Jan. 5, 1965 H. N. IPSEN 3,164,656

QUENCHING APPARATUS FOR METALLIC ARTICLES

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Fig. 1

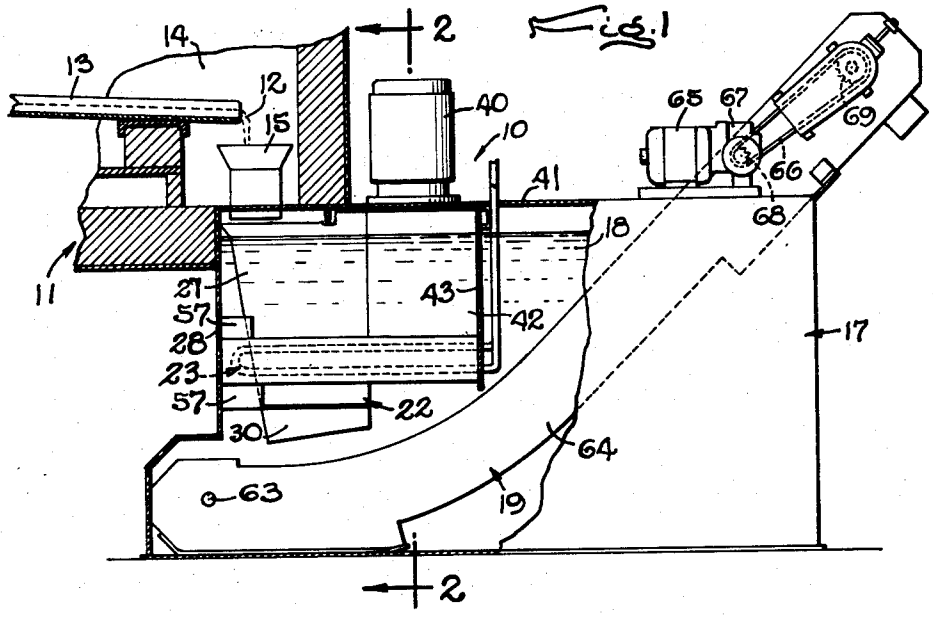
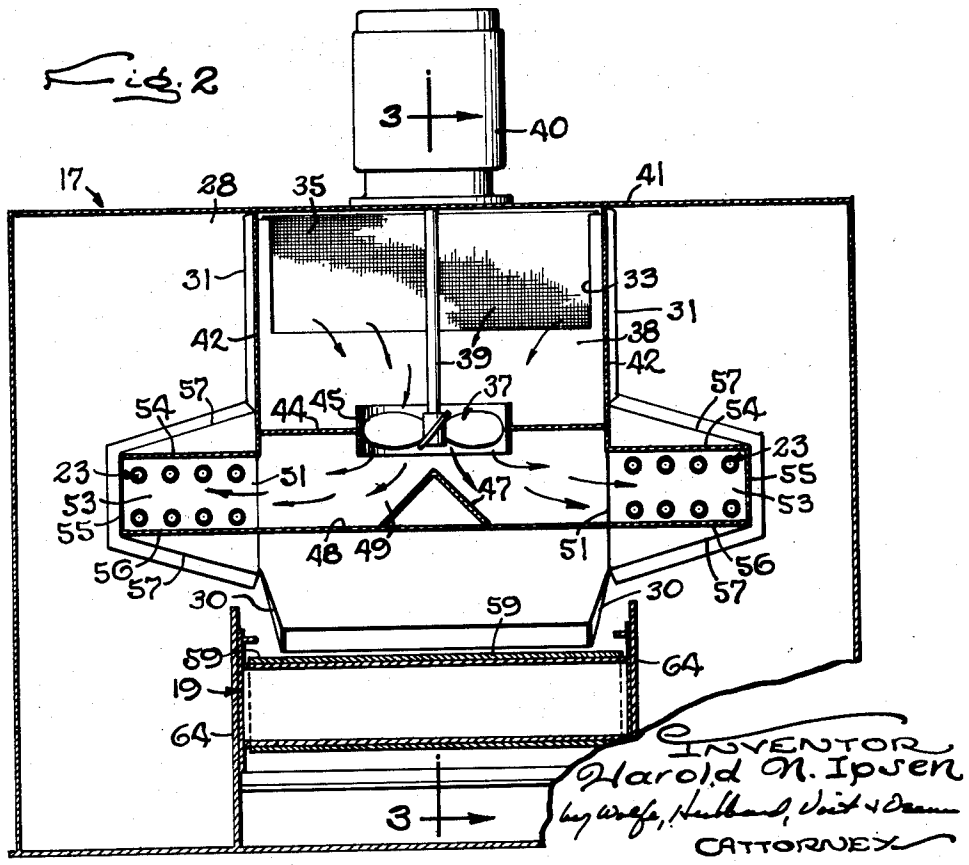


