Jan. 23, 1934. W. MELLOR 1,944,798

MEANS FOR QUENCHING STEELS

Filed July 18, 1931 3 Sheets-Sheet 1

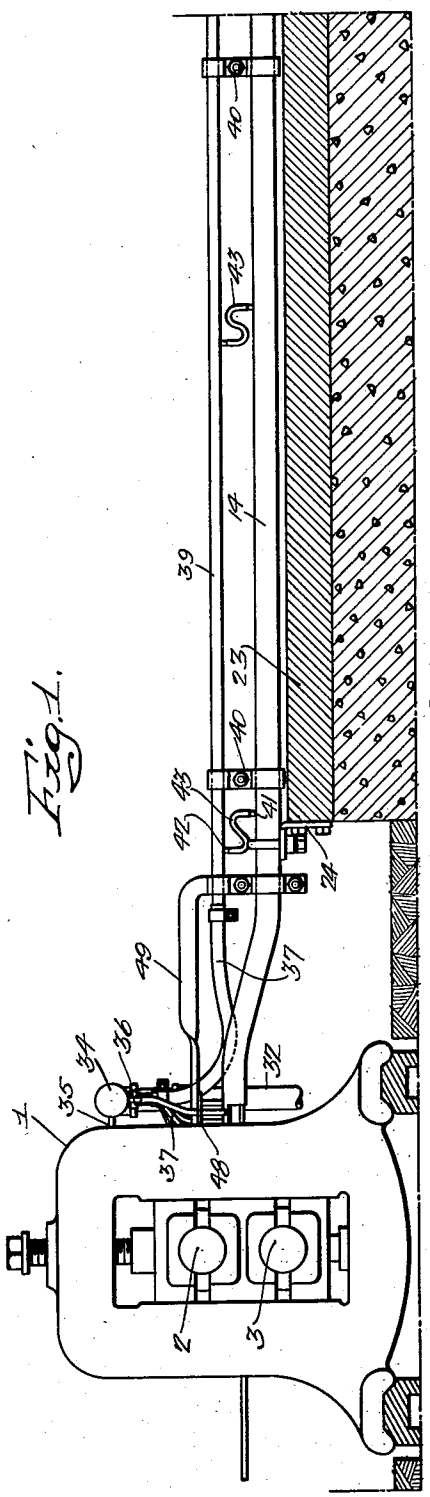

Fig. 1.

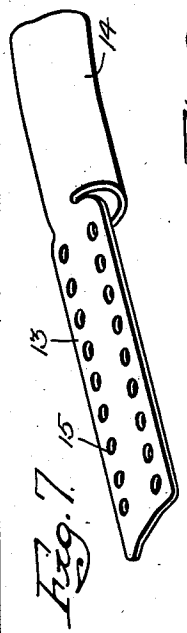

Fig. 7.

Fig. 2.

