This invention relates generally to article handling apparatus and in particular to power-operated apparatus adapted to be installed in a production line for continuously handling shells, projectiles or the like, to be quenched during heat treatment.

Various types of devices have been used to handle the shells through the quench tank or bath, but these usually involve at least some manual operation of the device to receive and discharge the shells, respectively, from and onto the conveyors. In some systems, a shell carrier or similar device is lifted by hoist or crane to transport the shells into and out of the quench tank between the various heat treating furnaces. This tends to interrupt the continuity of the production line, slowing up production and adding to the cost of manufacture of the shells.

It is an object of the present invention to provide a power-operated shell handling apparatus which eliminates the use of hoist or crane in handling of the shells.

Another object of the invention is to provide an apparatus as above described adapted to be installed in a mass production line for the uninterrupted handling of shells and similar articles through a quench or other treatment to which they are subjected.

A further object of the invention is the provision of an apparatus as above described which insures thorough and positive quenching of the interior of the hollow shells.

Still another object of the invention is the provision of an apparatus as described comprising a vertically movable elevator frame having rotatable shell holding cages adapted to receive the shells nose-first from a delivery conveyor, lower them nose-down into the quench tank, and unload them, after being raised from the quench tank, base-first by gravity onto a discharge conveyor.

These and other objects of the invention will be apparent to those skilled in the art from a study of the following description taken with the accompanying drawings, in which:

Fig. 1 is an end elevational view taken on line 1—1 of Fig. 2 showing the shell handling apparatus in raised and lowered positions in the quench tank between two heat treating furnaces along a production line;

Fig. 2 is a side elevation view of the apparatus in lowered position in the quench tank;

Fig. 3 is a plan view of the apparatus taken on line 3—3 of Fig. 2;

Fig. 4 is an enlarged plan view of one of the shell holding cages of the apparatus taken on line 4—4 of Fig. 2, and

Fig. 5 is an enlarged sectional view through one of the shell holding cages and positioning means in the quench tank taken on line 5—5 of Fig. 4.

Referring now more in detail to the drawings, the apparatus is shown in Fig. 1 installed between two heat treating furnaces, such as a heating furnace A and a draw furnace B, only diagrammatically shown. The apparatus is mounted in the quench tank C in the building floor and comprises a main frame D which may be formed of spaced upright H-beams 6 connected together at the top by channels 8 and 10. The main or stationary frame of the apparatus is supported on the bottom of the tank in any suitable manner, such as by base plates 11, and is reinforced at the top end side thereof by gussets 12 and braced at floor level by gussets 13. A pair of spaced channels 14 is mounted across the top of the main frame D for supporting a power cylinder 16 provided with a piston rod 18 from which is suspended an elevator frame generally indicated at E. The elevator frame E comprises a pair of spaced upright H-beams 20 tied together by oppositely arranged upper and lower channels 22, 24, respectively, and braced by gussets 25. The elevator frame E may be secured to the power piston rod 18 by any suitable means such as the clevis 26 and pin 28 journalled in an attaching member 30 fixed to the top of the upper channel 22 of the elevator frame. The elevator frame is vertically movable relative to the main frame and is guided thereon by rollers 32 carried by the H-beams 20 of the elevator frame and riding against the webs of the H-beams 6 of the main frame.

A shell holding cage carrier beam 34 formed of a pair of spaced outwardly facing channels 36 suitably tied together at their ends is journalled as indicated at 38 in suitable bearings 40 provided on the inner faces of the webs of the upright H-beams 20 of the elevator frame. Secured to this beam 34 are a plurality (nine, as shown in Fig. 2) of spaced-apart shell holding cages 42 each formed of a pair of rings 44 of proper diameter such as to embrace the lower middle portion of the shells S, and oppositely arranged pairs of rollers 46 for engaging the upper middle portion of the shells. The rings are tied together by circumferentially spaced ribs 48 welded to cross plates 50 extending between the webs of opposite channels 36 of the beam 34 and bolted as indicated at 52 to the lower flange of the channels, which are reinforced at the top by gussets 54. The rollers 46 are so arranged and shaped as to conform to the contour of the surface of the upper middle portion of the shells S with which they engage when holding the shells in the cages. The rollers 46 are journalled in angles 56 having portions bolted, as indicated at 58, or otherwise suitably secured, to the upper flanges of the carrier beam channels 36.

