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QUENCHING PRESS WITH WORK HANDLING MECHANISM

Filed March 18, 1955

3 Sheets-Sheet 1

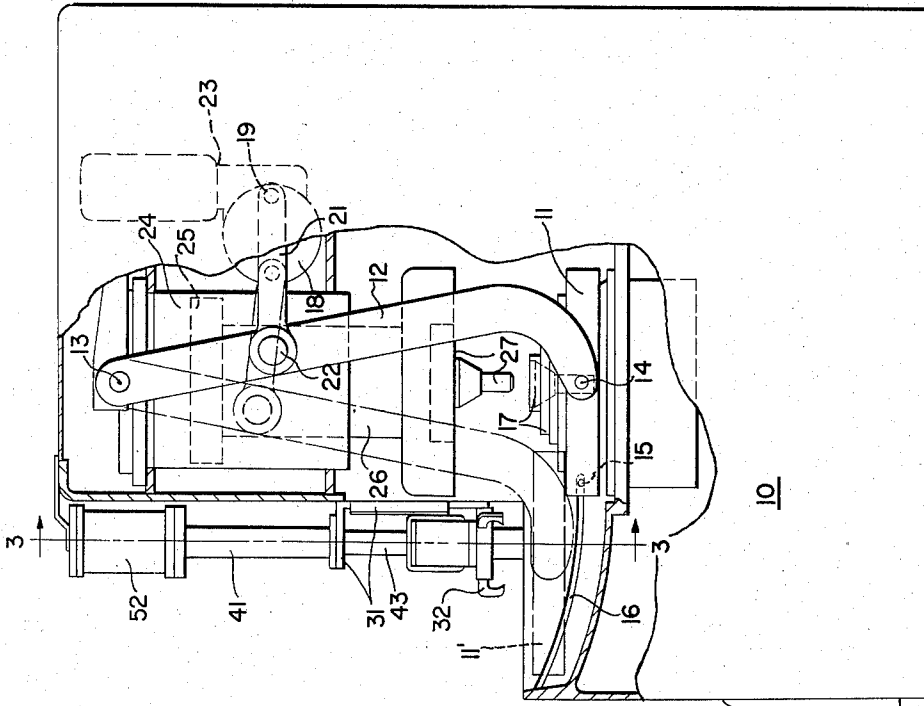


FIG. 2