Fig. 2



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Fig. 3

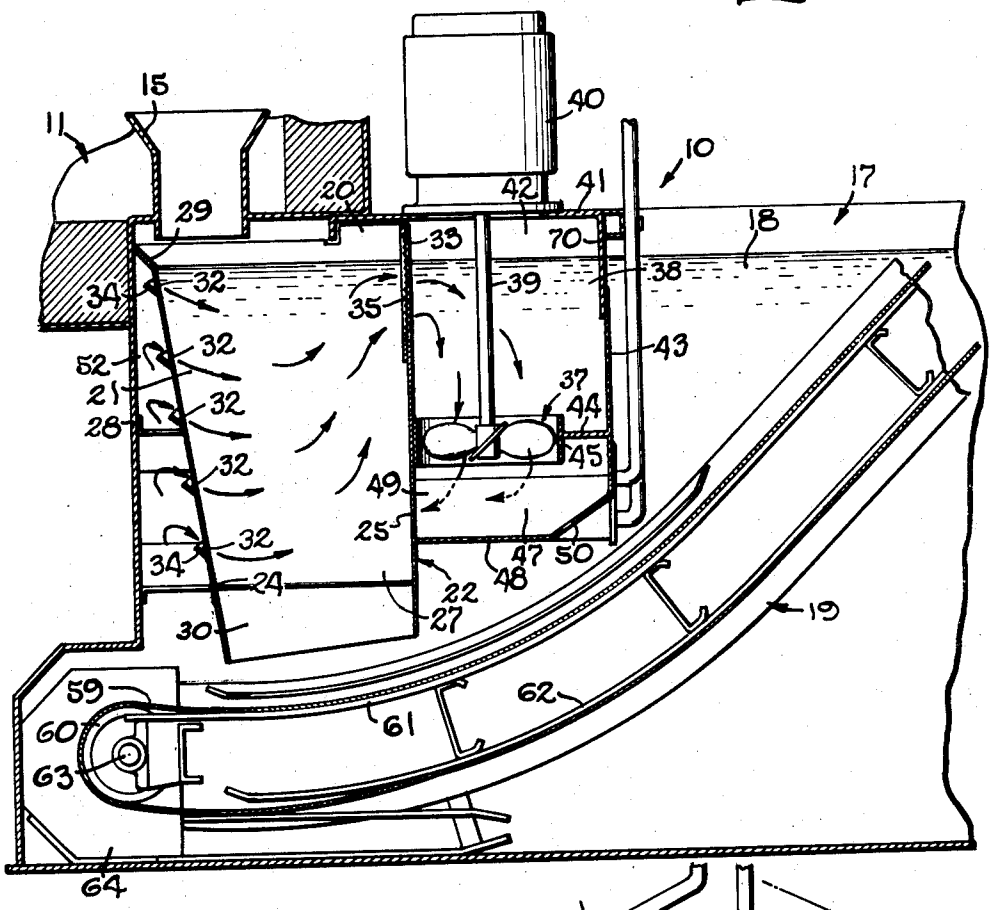
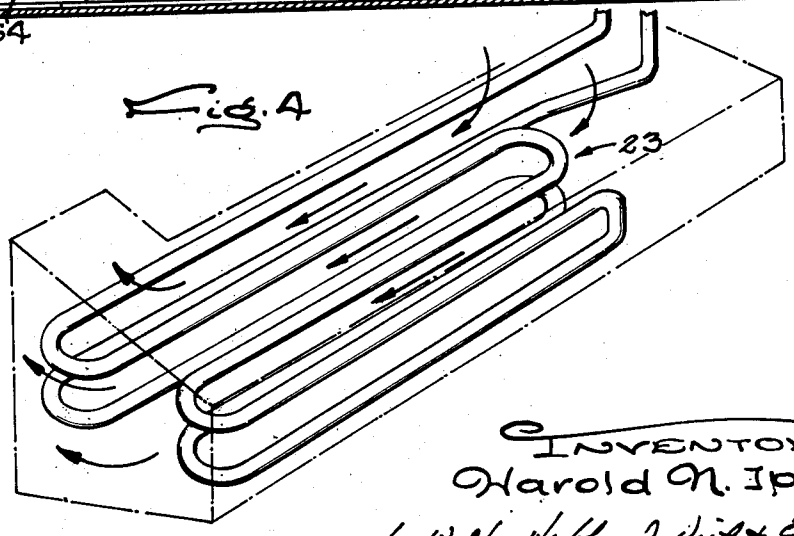


