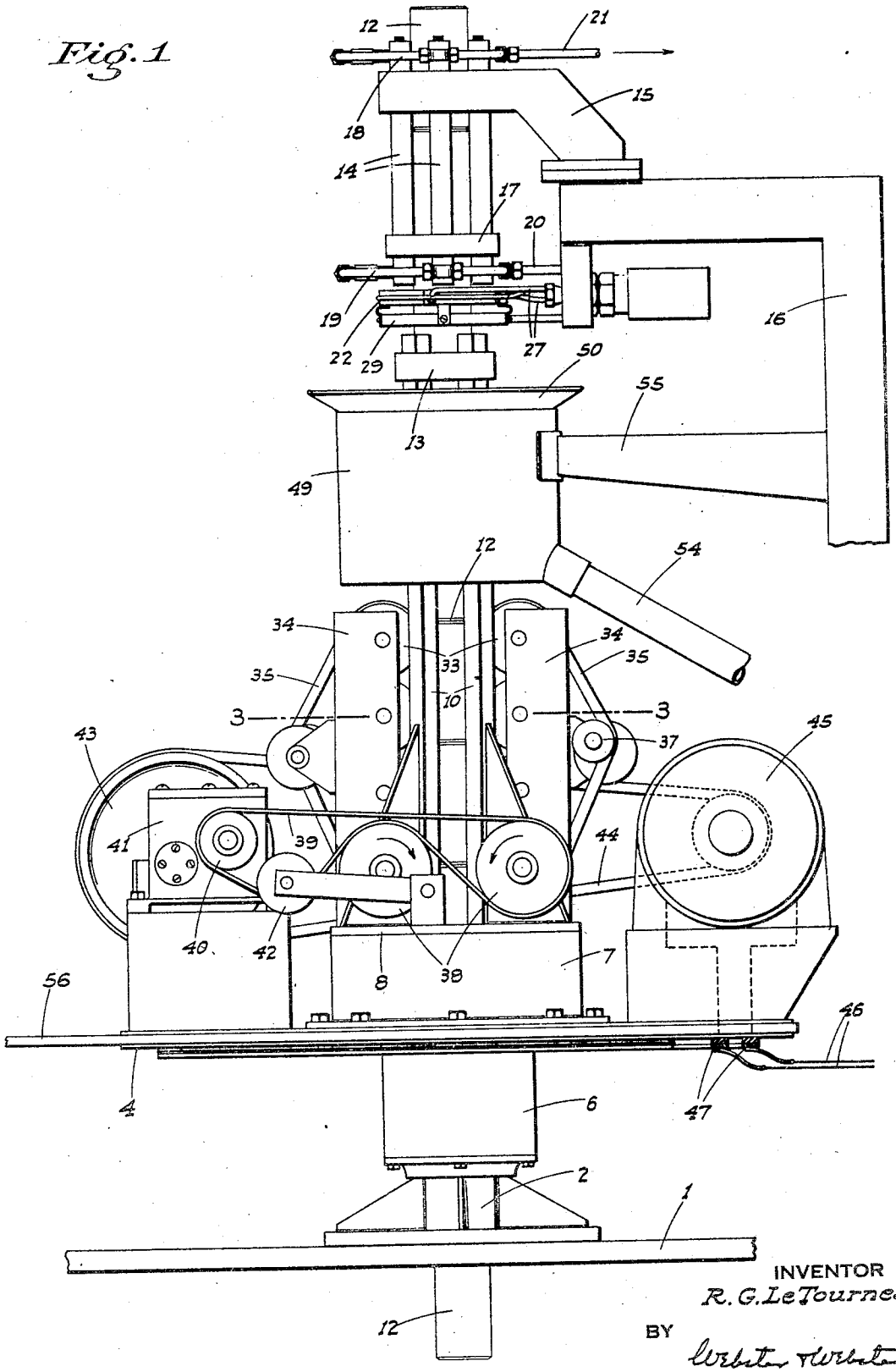
June 11, 1946. R. G. LE TOURNEAU 2,401,833

