May 19, 1953 W. C. HIATT ET AL 2,638,909

QUENCH TANK FOR HEAT-TREATING PROCESSES

Filed Sept. 22, 1949 3 Sheets-Sheet 1

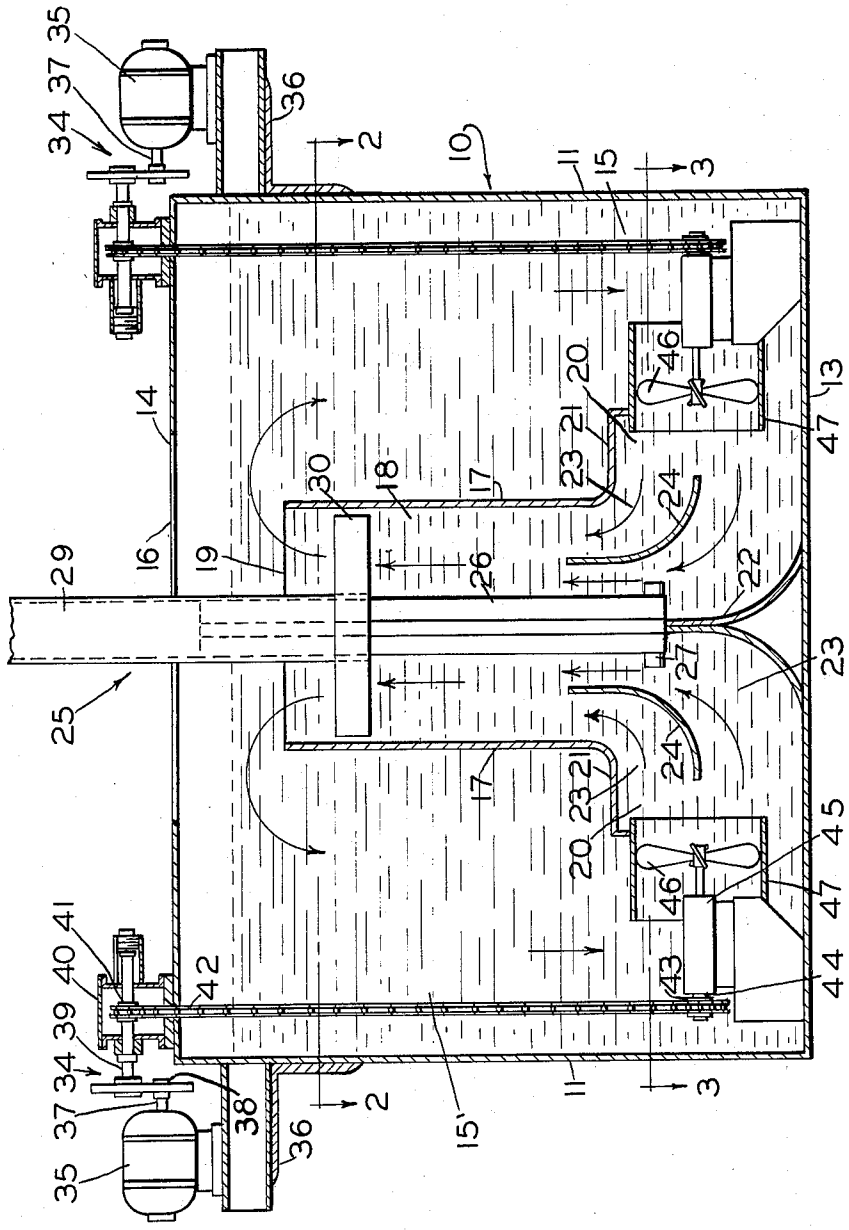


FIG. 1.