Fig. 4



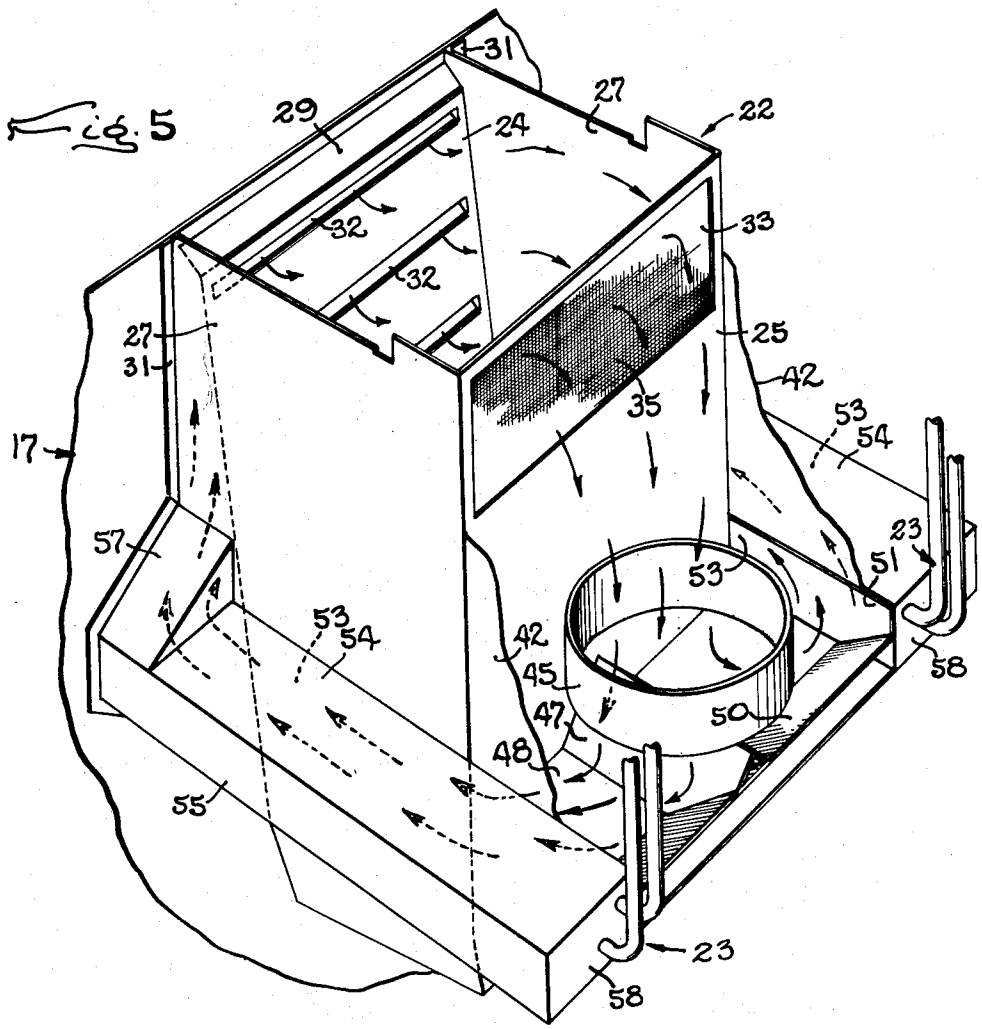
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QUENCHING APPARATUS FOR METALLIC ARTICLES