CASE HARDENING

Filed Feb. 20, 1942 3 Sheets-Sheet 1

Fig. 1



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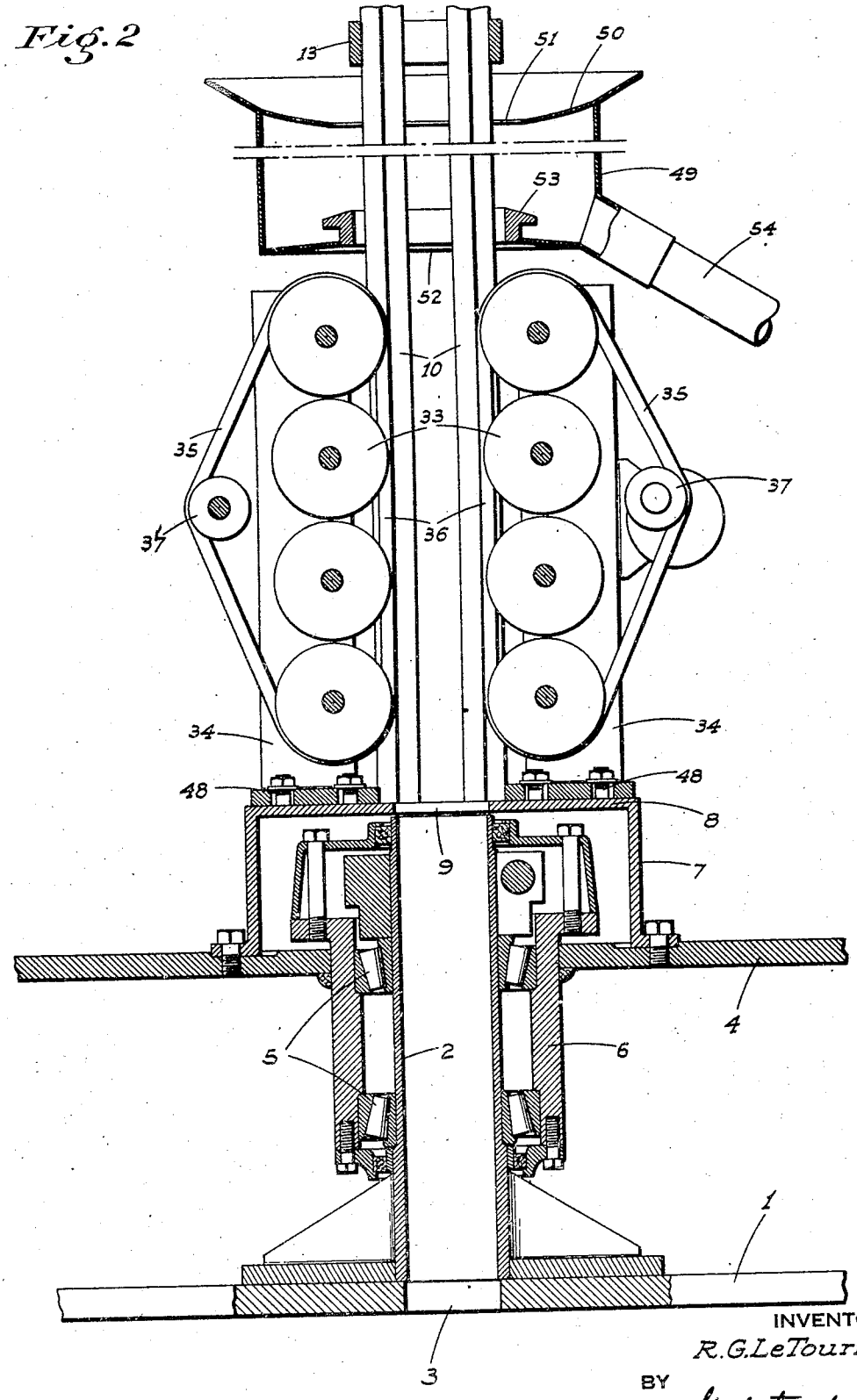
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Fig. 2



