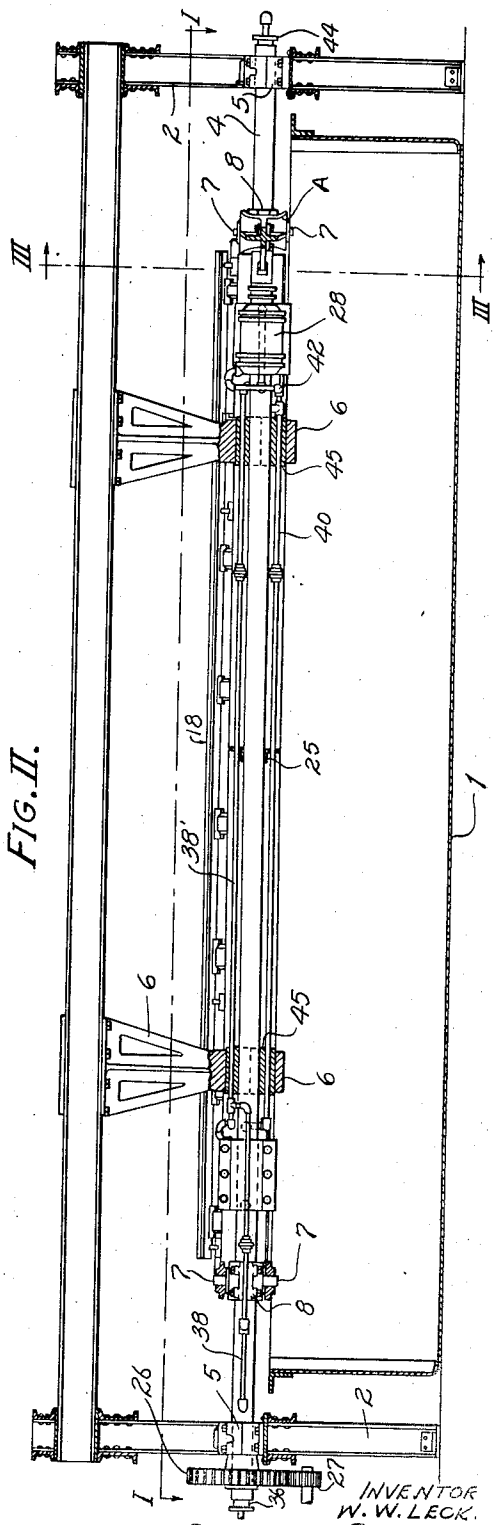


FIG. II.

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FIG. III.

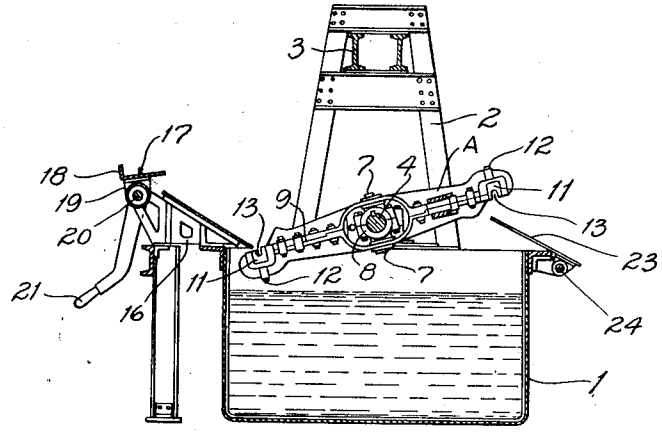


FIG. IV.

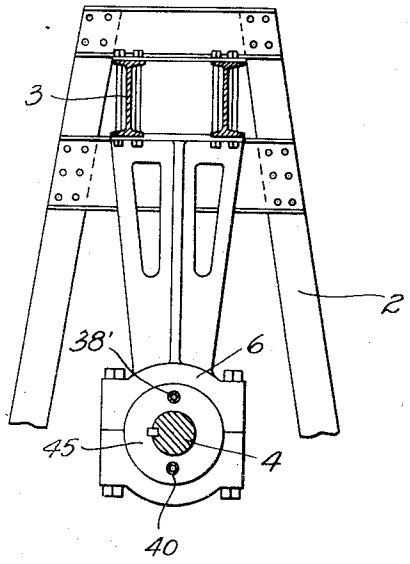


FIG. V.