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Fig. 5



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QUENCHING APPARATUS FOR METALLIC ARTICLES

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Filed Dec. 31, 1962, Ser. No. 248,664
6 Claims. (Cl. 266—6)

This invention relates to quenching apparatus and, more particularly, to apparatus of the type adapted for use with shaker hearth and other types of furnaces which deliver a substantially continuous flow of heated workpieces to the discharge end of the hearth and release these workpieces into a tank of quenching liquid to be cooled therein as they gravitate toward the bottom of the tank.

The primary object of the present invention is to circulate the oil in the tank in a novel manner to maintain a uniform flow of oil at an even temperature across the surfaces of the gravitating workpieces thereby evenly controlling the rate of cooling of the latter.

A more specific object is to provide an upright open-ended baffle substantially enclosing a cooling zone within the tank along the precise path of gravitation of the workpieces and to circulate oil at high velocity through the zone transversely of the path and to a substantial depth.

Another object is to insure that the workpieces gravitate through the cooling zone close to the ports through which the cooled liquid enters the zone.

The invention also resides in the novel manner of circulating and cooling the liquid.

Other objects and advantages of the invention will become apparent from the following detailed description taken in connection with the accompanying drawings, in which

FIGURE 1 is a fragmentary side elevational view of a quenching apparatus embodying the novel features of the present invention, the apparatus being shown in conjunction with a portion of a shaker hearth furnace and with parts broken away and shown in section.

FIG. 2 is an enlarged fragmentary sectional view taken along the line 2—2 of FIG. 1.

FIG. 3 is a fragmentary sectional view taken along the line 3—3 of FIG. 2.

FIG. 4 is an enlarged fragmentary perspective view of one of the cooling elements.

FIG. 5 is a fragmentary perspective view of a portion of FIG. 2 schematically illustrating the oil flow through the apparatus.

As shown in the drawings for purposes of illustration, the invention is embodied in a quenching apparatus 10 particularly adapted for use with a heat treating furnace 11 (FIGS. 1 and 3) of the shaker hearth type in which workpieces 12 to be treated are deposited on the outer end (not shown) of an elongated hearth 13 (FIG. 1) which extends through the heating chamber 14 of the furnace with the inner end of the hearth positioned over a funnel 15 leading to the quenching apparatus. In such furnaces, the hearth is agitated endwise back and forth, first slowly to the right as viewed in FIG. 1 and then rapidly back, to advance the workpieces step by step by inertia along the hearth and through the heating chamber.

When the workpieces reach the inner end of the hearth 13, they have been in the heating chamber 14 for a predetermined period of time and have been heated to a preselected conditioning temperature. Then, the heated parts fall off the hearth and into the funnel 15 which leads to a tank 17 containing a body of quenching liquid 18 such as oil to be cooled rapidly as they gravitate through the oil toward the bottom of the tank. In this instance, the workpieces settle onto the lower end portion of a conveyor 19 and are carried by the conveyor upwardly and

out of the tank to be deposited in a suitable container (not shown) for subsequent handling. Usually, a protective atmosphere is maintained in the heating chamber 14 and in the space 20 (FIG. 3) above the quench area in a well known manner to prevent oxidation of the surfaces of the hot workpieces, and oil vapor in the space 20 is drawn out by a suitable eductor (not shown).

In accordance with the present invention, the quenching oil 18 is circulated in a novel manner to insure effective quenching of the workpieces gravitating toward the bottom of the tank 17 by maintaining a uniform flow of oil at an even temperature across the surfaces of the workpieces whereby the rate of cooling of the workpieces is closely controlled. This is accomplished by providing a substantially enclosed upright cooling zone 21 within the tank 17 along the precise path of gravitation of the workpieces, and carefully controlling the temperature of the oil within this limited zone by circulating oil transversely of the path of the workpieces to a substantial depth and quickly withdrawing the oil after contact with the work for cooling and recirculation through the cooling zone.

