Die quenching apparatus having means operable to move a workpiece receiving portion of the machine to an unhindered position outside the machine frame to permit a hot heat-treated workpiece to be easily and quickly loaded into the machine; the machine further having means for rapidly flooding a quenching chamber with highly agitated quenching fluid.

**Background of the invention**

This invention relates to a new improved die quenching apparatus or machine. The invention particularly relates to a die quenching machine for holding and quenching crankshafts or similar workpieces, after they have been heated, so that they may be hardened without distortion.

The invention has specific application to a quenching machine of the type used in a hardening process in which the workpiece is first heated in a furnace to the required temperature and is then placed in the quenching machine to be held against distortion while a suitable quenching fluid is flowed over the workpiece to harden and cool it.

In conventional prior art forms of quenching apparatus, a lower die element is mounted directly beneath and in line with an upper die, and in order to put a hot blank into the press or to remove a hardened workpiece therefrom, it is necessary for the operator to reach over the lower portion of the machine and into the limited and relatively crowded space between the upper and lower dies. This is often awkward and therefore difficult and tiring. In addition, the workpieces are allowed further time in which to cool after being removed from the furnace which is undesirable. Furthermore, the entire operating cycle of the machine is slowed down.

One of the primary objects of the present invention is to provide a disengaging machine in which positioning and removal of the workpiece may be performed easily and quickly by the operator of the machine.

Another object of the invention is to provide a quenching machine on which the work may not only be quickly positioned but also accurately held within the machine so that the workpiece will remain true during the quenching operation.

A further object of the invention is to provide a quenching machine in which the workpiece is moved from a loading position to a quenching position automatically prior to the quenching operation and from an operating position to a loading position automatically after the quenching operation is completed.

Other objects of the present invention will be apparent from the following description and claims and are illustrated in the accompanying drawings which, by way of illustration, show preferred embodiments of the present invention and the principles thereof and what are now considered to be the best modes contemplated for applying these principles. Other embodiments of the invention, embodying the same or equivalent principles may be used and structural changes may be made as desired by those skilled in the art without departing from the present invention and the purview of the appended claims.

**Brief description of the drawings**

FIG. 1 is a front elevation of an exemplary embodiment of a die quenching machine constructed in accordance with the present invention;

FIG. 2 is a rear schematic view of the die quenching machine of the present invention having parts thereof partially in section;

FIG. 3 is a cross-sectional view taken on the line III-III of FIG. 2;

FIG. 4 is a sectional view taken on the line IV-IV of FIG. 2 and

FIG. 5 is a diagrammatic view of a hydraulic circuit for supplying quenching fluid to the die quenching machine of the present invention.

**Description of the preferred embodiment**

Referring now to the drawing, the quenching machine of the present invention is shown generally at 10. The machine 10 has a main frame 12 which is surrounded at its base by a large outer tank 14. An upper plate member 16 is attached underneath an upper cross-piece 17 of the main frame 12.

As best shown in FIG. 4, the upper plate 16 is provided with a hollow cavity 18 for receiving a suitable quenching fluid. An upper die block 20 is attached to the lower surface of the upper plate 16 and the upper die block is also provided with a hollow cavity 22 which communicates with a hollow cavity 18 of the upper plate 16 by means of a large aperture 24. The upper plate 16 and the upper die block 20 are adapted to be actuated upwardly and downwardly by means of large double acting jacks 26 which are received inside the main frame 12 (see FIG. 2). The rod end 28 of the jacks 26 may be attached to the upper plate 16 by any suitable means. Also, as shown in FIG. 1 a pair of conventional guide posts 29 are provided for insuring accurate vertical travel of the upper plate 16.

In FIGS. 1 and 3, it will be observed that three parallel arms 30, 32 and 34 extend downwardly from pivot pin connections 36 on the upper cross-piece 17 at each side of the machine. As best shown in FIG. 3, the lower ends of each set of parallel arms 30, 32 and 34 are pivotally connected at 38 to the outside ends of an inner quench tank 40. The inner quench tank 40 is movable onto and off of a compartmentalized base assembly 42.

The outer arms 30 and 34 of each three arm set are identical in structure and each comprises an upper arm portion 44 and a lower arm portion 46. The arm portions 44 and 46 are connected to each other by a turnbuckle assembly 48. An enlarged head portion 50 of upper turnbuckle rod 51 is slidably received in a cavity 52 formed in the upper arm portion 44. The enlarged head 50 is normally biased upwardly against the top of cavity 52 by the action of a very strong coil spring 54. Thus, the action of coil springs 54 will normally raise the inner quench tank 40 upwardly off of the base assembly 42 unless the bias of coil springs 54 is overridden by some other means. The turnbuckle assembly 48 provides an adjustment feature for determining the height at which inner tank 40 will be raised above the base assembly 42 under the action of coil springs 54.