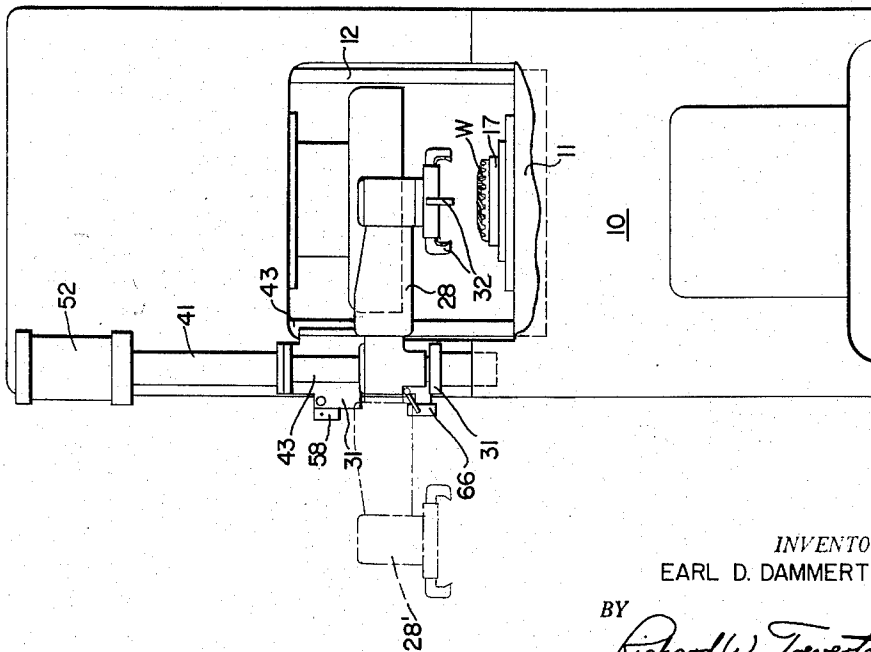


FIG. 1

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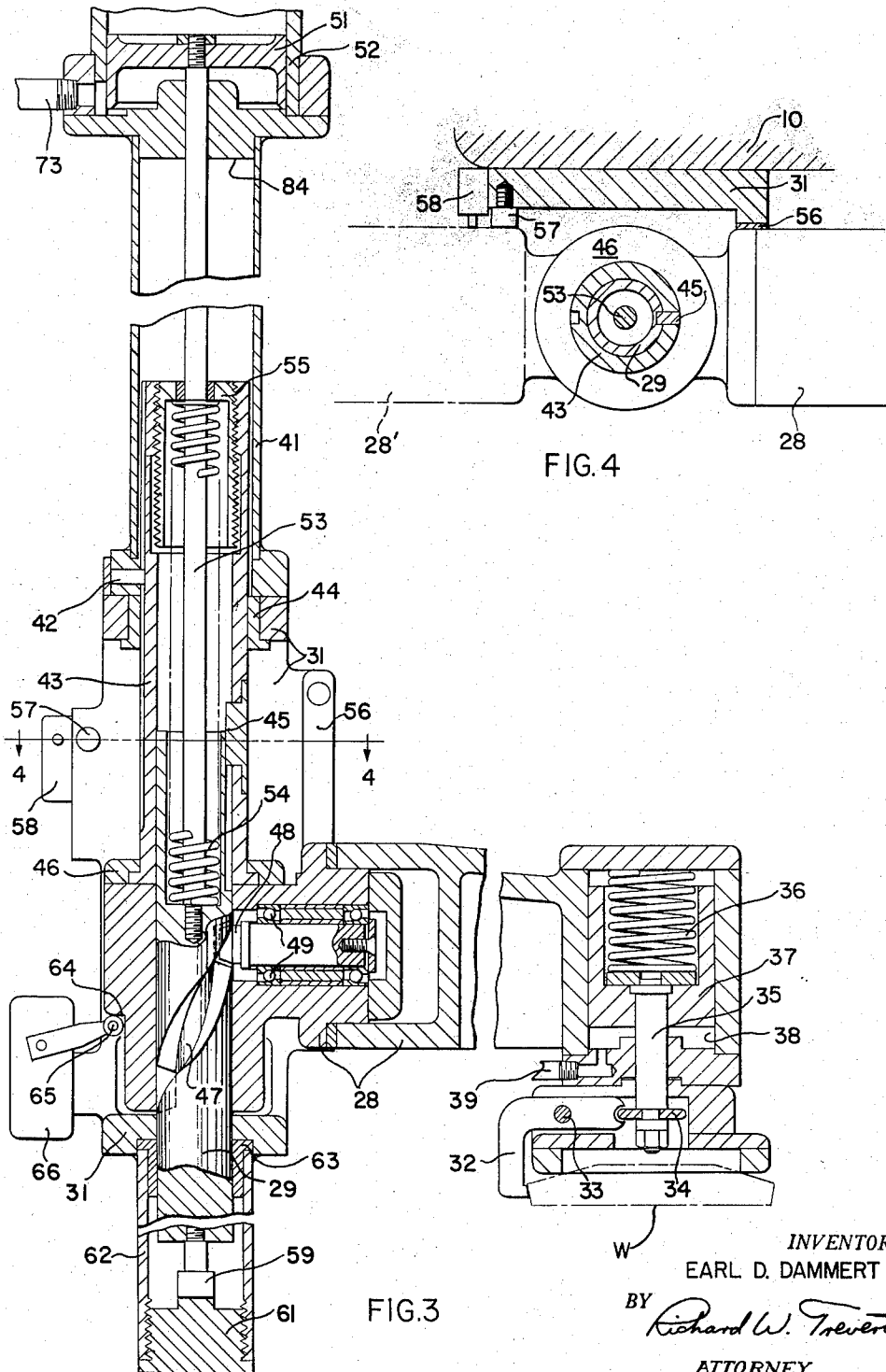
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3 Sheets-Sheet 2



