May 28, 1968 E. JABLONSKI 3,385,583

HEAT TREATING APPARATUS

Filed March 2, 1966

FIG.4.

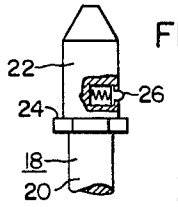


FIG.1.

FIG.5.

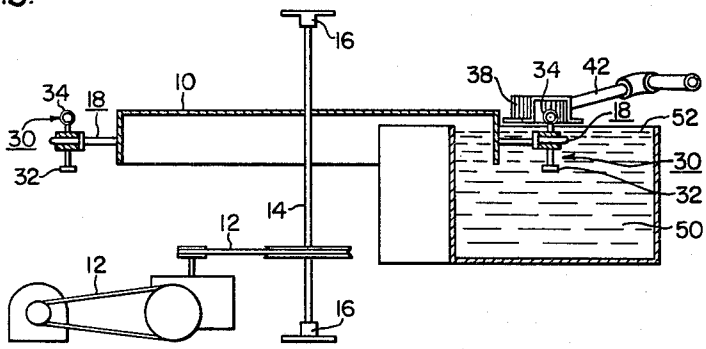


FIG.2.

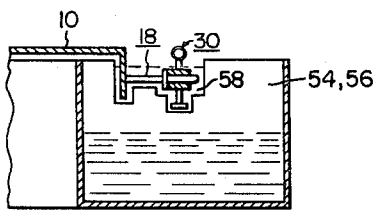


FIG.6.

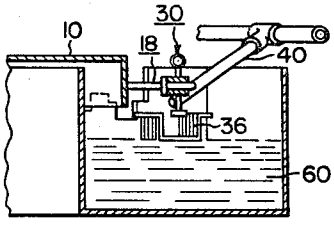


FIG.3.

WITNESSES

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HEAT TREATING APPARATUS

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The present invention relates to heat treating apparatus, and more particularly, to apparatus for introducing respective workpiece portions to a heating means and to a pool of liquid.

It is a prime object of the present invention to provide a novel heat treating apparatus capable of performing the above functions at relatively rapid production rates and in a manner of such mechanical simplicity as inherently affords opportunity for prolonged trouble-free performance.

In accord with general features of the present invention the above object is obtained by provision of a rotary workpiece-conveyor, or turntable, which receives a plurality of workpieces at its outer periphery and rotates to transport such workpieces along a horizontal circular path for subjection to the influence of a heating means disposed along said path as well as through a spillway or weir for introduction of at least a portion of such workpiece to a pool of liquid which overflows via such weir and to exit such pool by passage through a second weir through which liquid from such pool also overflows, thence to an unloading station.

It is a further object of the present invention to provide improved apparatus for heating an end of an elongated workpiece for hardening same while an adjacent portion of such workpiece is immersed during heating of such end to prevent such immersed portion from also being heated to the hardness-inducing temperature.

In keeping with such further object of the present invention, additional features of the invention provide for mounting of the workpieces on the turntable in a vertical attitude such that an end thereof to be hardened lies above the adjacent portion to be protected from becoming hardened, and the turntable transports such workpieces while remaining in such attitude into subjection to a heating means located along the circular path of travel of the workpiece to heat such upper end of the workpiece to a hardening-requirement temperature; to a quenching nozzle means for rapid cooling of such end following its becoming heated by the heating means; and through a first weir to effect immergence of the workpiece into a liquid bath to an extent necessary to heat-protect the workpiece portion adjacent to the upper end while the latter is being heated.

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

FIGURE 1 is a plan view of a schematic representation of an illustrative embodiment of the apparatus of the present invention;

FIG. 2 is a similar representation in vertical cross section taken along the line 2—2 in FIG. 1;

FIG. 3 is a partial vertical cross section view taken along the line 3—3 in FIG. 1;

FIG. 4 is a showing partially in outline and partially in section of the workpiece mounting members, a plurality of which are employed in the apparatus of FIG. 1;

FIG. 5 is a showing in outline of a workpiece ejecting member affiliated with the apparatus of FIG. 1 for automatic removal of the workpieces from the workpiece mounting members upon appearance of the workpieces at an unloading station; and

FIG. 6 is a fragmental view in elevation, showing details of a weir construction employed in the apparatus of FIGS. 1 and 2.

