

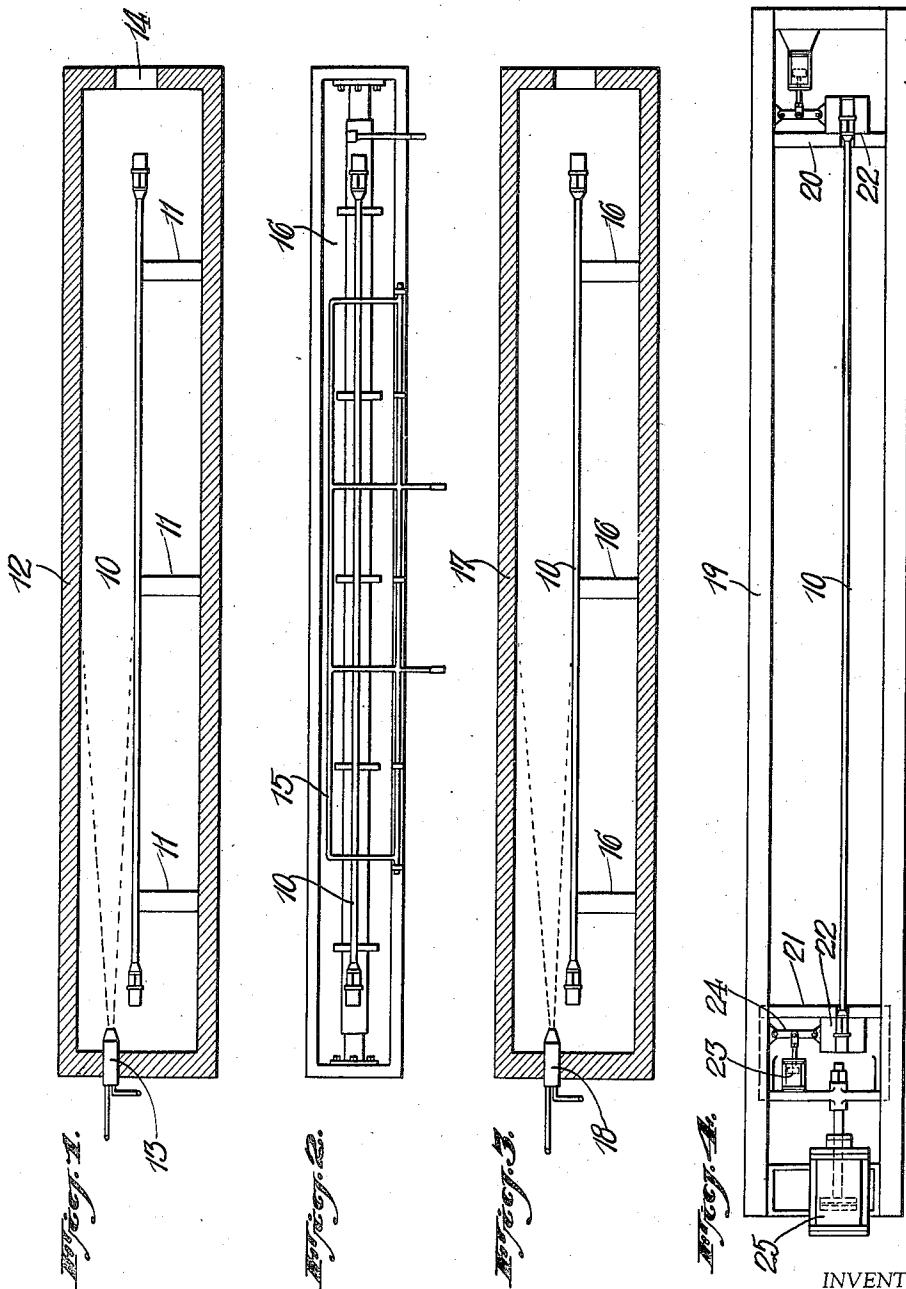
Aug. 4, 1936.

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2,049,830

PROCESS OF STRAIGHTENING AND TESTING LONG METAL ARTICLES

Filed Oct. 27, 1932



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2,049,830

PROCESS OF STRAIGHTENING AND
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Application October 27, 1932, Serial No. 639,929

6 Claims. (Cl. 148—12)

My invention relates to a method of straightening and testing long metal articles such as the sucker rods used in pumping wells.

Sucker rods are long rods having at one end a threaded socket and at the other a complementary threaded plug so that they may be screwed together end to end to form a continuous structure of any desired length. As these rods are subjected to tensile stresses, they are heat treated, first by heating them above their critical temperature and quenching and then by tempering or heating to a suitable tempering temperature. As a result of the stresses to which the rods are subjected in the heat treatments, they become warped and bent and in some cases develop undetected weaknesses. Owing to the fact that the rods are upset at their ends, they cannot be straightened by straightening rolls.