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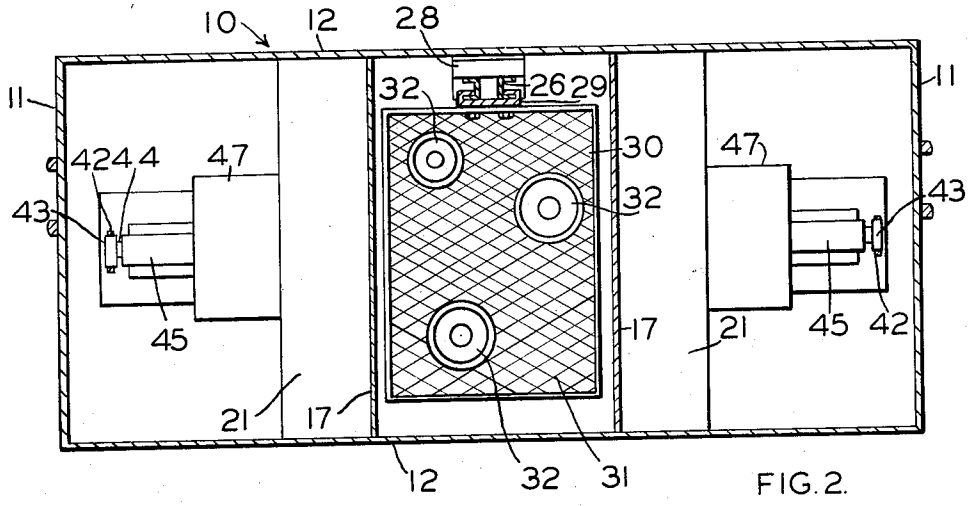


FIG. 2.

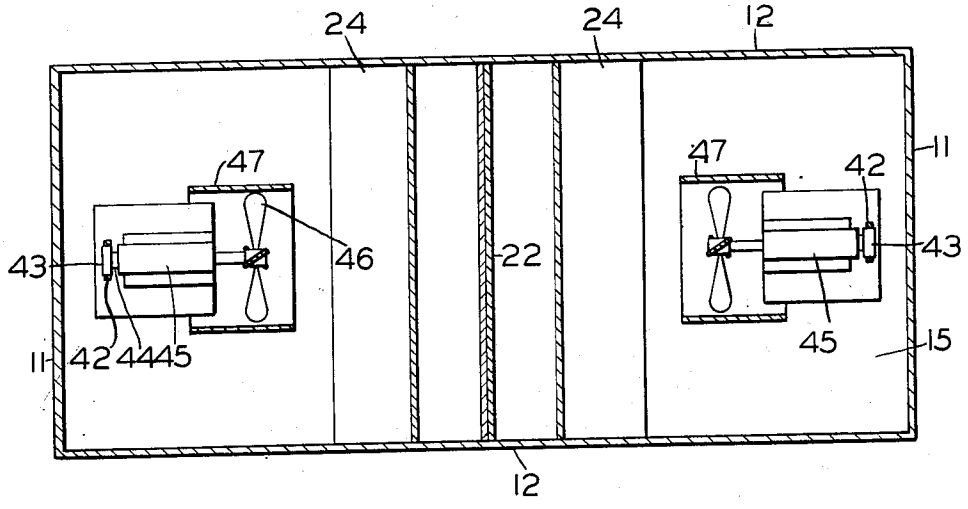


FIG. 3.