Referring to FIGS. 1 and 2, the illustrative embodiment of the present invention comprises a workpiece-conveying turntable **10** which is operated by a motorized driving means **12** to rotate about the vertical axis of the shaft **14** which is supported and constrained for rotation by a suitable bearing means **16**. The turntable **10** is provided at its outer periphery with a plurality of workpiece holder members **18** projecting horizontally outward therefrom and distributed at spaced-apart intervals around the circumference of such turntable. The particular workpiece holder members **18** as illustrated herein are adapted for support of workpieces having a cylindrical opening therein, such as the bore of a rocker arm.

Referring to FIG. 5, each such workpiece holder member **18** may simply take the form of a post **20** with an outer tapered end **22** onto which the bore part of the rocker arm may be inserted to a limit position defined by engagement with a shoulder **24** formed in such holder member and retained in place by a ball detent means **26** which projects into the usual oil groove found in the interior of a rocker arm bore. When suitably mounted on respective workpiece holder members **18**, the workpieces **30**, rocker arms for example, will be disposed so as to have one end of an extension thereof to be hardened projecting downwardly and an opposite projecting extension thereof extending upwardly, such for example, as the pad end **32** of a rocker arm extending downwardly and the cup end **34** of the rocker arm extending upwardly.

Disposed along the outer periphery of the turntable **10** along the path of travel of the workpieces **30** transported by the holder members **18** and occupying different fixed vertical positions with respect thereto are two heating means **36** and **38**, one for heating the lower end of the workpieces and one for heating the upper end of the workpieces. Each such heating means may take the form of an induction heating coil assemblage, as shown, which may include flux-concentrating laminations stacked together to form a U-shaped elongated channel through which the respective workpiece ends will pass during rotation of the turntables through the region of location of such heating means. The lower trough-shaped induction heating means **36** opens upwardly and the upper induction heating means **38** opens downwardly. Both occupy fixed positions and are supported by suitable means (not shown). Each is suitably energized by a source of alternating current at a frequency of such as 10,000 c.p.s. and a suitable power level to heat the end of the workpiece to a temperature suitable for hardening.

At the exit end of each of the heating means **36** and **38** there is provided a respective spray nozzle **40** and **42** for directing a quenching medium such as soluble oil onto the upper and lower heated workpiece ends **32** and **34** for quenching same. During rotation of the turntable the upper and lower workpiece ends **32** and **34** are introduced sequentially to the two heating means **36** and **38** and quenching medium so that each will be hardened consecutively.

After passage through each heating and quenching station, the workpieces **30** arrive succesively at an unloading station where they engage a fixed-position cam-shaped workpiece-ejecting member **46** which exerts a radial force against the workpieces to slide them off the end of the respective workpiece holder members **18**. The workpieces then drop into suitable receiving means (not shown). As shown in FIG. 5, the workpiece-ejecting member **46** simply takes the form of a flat bar having a suitable curved surface **48** thereon for slidable engagement with the workpieces.

In accord with a prime feature of the present invention, referring to FIGS. 1 and 2, the area adjacent to the upper end 34 of the workpiece 30 is protected from becoming heated and hardened during administration of heat to such upper end. This becomes desirable, for example, when the region to be hardened is located immediately adjacent to a region which it is not desired to impart hardness to, such as the bore region of a rocker arm where, as mentioned previously herein, such upper end 34 may be in the form of a socket part of a rocker arm located immediately adjacent to the cylindrical bore-containing part of the rocker arm. To accomplish this heat-protecting result in a simplified manner the present invention provides a bath 50 of liquid, preferably the quenching medium which exits the quench nozzles, disposed beneath the second heating means 38 and having an accurately-controlled surface level 52 so located that the workpiece 30 will be submerged at least to slightly above the level of the area thereof desired to be heat-protected while such upper end 34 to be hardened is being subjected to the heating effect of such heating means 38 in transit therethrough or therepast. While conceivably such second heating means 38 might take the form of a gas flame, it is conceivable that such flame might disturb the liquid surface to such an extent that the liquid would be displaced from the area of the workpiece desired to be heat-protected, and accordingly, in the preferred form of the invention as exemplified herein such heating means 38 is in the form of induction heating means, and the surface 52 of the heat-absorbing bath 50 will not be disturbed to any significant extent during application of heat to the upper end 34 of the workpiece 30.