Means are provided in the lower portion of the tank C engageable by the shell noses for keeping the shells when submerged and to insure thorough and positive quenching of the interior thereof. The shell positioning means comprising a plurality of pairs of vertically spaced rings 60 so arranged as to be in alignment with the shell holding cages 42 when lowered. These rings 60 are similar to the rings 44 of the shell holding cages 42, but are of smaller diameter such as to embrace at spaced points the lowermost or nose tip portion of the shells S when the latter are submerged to lowered position in the tank C. The rings 60 are welded or otherwise suitably secured to the inner face of the webs of and between a pair of spaced channels 62 secured to the tops of a pair of upright H-beams 64 supported on the bottom of the tank inwardly of the H-beams 6 of the main frame D. The beams 64 may be mounted in the tank C by any suitable means such as the pedestals 66, as more clearly shown in Fig. 1. Also supported by and between the upper portions of the beams 64 below the spaced channels 62 to which the pairs of rings 60 are secured, is another pair of narrowly spaced channels 68 to the inner faces of the webs of which are welded or otherwise secured nozzle guiding members 70. A quench pipe or conduit 72 extending substantially the full length of the tank C is supported at its
ends as indicated at 74, for vertical movement in the tank, on the ends of piston rods 76 working in cylinders 78, as clearly shown in Fig. 2. The cylinders 78 are mounted at opposite sides of the main frame D and connected by pipes 80 with a source of air pressure (not shown). The pistons 82 are sliding in suitable guide members 83 located on the outer surface of the webs of the H-beams 6 at opposite sides of the main frame D. The quench pipe 72 is closed at both ends and provided with upstanding quench nozzles 84 arranged to slidably extend through the nozzle guide members 83 and into the hollow noses of the shells S when lowered to submersed position. A flexible hose 86 is connected in any suitable manner as indicated at 88 to the quenching pipe 72 at one end with its other end connected to a pump P shown as located outside of the tank C for supplying quenching fluid under predetermined pressure to the pipe 72 and then through the quenching nozzles 84 to the interior of the hollow noses of the shells S, as shown in Fig. 2. The quenching pipe is provided with guiding guide member 90, the quench pipe extending through elongated slots in the webs of the H-beams 6 of the main frame 74 and the quench pipe and guide member extending through integral slots in H-beams 64 to permit vertical movement thereof, the opening in the latter being indicated at 92 in Fig. 1.

The elevator frame E is lowered into and raised from the quench tank C by the piston rod 96 working in power cylinder D. The elevator frame is connected to the cages 42 by piston rods 76, the rods being rotated thereon by a hydro or other suitable motor M mounted on top of the upper channels 22 of the elevator frame. The motor M is operatively connected to the rotatable carrier beam 94 by a drive indicated at 94 and gear wheel 96 fixed on a journaled end 100 of the carrier beam. In operation of the elevator frame, the elevator frame is initially in raised position as shown in the upper portion of Fig. 1, with the cages 42 in the full-line position as viewed therein to register with and receive a row of shells S nose first from a delivery roller conveyor F, only diagrammatically shown. The shells are moved in rows through the furnace A and discharged at intervals when heated to the required temperature onto the delivery conveyor F by any suitable means, the conveyor being downwardly inclined (about 20° from the horizontal, as shown) whereby to deliver the shells by gravity to the cages. The shells in the cages 42 are rotatably mounted on said elevator frame E whereby the shells fall by gravity base-first onto a conveyor means and into said cages simultaneously to successively receive shells nose first from said delivery conveyor means and position them successively inclined position as indicated by broken lines therein whereby the shells fall by gravity base-first onto a discharge roller conveyor G. The shells are then moved along the discharge conveyor toward the draw furnace B by any suitable means such as a ram R operated on tracks 104. The pistons 102 are sliding in the power cylinder J. The conveyors may be of any suitable type, being shown in the present instance for purposes of illustration as roller conveyors, with the discharge conveyor G supported on spaced I-beams K.

As indicated by the broken-line position of the shell and the arrows in Fig. 1, the shell-holding cages 42 are rotatable counter-clockwise from the full-line shell receiving position through approximately 200° to the reverse inclined shell unloading position. The cages are then rotated clockwise by the reversible motor M after unloading the shells at the end of each quenching operation back to the initial position shown in full lines to receive another row of shells to be quenched. When in the shell receiving position, the cages are inclined at approximately an angle of 20° from the horizontal in line with the downwardly inclined delivery conveyor F from which the shells are received nose-first by gravity. Since the cages are rotatable through approximately 200°, as noted above, it will be seen that they will be inclined at about an angle of 40° from the horizontal when in the reverse tilted base-first shell unloading position. This insures quick unloading of the shells from the cages by gravity to the draw furnace B, after the cages are lowered onto the discharge conveyor G at the completion of each quenching cycle. Unloading of the shells from the cages, as well as delivery thereto from the delivery conveyor F, is also facilitated by the rollers 46 which, in addition to the continuity provided by the apparatus in handling the shells, further speeds up movement thereof and the full-line movement of the apparatus in the quenching treatment. The cylinders 46, motor M, cylinders 78 and ram cylinder J are energized from a conveniently located control panel (not shown), providing centralized and coordinated control of the various mechanisms comprising the entire apparatus.

The invention may be modified in various respects as will occur to those skilled in the art, and the exclusive use of all such modifications that come within the scope of the appended claims is contemplated.

What is claimed is:

1. In an apparatus for handling shells and like articles to be lowered to and raised from a position where they are subjected to a treatment, in combination with delivery and discharge conveyor means, a stationary frame between said conveyor means, a vertically movable elevator frame supported by said stationary frame, open-ended cages adapted to receive and hold shells at the waist portion thereof rotatably mounted on said elevator frame, a bumper bar on the side of said stationary frame opposite the delivery conveyor means, means for lowering and raising said elevator frame to and from said treatment position, and means for rotating said cages simultaneously to receive shells nose-first from said delivery conveyor means against said bumper bar, said rotating means being operable to position the shells vertically downward for lowering to treatment position and swing them after being raised from said position to a reverse base-first tilted position whereby the same are unloaded by gravity onto said discharge conveyor means.