The middle arm 32 of each three arm set is provided with an extensible double-acting hydraulic jack 55 which is operable to overcome the bias of coil springs 54 and force the inner quench tank 40 downwardly in firm engagement with the base assembly 42 as shown in FIG. 3.

As best shown in FIG. 4 a lower plate 60 is located inside the quench tank 40 and is provided with an enlarged open-ended aperture 62 which during a quenching operation is positioned directly above an aperture 64.
formed in the top of base assembly 42. A lower die block 66 is mounted on the upper surface of lower platens 60 and is provided with a hollow cavity 68 which communicates with the aperture 62 formed in the lower platen.

As shown in Fig. 4, the face portions 70 of the upper and lower die blocks are provided with a plurality of small holes 71 which communicate with the cavities of each of the die blocks to transmit a spray of quenching fluid about a workpiece 72, such as a crankshaft, which is held between the dies during a quenching operation.

For condensing and unloading heavy parts which are quenched in the die quenching machine, means are provided for moving the inner quench tank 40 which houses the lower platen and die block to the position shown in phantom outline in Fig. 3.

As shown in Figs. 2 and 4, a double-acting ram 76 is securely fastened at its cylinder end 78 to the cross piece 17 of the quenching machine frame structure 12. The rod end of the ram 80 is provided with a plurality of rack teeth 82 which function to rotate a pinion 84 in either a clockwise or counterclockwise direction in response to upward or downward movement of the ram rod 80. The pinion 84 is secured on a long shaft 86 which runs lengthwise of the back end of the machine.

As best shown in Fig. 3, each end portion of the shaft 86 is provided with a pinion gear 88. Each pinion 88 engages a toothed rack member 90 which has a rod end 92 pivotally connected at 94. One of the arms 30 of each set of parallel arms. At this juncture it should be observed that the rack 90 is contained in a housing 94 which is pivoted about the center of shaft 86. Thus when the hold down jack 55 of middle arm 32 is released and the quench tank 40 and related components have moved upwardly under the bias of springs 54, the shaft 86 may be rotated in a clockwise direction to move the entire quench tank 40 containing the lower platen and die assembly to the phantom line position shown in Fig. 3 for easy loading or unloading of a workpiece such as 72. Counterclockwise rotation of shaft 86 swings the parallel arms and quench tank back under the machine frame until the tank contacts an upstanding stop block 95. After contacting the stop block 95, the jacks 55 are actuated to lower the quench tank 40 into proper position on the base assembly 42.

Referring now to Figs. 2, 3 and 4, the base assembly 42 is divided into four separate compartments 98, 100, 102 and 104. These compartments extend longitudinally across the base of the machine and each end of each compartment is provided with a tube such as shown at 105 for supplying a quenching fluid to the compartments from an accumulator and pumping system which system will be described in greater detail at a later point in the specification.

It will be noted that each of the compartments 98, 100, 102 and 104 is provided with a common bottom wall portion 106 which slopes upwardly from the outer end portions of the compartments to an apex 108 near the center of the machine. This upward slope or taper on the member 106 helps insure uniform fluid pressure throughout the length of the machine.

As best shown in Figs. 2 and 4 the compartment 98 supplies quenching fluid to bores 109 formed in the top plate of base assembly 42. The bores 109 allow the quenching fluid to pass into the lower portion 110 of a telescoping tubular assembly 112 which assembly is provided with a manifold 114 which communicates the quenching fluid to the hollow cavity 18 formed in the upper platen 16.

As shown in Fig. 4, the compartments 100 and 104 supply quenching fluid to the inner quench tank 40 through passageways 116 and 118, respectively. Compartment 102 supplies quenching fluid to the cavity 68 of the lower die 66 by way of passage 62 in the lower platen and passage 64 formed in the upper plate of the base assembly 42.

As shown in Fig. 5, a fluid source system comprising an accumulator 127, pumps 131 and 135, interconnecting conduits 126, 137 and 138 and twoway valves 139, 141 and 143 is provided to insure adequate quenching fluid in the upper die cavity 22, lower die cavity 68 and inner tank 40. The twoway valves 139, 141 and 143 are all located down stream of the branch conduit 137. A fluid conduit 125 is connected at one end to the compartments 100 and 104 leading to the inner tank 40 and at the other end to the twoway valve 139. A conduit 129 is connected at one end to the compartment 102 which leads to the lower die cavity 68 and at its other end to a twoway valve 141. Similarly, a conduit 133 is connected between a compartment 98 leading to a telescoping tubular assembly 112 which leads to the upper platen 16 and subsequently to the upper die cavity 22 on one end and a twoway valve 143 at the other end.

In a typical operation of the die quenching machine, a workpiece 72 to be quenched such as a crankshaft, is received in the lower die 66 when the upper platen 16 is in its raised position and the entire lower die, platen and inner tank assembly has been moved by actuation of the parallel arm sets 30, 32 and 34 to the phantom line position shown in Fig. 3. After the workpiece has been received in the lower die block, the parallel arms are actuated to move the lower die assembly to the full line position shown in Fig. 3. The upper platen is then lowered to the position shown in Fig. 4 so that the workpiece is firmly held between the upper die block 20 and the lower die block 66.