Inventor:
William Mellor
by his Attorneys
Howson & Howson

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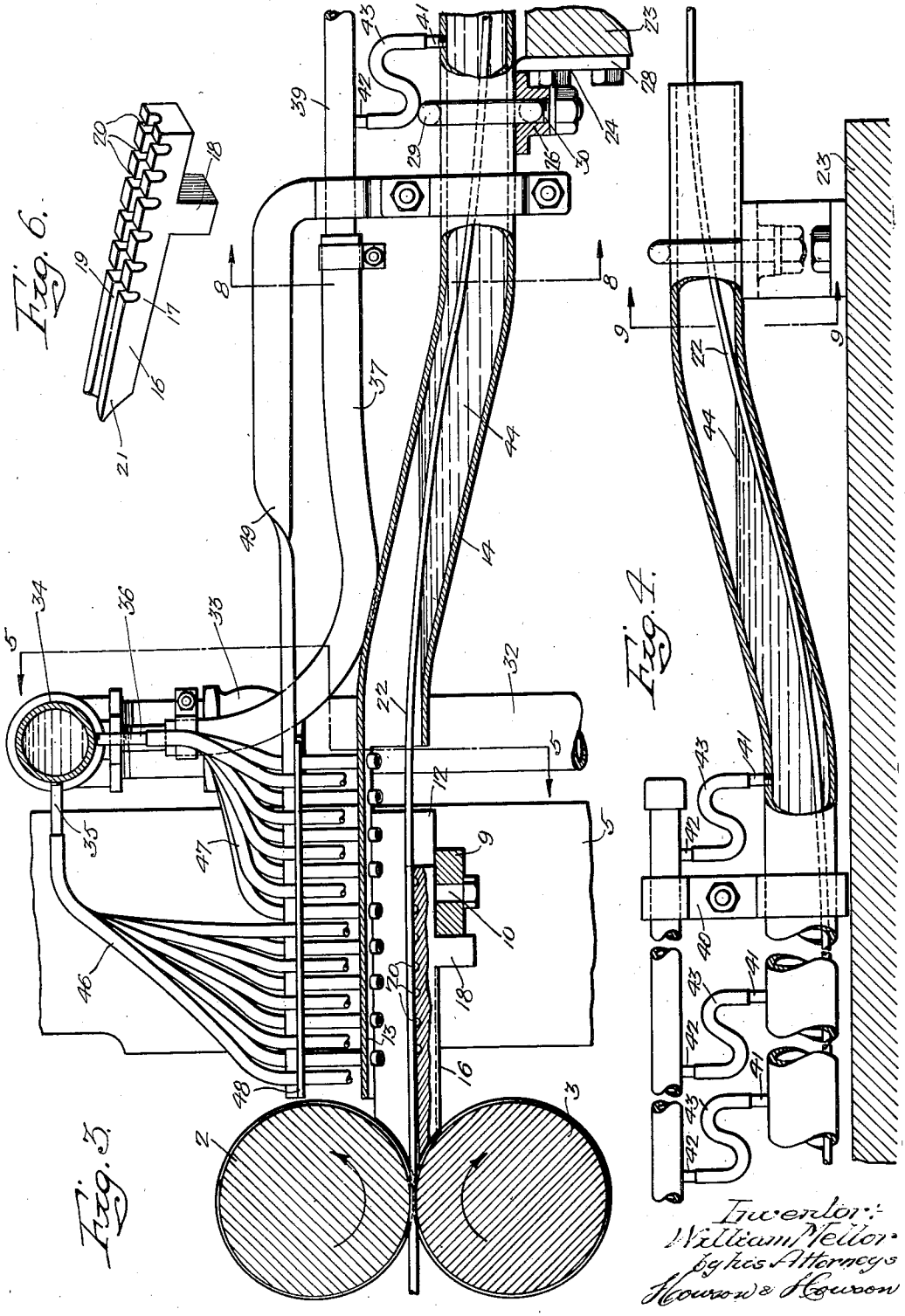

Fig. 5.

Fig. 6.

Fig. 4.

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by his Attorneys
Howson & Howson

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Fig. 5.