2. In an apparatus for handling shells and the like to be lowered to and raised from a position where they are quenched incident to heat treatment, in combination with shell delivery and discharge conveyor means, a stationary frame between said conveyor means, a vertically movable elevator frame supported by said stationary frame, shell-holding cages rotatably carried on said elevator frame, means for lowering and raising said elevator frame to and from shell quenching position, means for rotating said cages simultaneously to successively receive shells nose-first from said delivery conveyor means and position them
5 vertically with nose downward for lowering to quenching position, and means engageable by the shells when lowered to retain the same in position during quenching, said cage rotating means being operable to swing the shells after being raised from quenching position to a reverse base-first tilted position whereby the same are unloaded by gravity onto said discharge conveyor means.

3. In an apparatus for handling shells and like articles for lowering to and raising from a quench tank in the process of heat treatment, in combination with delivery and discharge conveyor means, a stationary frame mounted in the tank and extending upwardly between said conveyor means, a vertically movable elevator frame supported by said stationary frame, a beam journaled on said elevator frame, shell holding cages carried by said beam, means for lowering and raising said elevator frame into and out of the quench tank, means for rotating said beam to swing said cages simultaneously to sequentially receive shells nose-first from said delivery conveyor means and position them vertically with nose downward for lowering into the quench tank, and means adapted to be engaged by the nose of the shells to position the shells in the quench tank, said cage rotating means being operable to swing the shells after being raised from the quench tank to a reverse base-first tilted position whereby the same are unloaded from said cages by gravity onto said discharge conveyor means.

4. In an apparatus for handling shells and the like to be lowered to and raised from a position where they are subjected to a quench treatment, delivery and discharge conveyor means, a quench tank below said conveyor means, a stationary frame extending upwardly from the tank between said conveyor means, a vertically movable elevator frame supported by said stationary frame, shell holding cages rotatably carried by said elevator frame, means for lowering and raising said elevator frame into and out of the quench tank, means for rotating said cages to sequentially receive shells in a nose-first position from said delivery conveyor means and position them nose-downward for lowering into the quench tank, shell positioning means in the quench tank, and means for positively quenching the interior of the shells while positioned in the quench tank, said cage rotating means being operable to swing the shells after being raised from said quench tank to a reverse base-first tilted position whereby the same are unloaded from said cages by gravity onto said discharge conveyor means.

5. In a system for handling shells and similar hollow-nosed articles to be lowered and raised into and out of a quench tank, shell delivery and discharge conveyor means, a stationary frame extending upwardly from the tank between said conveyor means, a vertically movable elevator frame supported by said stationary frame, shell holding cages rotatably carried by said elevator frame, means for lowering and raising said elevator frame into and out of the quench tank, means for rotating said cages to receive shells in a nose-first position from said delivery conveyor means and turn them to a nose-downward position for lowering into the quench tank, vertically movable quench nozzles in the quench tank, and means for raising and lowering said nozzles into and out of the hollow noses of the shells whereby to positively quench the latter, said cage rotating means being operable to swing the shells after being raised from the quench tank to a reverse base-first tilted position whereby the same are unloaded from said cages by gravity onto said discharge conveyor means.

6. In a system for lowering and raising shells or similar hollow-nosed articles into and out of a quench tank during heat treatment, shell delivery and discharge conveyor means, a stationary frame extending upwardly from the tank between said conveyor means, a vertically movable elevator frame supported by said stationary frame, shell holding cages rotatably carried by said elevator frame, means for lowering and raising said elevator frame into and out of the quench tank, means for rotating said cages to receive shells in a nose-first position from said delivery conveyor means and swing them to a nose-down position for lowering into the quench tank, a horizontally extending vertically movable manifold in the quench tank, quench nozzles on said manifold, means for raising and lowering said manifold to move said nozzles up and down into and out of the hollow noses of the shells to positively quench the latter, and means for guiding the quench nozzles in their up and down movement, said cage rotating means being operable to swing the shells after being raised from the quench tank to a reverse base-first tilted position whereby the same are unloaded from said cages by gravity onto said discharge conveyor means.

7. An apparatus for handling a shell or like article to be lowered to and raised from a position where it is subjected to a treatment, including a stationary frame, a vertically movable elevator frame supported by said stationary frame, a shell holding cage rotatably carried by and on the stationary frame, for lowering and raising said elevator frame to and from shell treating position, said cage comprising spaced rings of varying diameter and anti-friction elements conforming to the contour of the shell, and means for rotat- ing said shell holding cage to sequentially receive a shell in nose-first position from a delivery conveyor means, position it vertically with nose down for lowering to treatment position, and swing the shell after being raised from said treatment position to a reverse tilted base-first position whereby the same is unloaded by gravity onto a discharge conveyor means.

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