To achieve these ends, a walled chamber or baffle 22 is supported in the oil 18 below the funnel 15 with an open upper end for receiving the parts falling from the hearth 13 and an open lower end for discharging the parts onto the conveyor 19 after they have passed through the cooling zone 21. At least one cooling element 23 (FIGS. 1, 2 and 4) is immersed in the oil outside the baffle and means is provided to withdraw oil from the baffle on one side of the path of the parts, circulate this oil past the cooling element to be cooled thereby, and return the cooled oil to the baffle on another side of the path of the parts to flow across the path to the point of withdrawal.

In the present instance, the baffle 22 comprises an open-ended box-like structure formed by four upright sheet metal walls 24, 25 and 27 joined together along their edges in the manner shown most clearly in FIG. 5. The baffle preferably is supported with the open end somewhat above the level of the oil and adjacent one side wall 28 of the tank, the left-hand wall in the drawings. The funnel 15 opens into the baffle somewhat to the right of the left-hand wall 24 of the baffle.

On the upper edge of the wall 24 is a flange 29 which is inclined upwardly and to the left and abuts against the tank wall 28 to prevent workpieces from dropping between the tank wall and the baffle wall 24. The latter is inclined downwardly and to the right from the flange 29 and thus guides workpieces away from the tank wall and onto the conveyor 19. The remaining baffle walls are vertically dispose with the exception of the lower end portions 30 of the opposed side walls 27 which are bent inwardly (see FIG. 5) to taper the lower end portion of the baffle for more effective guiding of parts onto the conveyor. The left-hand edge portions of these side walls extend past the inclined wall 24 and are formed with outwardly turned flanges 31 (FIGS. 2 and 5) secured as by welding to the tank wall 28 to provide a large portion of the support for the baffle on the tank.

The means for circulating oil through the baffle 22 includes a plurality of inlet ports 32 formed in the inclined wall 24 and an outlet port 33 formed in the opposite wall 25 at least partially below the surface of the oil. It is important to note that the inlet ports are vertically spaced along the inclined wall from a level adjacent the surface of the oil to a level well below the surface. Herein, the inlet ports comprise five horizontally elongated slots punched out of the wall and extending across most of the width of the latter, the uppermost slot being close to the top edge of the wall and the lowest slot being spaced somewhat above the lower edge of the wall. The metal from the slots is bent outwardly to form flanges 34 (FIG.

3) which are inclined upwardly and outwardly from the wall.

To form the outlet port 33, one relatively large rectangular opening is cut in the wall 25 adjacent its upper end and is covered by a filter screen 35 which prevents any large objects from being drawn through the opening during operation of the apparatus. A substantial portion of the port is below the surface of the oil.

As shown most clearly in FIGS. 2 and 3, oil is drawn out of the baffle 22 through the port 33 by an impeller 37 which herein takes the form of a motor-driven screw propeller mounted in the bottom of a chamber 38 formed outside the baffle and communicating with the interior of the latter through the outlet port 33. The propeller is fast on the lower end of a vertical motor shaft 39 which is rotated at high speed by a motor 40 mounted on the top wall 41 of the tank 17. Thus, in one direction of rotation of the propeller, the blades thereof draw oil through the outlet port and downwardly through the chamber 38.

The chamber 38 is formed by the baffle wall 25 on one side, upright side walls 42 (FIG. 5) depending from the top wall 41 of the tank, an upright wall 43 (FIG. 3) spaced from the baffle wall and connecting the edges of the side walls 42, and a horizontal bottom wall 44 (FIGS. 2 and 3) above the lower edges of the side walls and end wall. A tubular sleeve 45 fast in and projecting through the bottom wall 44 encircles the propeller 37 to define a flow passage for carrying oil out of the chamber 38.

Below the wall 44, the flow through the sleeve 45 is split into two lateral flows by a deflector 47 of inverted V-shaped cross-section centered below the ring and supported on a horizontal plate 48 spaced below the bottom wall 44 and connecting the lower end of the end wall 43 to the baffle wall 25 to form another chamber 49. The right-hand portion 50 of this plate is inclined upwardly as shown in FIGS. 3 and 5 to deflect the two lateral flows to the left (FIG. 3) and under the side walls 42 which terminate above the horizontal portion of the plate 48 thereby forming apertures 51 opening out of the lower chamber 49 to each side.