It has been proposed, heretofore, to prevent the rods from bending and warping during heat treatment by stretching the rods or placing them under tension during the quenching operation. This has not, however, proven successful. During quenching, the structure of the metal remains substantially the same as it was prior to quenching. The grain structure of the metal is very fine and as the molecules of metal have not had time to adjust themselves, internal strains and stresses are set up. It is not practicable to hold the rods against these stresses during quenching and moreover the internal stresses would tend to return the rod from its straightened position after the holding forces are released.

An object of my invention is to provide a method or process of straightening or of heat treating and straightening sucker rods, tubes and other long articles. A further object is to provide a straightening process in which flaws and weaknesses are detected in the straightening process.

The invention is illustrated in connection with the accompanying drawing which shows diagrammatically apparatus wherein the various steps may be carried on and in which—

Fig. 1 is a vertical longitudinal section of a heating furnace; Fig. 2 is a plan view of a quenching bath; Fig. 3 is a vertical longitudinal section of a tempering furnace; and Fig. 4 is a plan view of a stretching apparatus.

In my invention, the rod or other article is heated above the critical temperature and quenched in the usual way. It may be permitted to warp and bend during this heating and may

be heated and quenched in any suitable or standard apparatus. Preferably, it is heated in a continuous furnace in which the entire rod is heated above the critical quenching temperature while passing through the furnace, the time of passage being sufficient to permit the full and complete heating of the rods. As soon as this heating is completed, the rod is plunged into the quenching bath.

The rod is preferably quenched uniformly throughout its entire length and is for this purpose preferably held straight in a suitable jig which plunges all parts of the rod simultaneously into the quenching bath. It is desirable to attain uniformity and not to increase warping and distortion by non-uniform quenching and the rod may be held straight, but no tension need be placed on the rods in this operation.

The quenched rod is then heated to a tempering temperature. This temperature is sufficient to permit a molecular rearrangement that imparts the required toughness and ductility to the rod. Usually, the temperature is such as to relieve the internal stresses set up during the quenching. When the rod has been heated to, and kept at, the tempering temperature for a sufficient length of time it is subjected to tension to straighten it.

The tension is applied to the rod while it is at, or near, the tempering temperature. This may be done by gripping the end of the rod immediately after it has been delivered from the tempering furnace, or before it has cooled to too great an extent after being taken from the furnace and applying a separating force to the ends sufficient to stretch it slightly beyond its then elastic limit, or yield point. This will also test the tube, or rod, for heat treatment cracks, or flaws.

The rod, or tube, is now straight, the stretching removing the kinks, bend, or warpage. Since the straightening takes place at the tempering temperature, the metal is ductile and comparatively low in resistance to stretching and straightening and no lowering of properties results. On the contrary, a slight increase in some properties results with some metals.

The straightened rod or tube is laid flat and permitted to cool. It may be rolled or turned while cooling to retain its straightness.

In the accompanying drawing, a sucker rod 10 is placed on rails or supports 11, in a heating furnace 12 and heated by means of a fluid fuel burner 13, or other suitable means to a temperature above the critical range. It is then with-

drawn, as for example through an opening 14 and placed in a hinged frame 15, which plunges it below the surface of water content in a quenching bath 16. When the rod has been quenched and thereby hardened, it is placed on supports or rails 16 in a tempering furnace 17, which may be similar to the furnace 12 or may be the furnace 12 operated at a lower temperature, after the completion of the heating of a batch of rods for quenching. The rod 10 is heated in the furnace 17 by means of a fluid fuel burner 18 or other suitable means to a predetermined tempering temperature below the critical point. It is then removed from the furnace 17 and placed in a stretching machine 19. In this machine, one end is gripped in a stationary gripping head 20 and the other in a movable head 21, each of these heads being provided with a jaw 22 that engages its respective end of the rod and is forced into engagement by means of a fluid operated piston 23, acting through a toggle 24. When the rod 10 has been gripped at each end the movable head 21 is drawn by means of a fluid operated piston 25 to stretch the rod to its yield point and thereby straighten it.

Having described my invention, what I claim is:—

1. The method of heat treating and straightening long metal articles which comprises heating said articles to the temperature critical for quenching, quenching said articles, reheating said articles to a tempering temperature and

stretching said articles while at approximately said tempering temperature.

2. The method of heat treating and straightening long metal articles which comprises heating said articles to the temperature critical for quenching, quenching said articles, reheating said articles to a tempering temperature and stretching said articles while rendered ductile by said temper heating.

3. The method of straightening a long metal article of quenched steel which comprises bringing them to a temperature below a temperature critical for quenching and sufficiently high to render said article ductile and of lowered resistance to stretching and subjecting it to longitudinal tension sufficient to stretch it to approximately its yield point.

4. Heat treated and tempered sucker rods, said rods having been stretched beyond the yield point while at a tempering temperature after quenching.

5. Heat treated, straightened and tempered sucker rods, said rods having been stretched after quenching and at a tempering temperature.

6. A method of heat treating and straightening long metal articles which comprises heating said articles to the temperature critical for quenching, quenching said articles while holding them from excessive warping and twisting, reheating said articles to a tempering temperature and stretching said articles while at approximately said tempering temperature.

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