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3 Sheets-Sheet 3

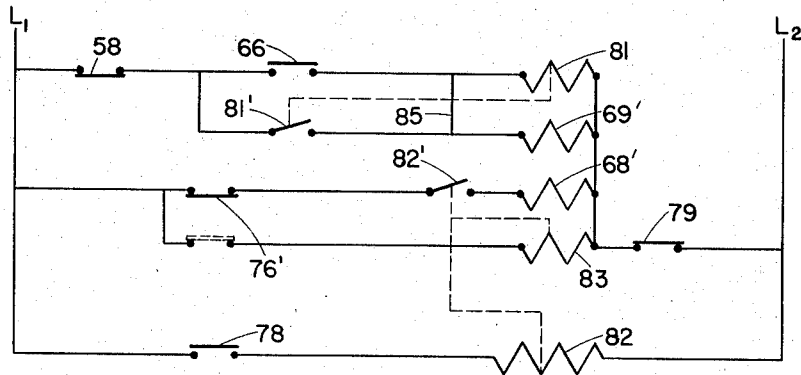


FIG. 5

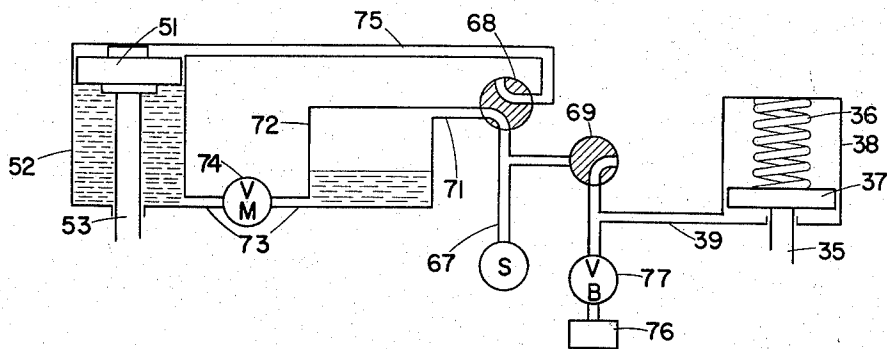


FIG. 6

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QUENCHING PRESS WITH WORK HANDLING MECHANISM

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6 Claims. (Cl. 214—1)

The present invention relates to an improved work handling device adapted especially, but not exclusively, for operation in combination with a quenching press, such for example as that disclosed in Patent No. 2,494,984, granted January 17, 1950 to O. F. Bauer.

The work handling device is adapted to remove workpieces from such a press, preferably automatically, so that there remains for the press operator only the tasks of reloading the press and restarting its operating cycle. The novel features of the invention, which are defined by the appended claims, will be understood from the following description of the preferred embodiment shown in the accompanying drawings, wherein:

Figs. 1 and 2 are respectively a front elevation and a side elevation partly in section, of a press equipped with the unloader;

Fig. 3 is a vertical sectional view through the unloader, in the plane designated 3—3 in Fig. 2;

Fig. 4 is a detail horizontal section in the plane 4—4 of Fig. 3; and

Figs. 5 and 6 are respectively a wiring diagram and a diagram of an air and hydraulic system for the unloader.