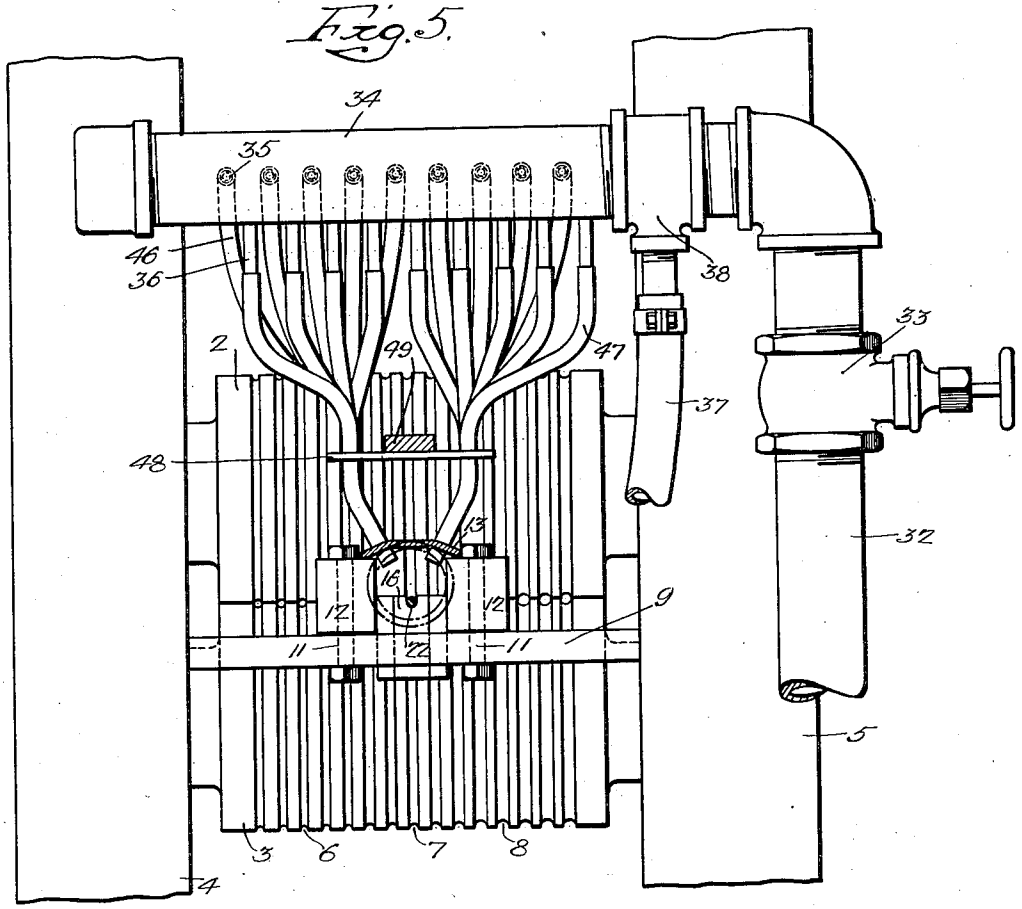


Fig. 8.

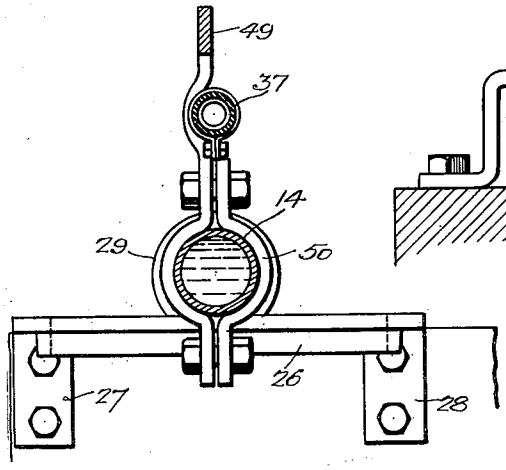
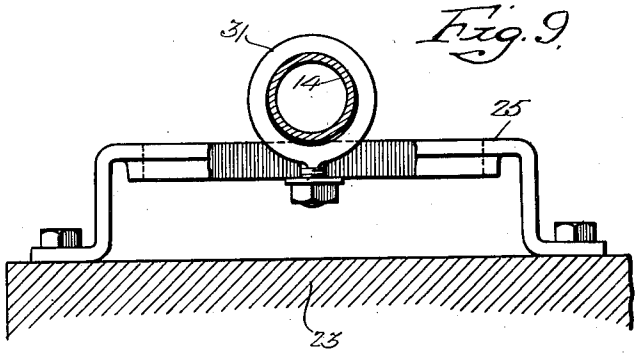


Fig. 9.



Inventor:
William Mellor:
by his Attorneys
Howson & Howson

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UNITED STATES PATENT OFFICE

1,944,798

MEANS FOR QUENCHING STEELS

William Mellor, Philadelphia, Pa., assignor to Henry Disston and Sons, Inc., Philadelphia, Pa., a corporation of Pennsylvania

Application July 18, 1931. Serial No. 551,780

6 Claims. (Cl. 266—3)

My invention relates to an apparatus for the production of an essentially austenitic structure in steels in immediate sequence to the hot working of the same.

One object of my invention is to provide means for treating austenitic steels, with the result that the steel has very high ductility, and hence is particularly suitable for cold working operations.

A further object of the invention is to provide apparatus for treating steels by which it is possible to treat austenitic steels in connection with hot working operations to maintain the austenitic structure at room temperature.

My invention contemplates the use of means for producing a very drastic liquid quench as an integral part of the machine used in the hot working, for example a hot rolling mill. The apparatus of the present invention is applicable for use in the treatment of those steels which may be quenched from a temperature above the austenitic critical temperature to maintain the austenitic structure at room temperature. The apparatus is particularly of value in the treatment of the alloy steels, known as austenitic steels, which are normally characterized by an austenitic structure at room temperature. As typical of these steels, a 12% manganese steel containing 1% to 1.1% carbon may be mentioned. Any of the other steels of this general class may also be treated, for example, one containing 18% chromium, 8% nickel, and varying amounts of carbon up to .50%, or a steel containing 18% chromium, 8% manganese, 1 to 2% copper, and with carbon varying up to .50%. I prefer to use cold water as a quenching medium, but other liquid media may be used if desired, particularly cold brine, although for some steels cold oil may be used. The water jets are so arranged as to give a rapid and uniform quench. Furthermore, the metal as it leaves the rolls of the rolling mill is kept in contact with the quenching medium for a period of time, so that the temperature of the bar will not resume a red heat.