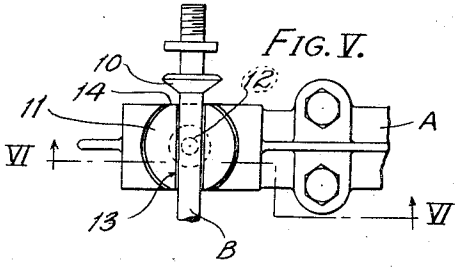
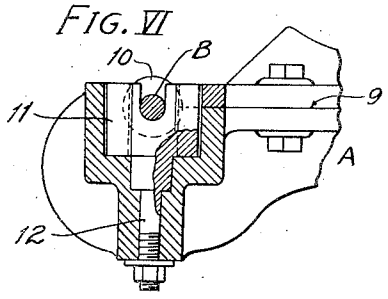


FIG. VI



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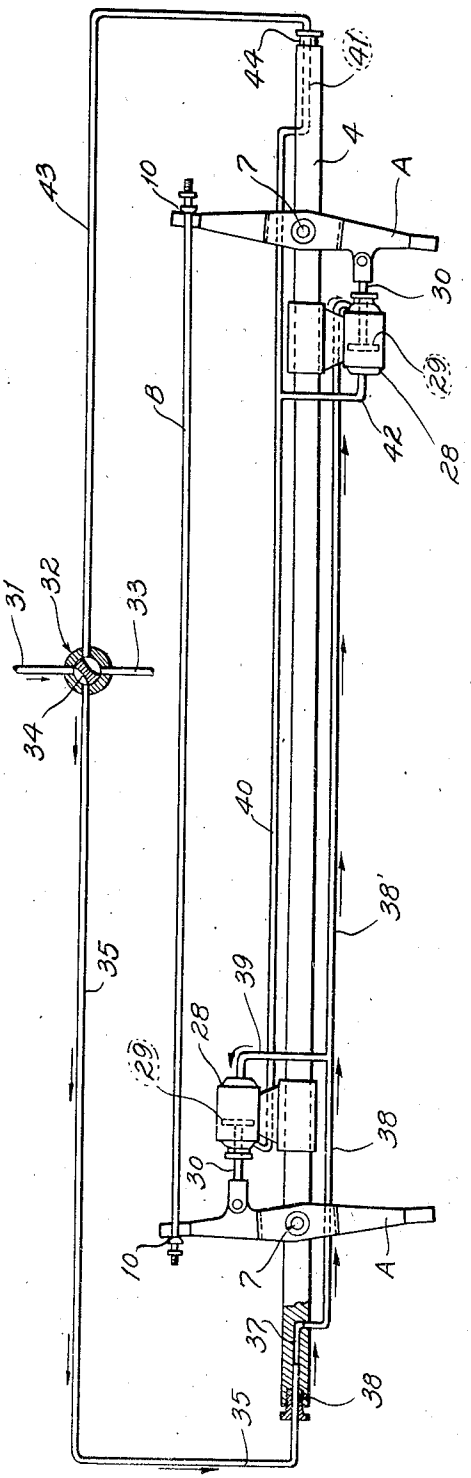


FIG. VII.

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Patented May 14, 1929. 1,713,137

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.

METHOD OF HEAT TREATING METALLIC ARTICLES.

Application filed June 14, 1926. Serial No. 115,729.

This invention relates to the art of heat-treating metal rods.

The main object of the invention is to provide a practicable method by which sucker rods, tension rods and other long rods of small cross-sectional area, can be heat-treated successfully without producing kinks or bends in same.

Another object is to provide a novel heat-treating method by which a long metallic member of small cross-sectional area can be tempered uniformly throughout its entire length. Other objects and desirable features of my invention will be hereinafter pointed out.