As shown in Figs. 1 and 2, the quenching press comprises a frame 10 on which a work support 11 is mounted for movement between a work station, in which the support appears in full lines, and a loading station in which it appears in broken lines at 11'. The work support is carried by a pair of links 12 which are pivoted to the frame at 13 and to the support at 14, and by guide rollers 15 which ride in arcuate guideways 16 on the frame. On the support is mounted a multi-part lower die 17 for seating the workpiece W, in this case a bevel ring gear. The links 12 are oscillated about pivots 13, to carry the work support between its work station and loading station, by means of a crank 18. The crank pin, 19, is connected to one link 12 by a pitman 21; the connection between the pitman and the link comprising a pivot pin 22. The crank is rotated by a motor and reduction gear unit 23.

Also supported on the frame 10 is a cylinder 24 in which a piston 25 is reciprocable, the piston being a part of a ram 26 to which is secured a multi-part upper die 27. The ram, which is raised and lowered by fluid pressure applied to the bottom and top of the piston, is aligned with the work support 11 when the latter is at its work station. The ram is lowered to clamp a workpiece between the upper and lower dies. The press includes means, not shown, for causing a flow of quench fluid over a workpiece while the latter is so clamped.

The press further includes control means for operating the motor of unit 23, for applying fluid pressure to the piston 25, raising and lowering the ram 26, and for controlling the flow of quench fluid. These control means, which preferably are of the type disclosed in aforementioned Patent No. 2,494,984, are not a part of the present invention, and hence they are not illustrated herein.

The unloader of the present invention comprises an arm 28 supported on a cylindrical cam 29 for swinging

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motion thereabout in a horizontal plane, and also for limited vertical sliding motion thereon.

A plurality of work-gripping jaws 32 are pivoted by pins 33 to the distal end of the arm. The inner ends of the jaws are bifurcated to straddle a collar 34 on a piston rod 35 which is urged downwardly relative to the arm by a spring 36. Cam 29 is slidable in a stationary support in the form of a U-shaped bracket 31 that is rigidly secured to the frame. A piston 37, reciprocable in a cylinder 38 provided in the arm, is adapted to move the rod 35 upwardly against the resistance of spring 36. The arrangement is such that when fluid pressure is applied through conduit 39 to the bottom chamber of the cylinder the piston 37 is raised against the resistance of spring 36 to close the jaws 32 for causing them to grasp a workpiece. When this fluid pressure is released the spring lowers the rod 35 and thereby opens the jaws, releasing the workpiece.

Secured to the upper flange of U-shaped bracket 31 is the lower flange of a tube 41, the latter supporting a key 42 that is seated in a longitudinal keyway in a sleeve 43 which is slidable in a bushing 44 in the upper flange of the bracket. The cylindrical cam 29 is slidable vertically in the sleeve; but is held against rotation relative thereto by a key 45 which projects from the sleeve into a longitudinal keyway in the cam. The arm 28 is rotatable relative to the sleeve, and is connected thereto for vertical motion by a ring-shaped gib 46 which confines an annular flange formed on the lower end of the sleeve 43. The cam has a helical cam groove formation 47 in which rides a cam follower roller 48 that is journaled on anti-friction bearings 49 in the arm 28. The cam and roller together constitute a screw connection between the member 29 and the arm member 28, which screw connection is of a sufficiently large lead angle that relative rectilinear motion between these members will effect a relative swinging or angular motion between them.

For effecting vertical motion of cam 29 there is provided a piston 51 that is reciprocable vertically in a cylinder 52 supported upon the tube 41, the piston being connected to part 29 by a piston rod 53. For the purpose of constantly urging the sleeve 43 and arm 28 upwardly relative to cam 29 a coiled spring 54 is provided. This spring extends into a bore in the upper end of cam 29 and is compressed between the latter and a plug 55 which is screw-threaded to the upper end of sleeve 43.