Various conditions of temperature and time are possible for the quenching operation, but in any event, the temperature from which the metal is quenched must be higher than the austenitic critical temperature for the particular steel being treated, and is invariably at a good red heat, for example, from 1600 to 1900 degrees F. After the quenching, the bar will have lost its red heat and as it emerges from the machine, it will be at a black heat varying under different circumstances, but generally ranging from 400 to 900 degrees F. The steel treated in accordance with the present invention may be used without further treatment in the fabrication of materials, or it may be subjected to cold drawing operations, with or without previous annealing and water quenching.

The novel process of the invention as well as the structural details of apparatus constructed in accordance with the principles thereof for carrying out the process will be more clearly understood from the following detailed description of the apparatus disclosed in the accompanying drawings.

In the drawings:

Figs. 1 and 2 are elevational views which when taken together illustrate apparatus constructed in accordance with the invention;

Figs. 3 and 4 are partial elevational views of the same apparatus illustrating the invention more in detail, certain parts of the apparatus being shown in section for clarity of illustration;

Fig. 5 is an elevational view along 5—5 of Fig. 3;

Fig. 6 is a perspective view of the guide member of the apparatus;

Fig. 7 is a perspective view of the forward end of the main pipe conduit;

Fig. 8 is an elevational view along line 8—8 of Fig. 3; and

Fig. 9 is an elevational view along 9—9 of Fig. 4.

Referring to the drawings and particularly to Figs. 1 to 5, there is disclosed a standard hot rolling mill 1 which comprises essentially a pair of grooved rolls 2 and 3 extending transversely between standards 4 and 5 and supported thereby. Rolls 2 and 3 are of substantial width, as shown clearly in Fig. 5, and are provided with sets of varying sized grooves 6, 7 and 8 to enable the rolling of steel rods of varying sizes.

In accordance with the invention, I provide a supporting bar 9 which extends transversely between standards 4 and 5 adjacent the rolls and is supported by the standards. This bar is provided with a longitudinal slot 10 which slidably carries a pair of bolts 11. The bar also supports a pair of blocks 12, each of which has a central bore extending therethrough, bolts 11 extending through the blocks and firmly attaching them to bar 9. The purpose of blocks 12 is to support the arcuate plate 13 (see Fig. 7) which is integrally formed at the forward end of pipe conduit 14. The manner in which plate 13 is supported by blocks 12 is clearly illustrated in Fig. 5, the plate resting upon the blocks between the heads of bolts 11. It will be apparent that the position of plate 13 along bar 9 may be varied

by sliding bolts 11 along the bar and thus properly adjusting the position of blocks 12. Plate 13 is provided with rows of apertures 15, the purpose of which will be set forth hereinafter. The rows of apertures are so arranged that the apertures of each row are staggered with respect to those of the other.

Bar 9 also serves to support guide member 16, the construction of which is shown in detail in Fig. 6. This member comprises a body portion 17 having a depending extension 18 near the back end thereof. A longitudinally extending groove 19 is provided in the upper face of the body portion and a plurality of transversely extending grooves 20 of greater depth than groove 19 are also provided. The front end of the guide is tapered, as at 21, and the portion thereof at the front end of groove 19 conforms in shape with the grooves in the rolls of the mill so that it may ride in the particular groove with which the member is associated. As shown more clearly in Fig. 3, the guide is adapted to have its back end rest upon bar 9 so as to be supported thereby, the depending extension 18 serving as a stop. The guide merely rests upon the bar and is not mechanically attached thereto. However, it is of such width that it fits snugly between blocks 12 which function to prevent lateral movement of the guide along bar 9. The forward end of the guide rests upon the lower roll 3 of the mill, the projecting end previously mentioned riding in a groove of the roll as previously stated.