Quenching of the workpiece 72 is then initiated by actuating the pumps 131 and 135 which serve to spray fluid under high pressure through the small holes 71 in the upper and lower die faces 70, and nearly simultaneously therewith the inner tank 40 is quickly filled with highly agitated water supplied from the fluid source system when valve 139 is opened. Upon completion of the quenching operation, the twoway valve 139 is closed and quenching continues for a short time in the upper and lower dies. After the quenching is completed, the valves 141 and 143 are closed and the pumps 131 and 135 are actuated to recharge the accumulator 127 by way of the branch conduit 137. While we have illustrated and described the preferred embodiments of our invention, it is to be understood that these are capable of variation and modification, and we therefore do not wish to be limited to the precise details set forth, but desire to avail ourselves of such changes and alterations as fall within the purview of the following claims.

What is claimed is:
1. Die quenching apparatus comprising: a main frame; upper and lower normally opposed platens equipped with die blocks and mounted for relative vertical movement upon said frame; movable means on said frame for moving said lower platen from an operative position in vertical alignment with said upper platen to a laterally offset position out of alignment therewith to facilitate easy loading and unloading of a workpiece with respect to said lower platen, said movable means comprising a set of parallel arms at each end of said main frame, each set of arms having first end portions pivotally connected to the upper portion of said frame and second end portions pivotally connected to said lower platen.
2. Die quenching apparatus as set forth in claim 1 wherein motor driven extensible rod means are provided on said frame for moving said parallel arms and said lower platen into and out of alignment with said upper platen.
3. Die quenching apparatus as set forth in claim 2 wherein said extensible rod means comprises a rod element at each end of said main frame, means mounting
said rod element for reciprocal movement in a generally horizontal plane, a first end of said rod having a pivotal connection with one set of said parallel arms, a second portion of said rod having rack teeth formed thereon. said rack teeth engaging a pinion gear mounted on a rotatable shaft, whereby clockwise rotation of said pinion gear moves said rod in a first direction and counterclockwise rotation of said pinion gear moves said rod in a second direction.

4. Die quenching apparatus as set forth in claim 1 wherein said main frame is provided with a base assembly for supporting said lower platen during a die quenching operation and each set of parallel arms are longitudinally extendible and retractable to selectively move said lower platen vertically onto and off of said base assembly.

5. Die quenching apparatus as set forth in claim 4 wherein each set of parallel arms comprises three arm members, the outer two arms having spring biasing means for normally urging the lower ends of these two arms vertically upwardly away from said base assembly, said third arm located intermediate said two outer arms and having motor means mounted thereon for overriding the biasing force of the spring elements associated with said two outer arms to selectively extend said arm members and the lower platen connected thereto downwardly onto said base assembly.

6. Die quenching apparatus as set forth in claim 1 wherein both said upper and lower die blocks have small holes formed in the faces thereof, said holes communicating with an internal cavity formed in each of said die blocks, each of said upper and lower platens associated with said die blocks also having an internal cavity formed therein and communicating with the internal cavity formed in its associated die block, a tank surrounding said lower platen and lower die block and having side walls which extend upwardly around said upper die block when the upper die block is lower to engage a workpiece supported by said lower die block, pump means for supplying quenching fluid under pressure to the cavities of both said upper and lower dies to transmit a high velocity spray of quenching fluid through the holes formed in said die blocks, and an accumulator for supplying a high volume of fluid both to the cavities of said upper and lower dies, and to said tank to quickly flood the tank and surround the workpiece held in said die blocks with highly agitated quenching fluid.

7. Die quenching apparatus as set forth in claim 6 wherein motor driven extendible rod means are provided on said frame for moving said parallel arms and said lower platen into and out of alignment with said upper platen.

8. Die quenching apparatus as set forth in claim 7 wherein said extendible rod means comprises a rod element at each of said main frame, means mounting said rod elements for reciprocal movement in a generally horizontal plane, a first end of said rod having a pivotal connection with one of said parallel arms, a second portion of said rod having rack teeth formed thereon, said rack teeth engaging a pinion gear mounted on a rotatable shaft, whereby clockwise rotation of said pinion gear moves said rod in a first direction and counterclockwise rotation of said pinion gear moves said rod in a second direction.

9. Die quenching apparatus as set forth in claim 8 wherein said main frame is provided with a base assembly for supporting said lower platen during a die quenching operation and each set of parallel arms are longitudinally extendible and retractable to selectively move said lower platen vertically onto and off of said base assembly.

References Cited

UNITED STATES PATENTS

492,259 2/1893 Barrett 100—229 XR
2,183,951 12/1939 Anderson 100—229 XR
2,678,656 5/1954 Palmer 134—141 XR
3,353,478 11/1967 Hopkins 100—229 XR

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