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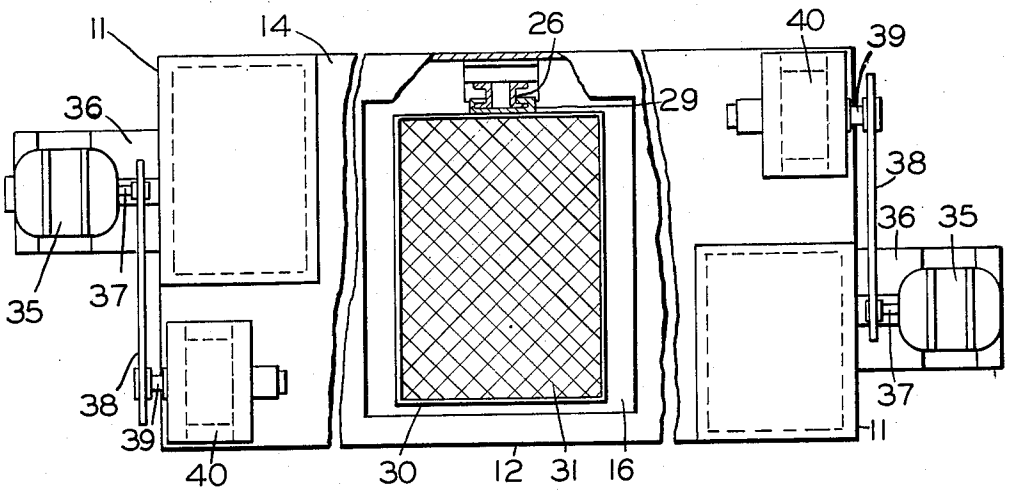


FIG.4.

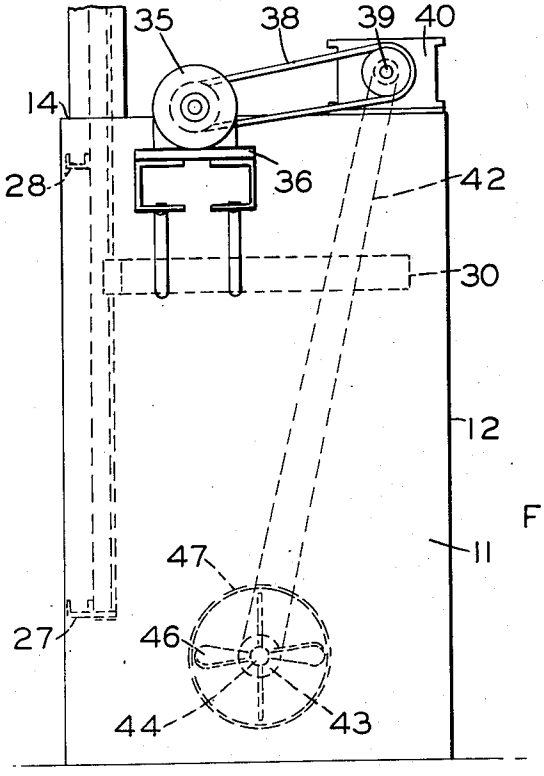


FIG. 5.

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QUENCH TANK FOR HEAT-TREATING PROCESSES

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Application September 22, 1949, Serial No. 117,164

5 Claims. (Cl. 134—147)

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This invention relates to an improved quench tank and more particularly to a tank especially adapted for the mass hardening of a plurality of objects during a heat treating process.

More specifically the invention relates to a quench tank especially adapted for quenching heated articles in a process resulting in the article having a fine martensitic grain structure throughout the material.

In the industrial art concerned with heat treatment of metals, the process of marquenching may be defined as the introduction of an interruption in the cooling cycle at the proper time to permit equalization of temperature within the metal before allowing transformation from austenite to martensite to begin. The metal when properly treated by this process shows a fine martensitic grain structure with increased hardness which increases the durability of the material and its resistance to wear. In order to properly perform this process the quenching operation is of prime importance. Various types of quench tanks have been designed in order to perform the quenching steps of this process. None of these have satisfactorily performed a quenching process in a manner intended to facilitate the mass or production quenching of the parts. Therefore marquenching on a mass production basis has heretofore been found to be impractical.

In order to secure rapid quenching it is desirable to agitate the fluid within the quenching tank so that a maximum dissipation of heat in the article is accomplished within a relatively short time cycle. Various types of impeller devices have been introduced and constructed to operate within the tanks. These impeller devices were intended to agitate the quenching fluid. Heretofore devices of this type have not proved satisfactory since the position of the impeller and the agitation of the fluid with respect to the articles to be quenched have not received sufficiently careful consideration. The agitation produced by these previous impeller devices has not been sufficient to produce a quick dissipation of the heat in the articles and therefore a uniform martensitic structure has not been obtained. Generally it was found that austenite and bainite would appear in the sections and consequently severe internal stresses would be set up in the articles treated. These faults are directly a result of improper quenching where the agitation of the fluid through the article is insufficient. It is applicant's prime object therefore to provide an improved quench tank that will be effective to quench articles in mass quantities in a manner

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that will facilitate the heat treating process known as marquenching.