The purpose of guide 16 is to guide the steel rod 22 as it emerges from the rolls, the rod passing through groove 19 of the guide as shown in Fig. 3. The method contemplated by the invention involves initial quenching of the steel by means of a jet or spray of the cooling liquid, as will be set forth more fully hereinafter. Grooves 20 of the guide are made deeper than groove 19, so that the lower surface of the steel rod will be subjected to the cooling action of the liquid in grooves 20.

The body portion of pipe 14 is of substantial length, as illustrated. While any desired length of this pipe may be used, we have found that a length of approximately thirty-five feet serves the purpose of the invention and enables the carrying out of the desired method. The pipe is formed as illustrated, its ends being bent upward so that its central portion lies below the ends, for a purpose to be described later. The body portion of the pipe is supported upon hot bed 23 by means of suitable brackets 24 and 25. Bracket 24 is attached to the front vertical wall of the hot bed and comprises a horizontal body portion 26 (see Fig. 8) with integral downwardly extending attaching feet 27 and 28. It is desired that pipe 14 be capable of adjustment transversely with respect to the hot bed and, to this end, the supporting brackets are made of substantial width. The body portion of bracket 24 has a longitudinal slot opening extending therethrough which is adapted to slidably receive the lower portion of clamping ring 29. The ring has an integral depending threaded shank 30 which extends entirely through the slotted portion 26 of the bracket and carries a nut and a lock washer at its end. Pipe 14 passes through ring 29 and it will be apparent that by slidably adjusting the position of the ring along the supporting bracket, the position of the pipe may be suitably varied.

Bracket 25 is disposed at the other end of pipe 14 and serves to support it in the same manner as does bracket 24. Bracket 25 is illustrated in detail in Fig. 9 and it will be seen that this member supports a ring 31 similar in construction to ring 29 and slidably carried in a slot opening through the bracket. The supported portion of the pipe may be adjusted transversely by adjusting the position of ring 31 in a manner similar to that already set forth in connection with bracket 24.

Referring particularly to Fig. 5, there is provided in accordance with the invention an inlet pipe 32 through which the quenching liquid flows. A suitable valve 33 is provided to enable cutting off of the liquid flow or to enable a variation in the pressure of the liquid. A manifold pipe 34 having horizontally extending branches 35 and downwardly vertically extending branches 36 is connected to the end of pipe 32 and supported thereby. Leading off from this manifold, there is also provided a flexible tube 37 connected to the manifold by means of a suitable T coupling 38. The other end of tube 37 is connected to a horizontal pipe 39 which runs parallel to the central portion of pipe 14 and is supported thereby a slight distance above such pipe. Two-part clamps 40 may be utilized to attach the auxiliary pipe 39 to pipe 14.

The central body portion of pipe 14 is provided with upwardly extending nipples 41 spaced at regular intervals and pipe 39 is provided with similar downwardly extending nipples 42 adjacent nipples 41. Flexible hose connections 43 connect nipples 42 to their corresponding nipples 41 so that a portion of the incoming quenching liquid flows through pipe 39 and enters pipe 14 via the hose connections. The purpose of bending pipe 14 as previously set forth will now be apparent since it is desired to provide a reservoir for the quenching liquid designated by the reference character 44 in Figs. 3 and 4. This reservoir subjects the steel rod 22 to a continuous quenching throughout the desired length of pipe 14 and serves to maintain the steel below red heat so that it will emerge from pipe 14 to a black heat prior to its being wound upon a suitable takeup reel 45.

Prior to this drastic quenching, however, the steel is subjected to the previously mentioned jet or spray quenching which is effected by the apparatus now to be described. Sets of flexible conduits 46 and 47 are attached respectively to branches 35 and 36 of manifold 34. These conduits extend downward through rows of apertures provided in a horizontally disposed plate 48 which is carried at the end of an L-shaped bracket 49. The depending arm of this bracket is formed so as to co-act with a clamping member 50 (see Fig. 8) to constitute a clamp about pipe 14. In other words, bracket 49 is rigidly supported by pipe 14 and plate 48 functions to hold conduits 46 and 47 in proper relation.

The lower ends of flexible conduits 46 and 47 extend through the previously mentioned rows of apertures 15 in the arcuate plate 13 at the forward end of pipe 14. The arcuate shape of the plate causes the liquid-emitting ends of conduits 46 and 47 to be angularly disposed in a pair of rows, as shown more clearly in Fig. 5. It will be seen that the liquid emitted by these conduits is directed in a jet or spray upon the steel rod as it passes through guide 16 and the steel is initially subjected to a drastic spray quenching. The purpose of the staggered relation of apertures 15 in plate 13 will now be understood since it is desired to arrange the liquid-emitting ends of conduits 46 and 47 so that the steel will be subjected to an even jet of liquid throughout the

length of plate 13. This initial quenching action is also aided by the previous described construction of guide 16 since the liquid in transverse grooves 20 of the guide contacts the lower surface of the moving steel to thereby quench the same.