Briefly stated, my method consists in heating the rod or other member that is to be heat-treated, immersing said rod in a quenching bath, and holding the rod under longitudinal tension during the quenching operation. Prior to or at the beginning of the quenching operation the rod is stretched slightly or subjected to an endwise pull, so as to remove any kinks or bends that may have formed in same during the heating operation, and when the rod is being introduced into and withdrawn from the quenching bath, it is essential that the rod be maintained in a position substantially parallel with the surface of said bath, so that all portions of the rod will remain in the bath the same length of time, thereby insuring the rod being tempered uniformly throughout its entire length. Any suitable means can be used to heat the rod and any suitable means can be used to handle the rod, during the quenching operation. As previously stated, the method is capable of use for heat-treating various kinds of long metallic articles of relatively small cross-sectional area, but it is particularly adapted for heat-treating sucker rods that are used to operate deep well pumps. Accordingly, I have herein described the method as being used for that particular purpose, and practised or carried out in an apparatus of the kind described in my pending application for Patent Serial No. 114,059, filed June 7, 1926.

Fig. I is a top view of an apparatus adapted for use in carrying out my method, some of the parts being in section taken on the line I—I in Fig. II.

Fig. II is a vertical section of the apparatus.

Fig. III is a transverse section 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 detail 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 section taken approximately on the line VI—VI in Fig. V.

Fig. VII is a diagrammatical view illustrating a means for transmitting power to the tensioning members.

1 designates a quenching receptacle adapted to contain a quenching fluid, preferably oil, as shown in Fig. III. The articles to be quenched are held under 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 structure. 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 free 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 place them under tension, 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 separated from the collar 10, but the lever A may be moved to force the abutment into firm engagement with the collar.

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 furnace may be employed to heat the rods, preferably while they are free of tension, and after being heated the rods are transmitted, 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. Thereafter, one or both of the levers A are rocked in a direction to cause the holders 11 thereon to engage the collars 10 on the hot sucker rod and stretch said rod slightly or subject it to an endwise pull, so as to remove any kinks or bends that may have formed in the rod during the operation of heating same. In addition to putting the rod under a slight longitudinal tension, the above described movement of the levers A causes the rod to be frictionally connected with the levers, thus eliminating 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 fluid 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 hold the rod 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) pivotally supported at 24 and having free upper end portions which extend into the path of the quenched rod. As the rod moves upwardly above the quenching fluid, 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 by the movement of the levers A, 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 levers A is moved on its trunnions 7 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 transmitting 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 transmitted 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 transmitted through a 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 transmitted 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 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 transmit 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 maintaining a rod under tension before, during and after the quenching operation.

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 is heated while free of tension in a suitable furnace 22 (Fig. I) and then transmitted 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. 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 placed under sufficient longitudinal tension to remove any kinks or bends in same, and thereafter while it is maintained in a horizontal position parallel to the surface of the quenching bath, it is immersed in and moved through said quenching bath, the longitudinal tension on the rod being maintained during the quenching operation and for a short period, after the rod leaves the quenching bath, so as to insure the rod being substantially straight and tempered substantially uniformly throughout its entire length at the completion of the quenching operation.

I claim:

1. A method of heat-treating rods and other long metallic members of relatively small cross-sectional area, consisting in heating the rod, placing it under a slight longitudinal tension, introducing all portions of the rod simultaneously into a bath of quenching liquid, holding the rod under longitudinal tension in said bath, and thereafter withdrawing all portions of the rod simultaneously from said bath.

2. A method of heat-treating rods and other long metallic members of relatively small cross-sectional area, consisting in heating the rod by heat applied externally to same, subjecting it to an endwise pull at the completion of the heating operation so as to remove kinks or bends from the rod and place it under longitudinal tension, and thereafter, while the rod is still under longitudinal tension, introducing it into a bath of quenching liquid, moving it through said bath, and finally withdrawing it from the bath.

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

WALTER W. LECK.