Still another object is to provide an improved quenching tank having strategically located baffling means designed to aid in the agitation of the quenching fluid.

A still further object is to provide an improved tank having a plurality of impellers for agitating the quenching fluid, the impellers being positioned at a point below the articles to be quenched, the articles being positioned in the direct path of the quenching fluid as it is accelerated and agitated at a high velocity by the impellers.

It is a still further object to provide an improved quench tank having impeller means constructed and arranged to agitate and circulate quenching fluid in a circular path at a relatively high velocity, the velocity ranging from a relatively high acceleration to a point of low acceleration, the articles to be quenched being positioned within the tank at a point directly in the path of the high velocity quenching medium.

These and other objects of the invention will become clearly apparent from the reading of the following specification when examined in connection with the accompanying drawings.

In the drawings:

Figure 1 is a sectional view in elevation through a quench tank embodying the novel aspects of the invention.

Figure 2 is a sectional view through a quench tank taken substantially along the line 2—2 of Figure 1.

Figure 3 is a sectional view through a quench tank taken substantially along the line 3—3 of Figure 1.

Figure 4 is a plan view, partially in section, of a quench tank.

Figure 5 is a left end view in elevation of a quench tank.

The improvement is generally embodied in the form of a quench tank designated by the reference character 10. The quench tank 10 consists of end walls 11 and side walls 12 supported on a bottom 13. A top or cover 14 covers the tank 10 to provide a substantially enclosed chamber 15. The chamber 15 is fluid-tight and is adapted to contain a quenching fluid as best shown in Figure 1. The chamber 15 is filled with the quenching fluid to a point just below the cover 14. An opening 16 is provided in the cover 14, the opening being arranged to provide an access for the entrance of articles to be treated within the chamber 15.

A pair of separators or walls 17 are substantially centrally positioned within the chamber 15. The separators 17 are horizontally spaced and extend laterally across the width of the tank 10 as best shown in Figures 2 and 3 to divide the chamber 15 into first and second subchambers 15'. A passageway 18 is defined by the separators 17, the passageway 18 being substantially in alignment with the opening 16. The passageway 18 is open at its upper end as indicated at 19 and is provided at its lower end with oppositely disposed inlet throats or openings 20. The inlet openings 20 are formed by a pair of horizontal walls 21, the walls 21 extending or projecting laterally outwardly from the separators 17 as best shown in Figures 1 and 2. The lower end of the passageway 18 is provided with a centrally located baffle 22. The baffle 22 is positioned to divide the lower end of the passageway 18 into separate channels 23. Baffles 24 are located in the channels 23, the baffles being formed of an arcuate sheet and being arranged to direct fluid entering into throats 20 upwardly through the passageway 18.

An elevating device 25 extends through the opening 16 of the tank. The elevating device 25 is provided for the purpose of delivering and removing articles to be treated to and from the passageway 18. This device may be of conventional construction and includes, generally, a vertically extending track 26 which extends through the opening 16 down into the passageway 18. The track 26 is suitably connected to one side 12 of the tank by means of brackets 27 and 28. A channel 29 is slidably secured to the track 26 and a tray or carrier 30 is connected to the channel 29. The channel 29 may be moved in a vertical direction by an elevating mechanism not shown. The tray or carrier 30 is provided with a reticulated or screened platform 31 on which a plurality of articles 32 to be treated may be carried.