To obtain this heat-protecting partial immersion of the workpiece 30 during heating of its upper end, the pool 50 of heat-protecting liquid is confined within a reservoir having radially-extending end walls 54 and 56 which are provided with suitably-contoured respective spillway or weir slot 58 through which such liquid constantly flows during operation of the apparatus and via which the lower portions of the workpieces 30 pass to obtain the aforementioned degree of immersion and to permit exiting from such heating station prior to dislodgement from the workpiece holder members 18 and ejection from the apparatus. Control of liquid level in the bath or pool 50 is obtained by controlling the rate of feed of liquid to the bath 50 by valve means (not shown).

In accord with another feature of the present invention, a second liquid pool 60 is disposed beneath the first heating means 36 and first quench nozzle 40 which receives liquid from such quench nozzle. The liquid in such second pool is maintained at a level suitable for subjecting the iron laminations of the first induction heating means 36 thereto to assist in maintaining a cooled state of operation thereof, as may be seen in FIG. 3. This latter liquid level is maintained automatically to a suitable design by a weir slot 62 in an end wall 64 of tank means containing such pool. Spillover from this latter weir enters a return sump 68 which supplies quenching medium to a motor-operated pump 70 which supplies such medium to the quench nozzles 40 and 42. Spillover from the exit weir 58 affiliated with the heat-protecting pool 50 occurs also into a portion of such return sump.

From the foregoing it will be apparent that workpieces having oppositely extending portions to be heat treated, such as rocker arms having opposite pad and socket ends to be hardened, and also having a region adjacent to the one end which is desired to be protected from hardness-inducing heating, such as the bore-containing region adjacent to the socket end of certain rocker arms, can be so heat treated expeditiously by an apparatus which is of such mechanical simplicity that the rocker arms can simply be introduced to the apparatus in a selected attitude and be transported by a simple rotary means into subjection to the required heating, quenching, and heat-protecting medium while remaining in such selected attitude and without requiring any movement of the workpieces other than the simple rotary-transported movement afforded by the turntable. In particular, no raising and lowering of the workpieces need be imparted to obtain immersion thereof for subjection to the heat-protecting liquid, for example. The circumferential area of the apparatus not occupied by the heat-quench stations is available for loading of workpieces onto the turntable.

Various modifications may be made within the spirit of the invention.

I claim:

1. Apparatus operable to apply heat successively to a portion of each of a plurality of similar workpieces for raising the temperature thereof to a desired extent while preventing an adjacent portion of each of such workpieces from experiencing a similar temperature rise, said apparatus comprising a rotary workpiece-conveyor means rotatable in a horizontal plane about a vertical axis and adapted to removably support an array of circumferentially spaced-apart workpieces in an atttiude in which their respective portions to be temperature-raised occupy a vertical position above their adjacent portions to be temperature-rise-protected; a fixed-location heating means disposed along a path of travel of the to-be-temperature-raised workpiece portions for subjection of same to a heating effect; and heat absorbing means including a pool of liquid beneath said heating means having a surface level maintained at a height substantially equal that to which the to-be-temperature-rise-protected workpiece portions extend, and weir means including notches open to the liquid pool and extending below such surface level, said notches being disposed along the path of travel of the to-be-temperature-rise protected workpiece portions to permit travel of such portions therethrough for their immersion into and removal from the pool of liquid.

2. The apparatus of claim 1, wherein said heating means raises the to-be-temperature-raised workpiece portions to a hardening temperature, the liquid in the pool beneath such heating means is a suitable quenching medium, the pool of liquid extends along the path of workpiece travel beyond such heating means, and such apparatus includes quenching nozzle means for introducing such quenching medium onto the hardening-temperature-heated workpiece portions.

3. The apparatus of claim 1, wherein said heating means is in the form of induction heating means and includes an induction heating coil means and a high frequency energy source therefor.

4. The apparatus of claim 3, wherein said induction heating coil means is in the form of an elongated inverted U-shaped trough through which the to-be-temperatured workpiece portions pass.

5. The apparatus of claim 4, wherein said induction heating coil means includes a coil and laminations for directing electromagnetic flux generated by such coil to an area for concentrated subjection to such to-be-temperature-raised workpiece portions.

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