Another chamber 52 (FIG. 3) is formed on the opposite side of the baffle 22 in the space between the inclined wall 24 and the adjacent wall 28 of the tank, the sides of this chamber being closed by the baffle side walls 27. The lower end of the chamber may be left open. Oil drawn from the baffle by the propeller 37 is carried to this chamber through a passage 53 (see FIG. 2) communicating between the chamber 52 and the upper chamber 38 through the lower chamber 49, there being two such passages in the present instance extending around the opposite sides of the baffle as shown in FIGS. 2 and 5.

Each passage 53 is formed by three elongated panels 54, 55 and 56 joined together to form an elongated trough of rectangular cross-section open along one side and mounted alongside the baffle 22 with the latter closing the open side along most of its length. Both ends of the trough project beyond the baffle, however, to open into opposite sides of the lower chamber 49 through the apertures 51 at one end and into opposite sides of the chamber 52 at the other end. The left-hand or outlet ends of the passages are enlarged by flaring top and bottom walls 57 formed with flanges secured to the tank wall 28. The right-hand ends of the troughs are closed by plates 58 (FIG. 5).

In this instance a cooling element 23 is disposed in each passage 53 to cool the oil as it flows through the passage. These elements may take the form of continuous tubes extending into and out of the troughs through the end plates 58 and bent back and forth within the passages to form two sets of parallel lengths in vertically spaced planes (see FIGS. 2 and 4). A cooling medium from a suitable source (not shown) is pumped continuously

through the tubes. Each of these tubes, therefore, provides a relatively large heat transfer surface to effect rapid cooling of the oil flowing around the tubes.

With the foregoing arrangement, the rotating propeller 37 creates a low pressure area in the upper chamber 38 to draw oil from the baffle 22 through the outlet port 33 into the low pressure chamber. The oil then is forced downwardly into the chamber 49 where it is deflected laterally into and flows through the passages 53 and is cooled therein. The passages discharge the cooled oil into the chamber 52 from both sides of the latter, mixing the two flows and creating a high-pressure area within this chamber. Thus, the oil is forced through the inlet ports 32 in the wall 24 into the low-pressure area created within the baffle by the action of the propeller, and flows across the cooling zone 21 toward the outlet port. A relatively high velocity flow of oil through the ports is obtained when the propeller is rotated at high speed.

It will be seen that heavier workpieces dropped through the funnel 15 either gravitate through the baffle along paths passing close to the inclined wall 24 or actually slide down the wall itself. The upwardly inclined flanges 34, of course, prevent sliding workpieces from falling through the slots and out of the baffle. With cooled oil flowing across the cooling zone from evenly spaced elongated inlets, the temperature within the cooling zone is evenly controlled to a substantial depth for effective, even quenching of the gravitating parts before they settle on the conveyor. In addition, the transversely flowing oil will carry relatively light workpieces laterally and thereby to some extent prolong the period of time required for the parts to reach the conveyor, thus prolonging effective exposure and cooling of these lighter pieces.

It will be evident that there will be a constant exchange of oil back and forth between the larger body of oil outside the baffle and that portion of the oil in the circulation system, this exchange occurring at the open bottoms of the chamber 52 and baffle 22. The temperature in the critical area of the cooling zone 21, however, is determined solely by the cooled oil flowing through the inlet ports.

The conveyor 19 is formed by an endless belt 59 trained around the upper and lower pulleys 60 and sliding along two spaced guide plates 61 and 62 which are disposed between the two runs of the belt and curve upwardly from a generally horizontal attitude below the baffle 22 to a fairly sharp incline which carries the belt out of the oil and the tank at the right-hand end of the latter. The pulleys are mounted on shafts 63 spanning and journaled in two upright side plates 64 which are shaped to follow the path of the belt and are disposed on opposite sides thereof. The belt is driven in the appropriate direction by a motor 65 (FIG. 1) driving an endless chain 66 through a reducer 67 and a sprocket 68, the chain 66 being trained around a sprocket 69 rotatable with the upper pulley 60.