A pair of agitating units 34 are symmetrically positioned at opposite ends of the tank 10. Each agitating unit includes an electric motor 35 which is rigidly mounted on a support 36 connected to an end wall 11 of the tank 10. Each motor 35 rotates a shaft 37 which in turn drives a belt 38. The belt 38 in turn is arranged to rotate a shaft 39 which is journaled in a bearing box 40. The bearing box 40 is suitably connected to the top 14 of the tank 10. A sprocket 41 is rotated by the shaft 39, the sprocket in turn being arranged to drive a chain 42 for driving a sprocket 43. The sprocket 43 is positioned within the tank adjacent the bottom 13. A shaft 44 is driven by the sprocket 43, the shaft 44 being journaled in a bearing box 45. Each impeller 46 is driven by a shaft 44, each impeller being enclosed by a shroud 47 positioned to direct liquid into each feed throat 20. The motor 35 may be of a variable-speed type or the belt drives may be so arranged as to provide for variable speeds in the rotation of the impeller.

In the operation of the quench tank 10 articles to be quenched 32 are removed from a furnace, not shown, and placed upon the reticulated platform 31 of the tray 30. The elevating device 25 is actuated to move the tray 30 into a position within the passageway 18 as best shown in Figure 1. It will be noted that the tray 30 is, in this position, below the upper open end 19 of the passageway. Quenching fluid is present within the tank and each impeller 46 is driven to circulate and force the fluid directly through the passage 18 in a circular path as indicated by the arrows. The fluid is thus constantly in flow and in agitation and the impellers are arranged to direct a high velocity flow through the passageway 18. It must be especially noted that the tray is positioned in the passageway at a point where the rate of the fluid flow is at or near a maximum velocity.

The position of the baffles is so arranged that the fluid is moved from the impellers 46 in a circular path up through the passageway 18 and down back to the impellers. At a certain location in this circular path a point is reached where the velocity of the fluid flow (as determined by the pressure exerted by the impeller) is at a minimum, and the subsequent movement of the fluid is occasioned by the natural forces of gravity, molecular cohesion etc., rather than due to the positive impelling force exerted by the impeller. Quench tanks have been designed previously that have contained impellers but all of these have been designed with the primary view of creating a general turbulence and none has taken into consideration the location of the impeller as related to the material to be treated as being significant. The location of the impeller and the velocity of the flow with relation to the articles, in previous devices, was such that an effective martempering could not be attained. In articles hardened in these previous devices the grain structure would be imperfect and this process therefore never reached extensive use.

The general theory covered by applicant's novel invention may be also described by the following terminology. The impeller exerts a force against the liquid which may be likened to a pushing force. This pushing force exerts a high acceleration and the fluid under a high velocity courses through and around the articles on the reticulated platform thus dissipating heat from the articles in a quick or rapid manner. The flow of the fluid is in a circular path, and at a point in this path the impeller no longer creates a positive pushing force. The fluid beyond this point, continues to move but the movement is the result of a pulling force which may be considered only as an indirect result of the work of the impeller assisted by natural forces such as gravity etc. It is not however, directly occasioned by the energy expended by the impeller. Applicant has positioned his tray within the passageway 18 so that the articles are brought in contact with the flow of fluid at a point where the impeller is pushing the liquid at a high acceleration and before the velocity has reached a minimum point. As previously indicated in the specification, this novel arrangement is of great significance since it makes possible the mass production of heat treated articles having a fine martensitic grain structure.

It can therefore be seen that the position of the impeller with relation to the carrier is of prime importance. In an effort to secure the rapid dissipation of heat in the articles, applicant has designed a tank including a passageway baffled in a manner that will facilitate the rapid flow of quenching fluid to the article treated. The novel tank design therefore makes it possible to marquench large quantities of articles in a manner resulting in a properly hardened article.

In the process of marquenching the quenching

operation is of prime importance. Applicant has provided a tank that will perform this quenching process in a production manner heretofore not considered possible. It must be understood that a preferred embodiment of the invention has been disclosed and that changes and modifications may be made in the design and construction without departing from the spirit of the invention nor the scope thereof as defined in the appended claims.