It will thus be seen that the method involved in the invention and carried out by the disclosed apparatus comprises two main and essential quenching operations, viz., the initial jet or spray quenching and the subsequent continuous quenching in the reservoir of pipe 14. Austenitic steel which is subjected to this quenching process displays highly desirable characteristics and advantages over similar steel treated in the usual manner. For example, steel treated in accordance with the present invention has a materially greater precentage elongation than that treated in the usual manner. Whereas the percentage elongation of austenitic steels cooled in the usual manner runs from 4.0% to 7.5%, such steels when subjected to the process of my invention show an elongation of from 17% to 22%. Another advantage of the process disclosed herein is that by maintaining the austenitic property or structure of the steel being rolled, the ductility thereof is materially increased. This is very important since the subsequent cold working to which the steel may be subjected depends entirely upon its ductility. When steel of the class in question is hot rolled in the ordinary manner, it cannot be cold drawn into wire before a preliminary treatment; nor can it be woven into screen without such treatment. However, the same steel if it has been hot rolled by means of the present method can be immediately cold drawn or woven into screen or may be bent in any manner without danger of rupture.

The method of hot rolling and quenching steels is the subject of a divisional application Serial No. 635,100, filed September 27, 1932.

While there is disclosed herein specific apparatus designed to carry out the contemplated method, it will be obvious that various changes and modifications in such apparatus are possible and within the scope of the invention. The invention consists in the apparatus set forth herein and includes any apparatus which may be utilized to carry out the method in accordance with the disclosed principles.

I claim:

1. Apparatus for treating steel to maintain the austenitic structure thereof after hot working, comprising means for subjecting said steel to a drastic liquid quench simultaneously with its emergence from the hot working apparatus to cool it rapidly, said means comprising a guide adjacent the hot working apparatus over which said steel passes, a quenching liquid jet adapted to play on said steel, and a passage containing running quenching liquid through which said steel passes.

2. Apparatus for treating steel, to maintain the austenitic structure thereof after hot working, comprising means for subjecting said steel to a drastic liquid quench simultaneously with its emergence from the hot working apparatus to cool it rapidly, said means comprising a guide adjacent the hot working apparatus over which said steel passes, a quenching liquid jet adapted to play on said steel, a passage containing running quenching liquid through which said steel passes, and means for laterally adjusting said guide, said jet, and said passage.

3. Apparatus for treating steel to maintain the austenitic structure thereof after hot working, comprising means for subjecting said steel to a drastic liquid quench simultaneously with its emergence from the hot working apparatus to cool it rapidly, said means including a guide adjacent said rolls over which said steel passes, and a quenching liquid jet adapted to play on said steel during its advance along said guide.

4. Apparatus for treating steel to maintain the austenitic structure thereof after hot working, comprising means for subjecting said steel to a drastic liquid quench simultaneously with its emergence from the hot working apparatus to cool it rapidly, said means including a guide adjacent said rolls over which said steel passes, a quenching liquid jet adapted to play on said steel, and means for laterally adjusting said guide and said jet.

5. Apparatus for treating steel to maintain the austenitic structure thereof after hot rolling by rolls having grooves therein, comprising means for subjecting said steel to a drastic liquid quench simultaneously with its emergence from said rolls to cool it rapidly, said means including a guide adjacent said rolls over which said steel passes, said guide having a tapered end riding in one of said grooves, and a quenching liquid jet adapted to play on said steel.

6. Apparatus for treating steel to maintain the austenitic structure thereof after hot working, comprising means for subjecting said steel to a drastic liquid quench simultaneously with its emergence from the hot working apparatus to cool it rapidly, said means including a guide adjacent said rolls over which said steel passes, said guide having a longitudinal groove which slidably receives the steel and a plurality of transverse grooves of greater depth than said longitudinal groove, and a quenching liquid jet adapted to play on said steel, whereby the liquid accumulates in said transverse grooves to cool the lower surface of the steel.

WILLIAM MELLOR.