As shown most clearly in FIGS. 2 and 3, the space 20 above the quench area of the oil 18 may be sealed off by the plates 27 and the upper portion 70 of the wall 43. Herein, the upper portion 70 comprises a plate of rectangular cross-section sealed both to the wall 43 and to the top wall 41 of the tank. In this manner, the controlled-atmosphere space above the tank is limited to a relatively small volume and is segregated from the area through which the conveyor protrudes.

It will be apparent that the provision of an upright, open-ended baffle within the quench tank and substantially surrounding the path of gravitation of the workpieces makes it possible to maintain a zone of even, closely-controlled temperature to a substantial depth along the path of the workpieces. With a conveyor 19 in the tank below the baffle, the workpieces are cooled at the desired, uniform rate and are removed from the tank without any attention by an operator. This is of particular importance

when used with a furnace of the type which produces a substantially continuous flow of heated workpieces which are quenched automatically as they drop from the hearth.

I claim as my invention:

1. Quenching apparatus for a controlled atmosphere furnace including, in combination, a tank for holding a body of liquid to a preselected level and having an open top, a baffle supported in said tank and having upright side walls substantially enclosing a portion of the liquid in said tank, an open upper end disposed above said level to receive workpieces from said furnace, and an open lower end spaced above the bottom of said tank for discharging workpieces into the tank after the workpieces have gravitated through the liquid in said baffle, a conveyor in said tank having a lower end portion disposed beneath said baffle to receive workpieces therefrom and an upper end portion extending upwardly out of the tank outside the baffle to carry the workpieces out of the tank, means defining first and second walled chambers on opposite sides of and adjacent said baffle and segregated from the remainder of the tank outside the baffle, the wall of said baffle adjacent said first chamber being formed with an outlet port below said level communicating with the first chamber, and the wall of said baffle adjacent said second chamber being formed with a plurality of horizontally elongated and vertically spaced inlet ports below said level and communicating with said second chamber, means defining at least one enclosed passage extending around said baffle and communicating at its opposite ends with said chambers, cooling means in said passage, an impeller in said first chamber for drawing liquid through said outlet port and forcing the liquid through said passage to be cooled and into said second chamber to flow across the interior of said baffle to said outlet port, and means for maintaning a protective atmosphere above the liquid in said baffle and said chambers.

2. Quenching apparatus for a controlled atmosphere furnace including, in combination, a tank for holding a body of quenching liquid and having an open top, an upright baffle supported in said tank and having an open upper end for receiving workpieces to be quenched from said furnace and an open lower end spaced above the bottom of said tank for discharging workpieces into the tank after the workpieces have gravitated through the liquid in said baffle, a conveyor in said tank having a lower end portion disposed beneath said baffle to receive workpieces gravitating through the baffle and an upper end portion extending upwardly out of the tank outside the baffle, means defining inlet and outlet ports in said baffle spaced apart across the latter, means defining a flow passage segregated from the liquid in the tank outside the baffle and communicating at its opposite ends with the respective ports, means for inducing a flow of liquid from the interior of said baffle and successively through said outlet port, through said passage, back to said baffle through said inlet port, and across the interior of the baffle and the path of gravitation of workpieces to said outlet port, means for cooling the liquid flowing through said passage, and means for maintaining a protective atmosphere in said tank above said baffle and segregating the protected area of the top of the tank from the area through which the upper end portion of the conveyor extends.

3. Quenching apparatus as defined in claim 2 in which the means for maintaining a protective atmosphere includes a top wall partially covering said tank and formed with an opening above the upper end of said baffle for receiving workpeces from the furnace.

4. Quenching apparatus as defined in claim 2 in which said flow passage includes first and second chambers disposed on opposite sides of said baffle and communicating respectively with said outlet port and said inlet port and with opposite ends of an intermediate passage extending around one side of said baffle to complete the flow passage.

5. Quenching apparatus as defined in claim 4 in which said flow-inducing means comprises a power-driven impeller mounted in said first chamber to force liquid therefrom through said intermediate passage to said second chamber.

6. Quenching apparatus as defined in claim 5 in which a plurality of horizontally elongated inlet ports are vertically spaced along one side of said baffle in communcation with said second chamber.

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