Swinging of the arm 28 in a counterclockwise direction (in Fig. 4) is limited by the arm abutting a stop plate 56 on the bracket 31. In the limit position of the arm the jaws 32 are vertically aligned with a workpiece on the support 11 at the loading station. Swinging of the arm in the opposite direction, to its broken line position 28' in Figs. 1 and 4, is limited by a stop button 57 on the bracket. In this limit position the arm also abuts the actuating stem of a normally closed limit switch 58 that is mounted on the bracket, thereby opening the switch. Downward motion of the cam 29 is limited by abutment of a stop 59 on its lower end with a plug 61 that is secured to the bottom of a tubular part 62 which depends from the lower flange of bracket 31. As shown, a bushing 63 slidably engaged by the cam 29 is supported by this tubular part 62. When in its lower limit position shown in Fig. 3, a shoulder 64 on the arm 28 abuts a roller 65 on the actuating arm of a normally open limit switch 66 supported on the bracket, and thereby closes this switch.

Other apparatus for controlling the unloading mechanism is shown diagrammatically in Figs. 5 and 6. It comprises a conduit 67 leading from a source S of compressed air to a two-position solenoid-and-spring operated valve 68 and having a branch leading to another sole-

noid-and-spring operated valve 69, a conduit 71 extending between valve 68 and the upper end of a tank 72 containing air and hydraulic fluid, and a conduit 73 extending from the lower end of the tank to the lower end of cylinder 52, this conduit containing a metering valve 74.

The control apparatus further comprises an air conduit 75 extending between the upper end of cylinder 52 and valve 68, an air-and-spring actuated switch 76 connected to the air conduit 39 which extends between the valve 69 and the bottom of cylinder 38, and an air bleed valve 77 in air line 39 upstream from valve 76. Valve 76 is of a conventional type having a movable contact 76' which is held by a spring in its full line position in Fig. 5 and is moved to its broken line position when the air pressure applied to the switch unit reaches a predetermined value. Valve 68 is normally held by its spring in the position shown in Fig. 6 wherein conduits 67 and 71 are in communication and conduit 75 is open to the atmosphere, but when its solenoid 68' is energized it is shifted to vent conduit 71 to the atmosphere and place conduit 67 in communication with conduit 75. Valve 69 is also normally held by its spring in the position shown in Fig. 6 wherein it vents conduit 39 to the atmosphere, and when its solenoid 69' is energized it is shifted to connect conduit 39 to air pressure conduit 67.

The control apparatus still further includes a normally open limit switch 78 which is controlled by the ram 26, being closed only when the latter is lowered; a normally open limit switch 79 which is controlled by work support 11 of the press, being closed only when the support is in its loading position 11', Fig. 2; a relay having a winding 81 and a movable contact 82 which is closed only when the winding is energized; and a relay having windings 82 and 83 and a movable contact 82'. The latter contact is closed upon energization of winding 82, opened upon energization of winding 83.

The electrical apparatus described is connected in the circuit arrangement shown in Fig. 5 across leads L_1 and L_2 which extend to a suitable source of electrical energy.

In the idle condition of the press the ram 26 is raised and the unloader arm is raised and in its unloading position 28'. Accordingly switch 79 is closed and switch 58 is open. Solenoids 68' and 69' are deenergized and hence the fluid control system is in the condition shown in Fig. 6, wherein piston 51 is held raised by hydraulic fluid from tank 72 which is being subjected to air pressure from source S, and wherein conduit 39 is opened to the atmosphere so that spring 36 holds jaws 32 open.

In this position of the loader arm the upper end of sleeve 43 is in abutment with the bottom surface 84 of the cylinder assembly 52 and the spring 54 is compressed by the cam 29 being raised relative to the sleeve as compared with the position shown in Fig. 3.