What is claimed is:

1. A device for quenching heated articles comprising a quench tank having a fluid chamber, walls extending vertically within said chamber, said walls defining a passageway open at its upper end for communication with said chamber, said walls having inlet openings adjacent their lower ends, a baffle positioned at the lower end of said passageway arranged to divide the lower end thereof into separate inlet channels, each channel including wall portions projecting outwardly from the passageway into the chamber, an impeller positioned adjacent each inlet channel, each impeller being arranged to impel quench fluid at high velocity from the chamber through said passageway, and an article carrier positioned in said passageway whereby articles to be quenched on the carrier are immersed in the high velocity flow.

2. A device for quenching heated articles comprising a quench tank having a fluid chamber, walls extending vertically within said chamber, said walls defining a passageway open at its upper end for communication with said chamber, a baffle positioned at the lower end of said passageway and extending vertically into a portion of said passageway to divide the lower end of said passageway into separate inlet channels, said walls having inlet openings adjacent their lower ends, an impeller positioned close to each inlet channel, each impeller being arranged to impel quench fluid at high velocity from the chamber into said inlet channels and through said passageway, and an article carrier positioned in said passageway whereby articles to be quenched on the carrier are immersed in the high velocity flow.

3. A device for quenching heated metals comprising a fluid quench tank, a pair of spaced vertically extending separating walls disposed in the tank, said walls providing a vertically extending passageway positioned to divide said tank into first and second fluid chambers, the passageway being open at its upper end to provide a fluid outlet, a tray movable in the passageway to a position below the fluid outlet of said passageway, inlet channels positioned at a lower end of said passageway, said channels including walls projecting outwardly of the separating walls and into the first and second chambers, a baffle at the lower end of said passageway for dividing the lower end of said passageway into separate passages, the separating walls and said baffle being arranged to direct liquid upwardly through said passageway outwardly through said fluid outlet, means for impelling fluid disposed within the tank, said impelling means being positioned sufficiently close to said inlet channels to impel fluid through said inlet channels and through said passageway at a high velocity, said tray being positioned in said passageway and in the high velocity flow.

4. A device for quenching heated metals comprising a fluid quench tank, a pair of spaced vertically extending separating walls disposed in the tank, said walls providing a vertically extending passageway positioned to divide said tank into first and second fluid chambers, the passageway being open at its upper end to provide a fluid outlet, a tray movable in the passageway to a position below the fluid outlet of said passageway, inlet channels positioned at a lower end of said passageway, said channels including walls projecting outwardly of the separating walls and into the first and second chambers, a first baffle at the lower end of said passageway for dividing the lower end of said passageway into separate passages, a second baffle in each passage, the separating walls and said baffles being arranged to direct liquid upwardly through said passageway and outwardly of the fluid outlet, impeller means disposed within the tank, said impeller means being positioned sufficiently close to said inlet channels to impel fluid through said inlet channels and through said passageway at a high velocity, said tray being positioned in said passageway and in the high velocity flow.

5. A device for quenching heated metals comprising a fluid quench tank, said tank including an opening formed in a top portion thereof, a pair of spaced vertically extending separating walls disposed in the tank, said walls providing a vertically extending passageway positioned to divide said tank into first and second fluid chambers, the passageway being open at its upper end to provide for communication with the fluid chambers, a reticulated tray movable through the opening in said tank and into said passageway to a position below the upper open end of said passageway, inlet channels positioned at the lower end of said passageway, said channels including walls projecting outwardly of the separating walls and into the first and second chambers, a first centrally disposed baffle at the lower end of said passageway for dividing the lower end of said passageway into separate passages, a second baffle in each passage, the separating walls and said baffles being arranged to direct liquid upwardly through said passageway and outwardly therefrom, impeller means positioned sufficiently close to said inlet channels to impel fluid through said inlet channels and through said passageway at a high velocity, said tray being positioned in said passageway and in the high velocity flow.

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