In operation, the press operator loads a heated workpiece W on the lower die 17 and presses a start switch to cause the press to operate through its normal cycle described hereinbefore, during which the motor unit 23 turns the crank 18 through 180° to thereby move the work support 11 into its work position. This allows switch 79 to open. The ram 26 lowers, closing switch 78 and thereby energizing relay winding 82. This causes contact 82' to close, which however has no immediate effect since switch 79 is open. The quenching operation takes place, and the ram 26 is then raised, allowing switch 78 to open and so deenergizing winding 82, and the work support moves out to its loading position 11'. This closes switch 79 and thereby establishes a circuit from L_1 to L_2 through pressure switch contact 76' (in its full line position in Fig. 5), now closed relay contact 82' and solenoid 68'.

When solenoid 68' is thus energized it moves valve 68 to vent conduit 71 to the atmosphere and connects conduit 75 to pressure line 67. Hence air pressure is

applied to the upper side of piston 51, lowering it as rapidly as hydraulic fluid can be displaced through metering valve 74 into tank 72. During the first part of the down-motion of the piston and cam 29, the compressed spring 54 holds the sleeve 43 and arm 28 in their raised position where the sleeve abuts surface 84 of the bottom head of cylinder 52. Since keys 42 and 45 prevent any rotation of the cam 29, the helical cam groove 47 and follower roller 48 coast during the initial down-motion of the cam to swing the arm 28 to its full line position in Figs. 1 and 4, wherein the jaws 32 are aligned vertically with the workpiece. As soon as the arm starts to swing away from stop 57 the switch 58 resumes its normal closed position. When the swing motion is arrested by the abutment of the arm with stop plate 56, the arm 28 and sleeve 43 are forced to move as a unit with the piston 51 and cam 29 during the continued down-motion of the latter which terminates when stop 59 abuts plug 61. At this time the jaws 32 encircle the workpiece as shown in Fig. 3, and the switch 66 is closed.

Closing of switch 66 establishes a circuit from L_1 to L_2 through now closed switch 58 and relay winding 81 and, by reason of cross-connection 85, also a circuit through valve solenoid 69'. The results are that relay contact 81' is closed and valve 69 is moved to connect conduit 39 to pressure line 67. This causes the piston 37 to be moved upwardly against the resistance of spring 36, thereby closing the jaws 32 upon the workpiece. With a very slight delay, due to the restriction of bleed valve 77, the air pressure shifts contact 76' of valve 76 to its dotted line position in Fig. 5. This opens the circuit through solenoid 68', resulting in valve 68 returning to the position thereof shown in Fig. 6, and closes the circuit through relay winding 83, causing relay contact 82' to open. Air pressure from line 67 now acts on the liquid in tank 72, forcing it into the bottom chamber of cylinder 52, and thereby raising piston 51 as rapidly as permitted by the limited flow past metering valve 74. Air above piston 51 is discharged through conduit 75 and valve 68 into the atmosphere.

As the piston 51 and cam member 29 move upwardly, the spring 54, by urging upward motion of the sleeve 43 and arm 28 relative to the sleeve, acts through the cam and cam follower connection 47, 48, to hold the arm against stop plate 56. Accordingly the arm moves upwardly as a unit with the piston and cam until the sleeve abuts surface 84. At this time the arm, carrying the workpiece in its now closed jaws 32, is in the position shown in full lines in Fig. 1. Continued upward motion of the piston compresses spring 54 and, by relative vertical motion between the cam and cam follower roller, swings the arm clockwise in Fig. 4 to the broken line position 28' in Figs. 1 and 4.

At the initiation of the upward motion of arm 28 the normally open switch 66 is allowed to open, but this has no immediate effect since the now closed contact 81' maintains the circuit through relay winding 81 and solenoid 69'. However when arm 28 abuts stop 57 it also opens normally closed switch 58, thereby deenergizing both winding 81 and solenoid 69'. This opens relay contact 81' and also allows valve 69 to cut off conduit 39 from the pressure line 67 and vent it to the atmosphere. Accordingly spring 36 opens jaws 32 and the workpiece drops, preferably into a tote box or conveyor, not shown, at the left side of the press (in Fig. 1), and the switch contact 76' returns to its full line position, Fig. 5.

It will be understood that the sequence of operations described above will be repeated automatically at the conclusion of each operating cycle of the press. It will be understood further that the foregoing disclosure of the preferred embodiment of the invention is made by way of example and illustration of the inventive principle involved, and not by way of limitation, and that these

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principles may be incorporated in other physical forms without departing from the spirit of the invention or from the scope of the appended claims.

What is claimed is:

1. A quenching press for gears and the like, comprising a frame, a work support for holding a workpiece at a loading station, a workpiece-carrying arm mounted on the frame for swinging motion about a substantially vertical axis, to carry a workpiece from said loading station to an unloading station, and also for reciprocation along said axis, and an actuating mechanism comprising a piston that is reciprocable relative to the frame along said axis and non-rotatable about said axis, said piston having a screw connection of large lead angle to said arm whereby upon relative axial motion of the piston and arm the latter will be swung about said axis, resilient means for resisting vertical motion of the arm relative to the piston, and means for limiting the vertical travel of the arm relative to the frame, whereby upon downward motion of the piston the arm will first be rotated about said axis from the unloading station to the loading station and then moved downwardly as a unit with the piston, and upon upward motion of the piston the arm will first move upwardly as a unit therewith and then will be rotated from the loading station to the unloading station.

2. A quenching press according to claim 1 in which there is a ram mounted for vertical reciprocation on the frame, the work support is movable on the frame to carry a workpiece thereon between the loading station and a work station wherein it is in alignment with the ram, and there is a means for operating said actuating mechanism in response to the movement of the work support which brings a quenched workpiece to said loading station subsequent to operation of the ram.

3. A quenching press for gears and the like comprising a frame, a ram mounted for vertical reciprocation on the frame, a work support movable on the frame to carry a workpiece thereon between a loading station and a work station wherein it is in alignment with the ram, a work handling arm mounted on the frame for swinging motion about an upright axis to carry a workpiece between the loading station and an unloading station and also for vertical motion to cause the arm to engage the workpiece on the support and to lift it therefrom, an arm-actuating piston reciprocable relative to the frame along said upright axis, a helical cam and cam follower of which one is on the piston and the other on the arm, the helix axis of the cam being coincident with said upright axis, resilient means for resisting vertical motion of the arm relative to the piston, and means for limiting the travel of the arm relative to the frame.

4. A work handling device comprising a stationary support, a member reciprocable thereon, an arm mounted on said member to swing thereabout in a plane perpendicular to the direction in which the member is reciprocable and also to move on the member in said direction, cooperating cam and cam follower means on the arm and the member for effecting said swinging motion in response to their relative motion in said direction, resilient means acting between the arm and member to resist such relative motion between them, and means for limiting motion of the arm relative to the support in said direction.

5. A work handling device comprising a stationary support having a cylinder, a piston reciprocable in the cylinder, a cylindrical cam movable with the piston and having a helical cam formation, an arm mounted on the cylindrical cam for swinging motion thereabout in a plane perpendicular to the direction of motion of the piston and also for movement thereon in said direction, a cam follower on the arm engaging said cam formation for effecting swinging motion of the arm upon relative motion of the cam and arm in said direction, resilient means acting between the arm and cam for resisting such relative motion, and stop means for limiting motion of the arm relative to said support, whereby during a part of the stroke of the piston the arm will move as a unit with the cam and during another part of the stroke will swing relative to the support.

6. A work handling device comprising a stationary support, a member reciprocable thereon, an arm having a screw connection with the member, with the screw axis extending in the direction of reciprocation of the member, whereby upon motion of the member in said direction relative to the arm the latter will be swung about said axis, a spring acting between the member and arm for resiliently holding them in one limit position of such relative motion, and stop means to limit motion of the arm relative to the support, whereby during one stroke of the reciprocation of said member the arm first moves angularly and then rectilinearly, and upon the opposite stroke of said member has a return rectilinear motion and then a return angular motion.

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