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Fig. 3

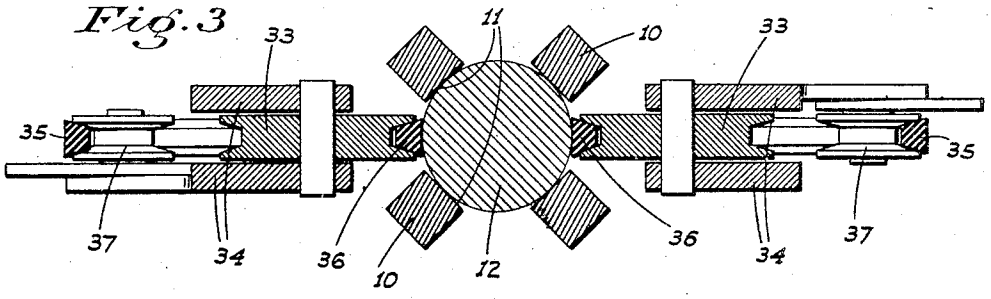


Fig. 4

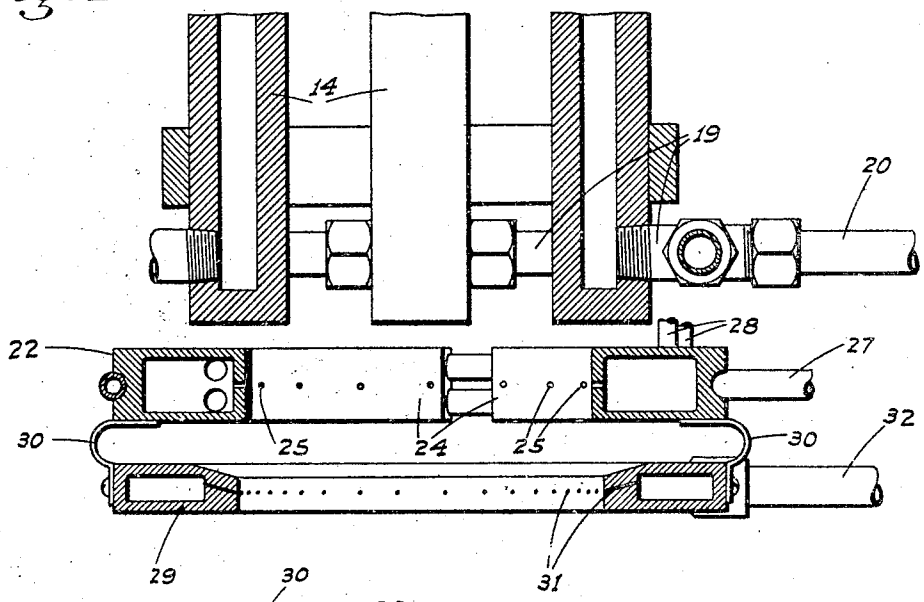
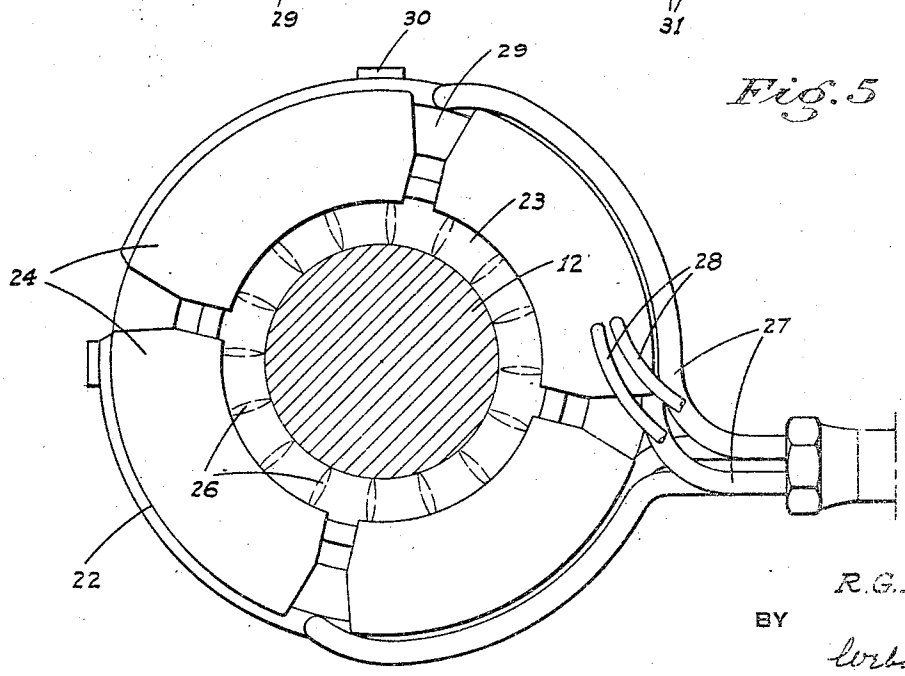


Fig. 5



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Patented June 11, 1946

2,401,833

UNITED STATES PATENT OFFICE

2,401,833

CASE HARDENING

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Application February 20, 1942, Serial 431,729

4 Claims. (Cl. 266—4)

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This invention relates generally to an improved method and apparatus for case or surface hardening machine elements, as for example sheave pins or the like which must have an extremely hard outer or wearing surface and a tough core; and in particular the invention contemplates, and it is the principal object to provide, a method and apparatus for the continuous and relatively fast case hardening of like machine elements; this as distinguished from the older and slower method of pack carburizing of steel followed by subsequent quenching.

Another object of the instant invention is to provide case hardening apparatus for like machine elements, which includes mechanism to continuously advance a row of such machine elements at a predetermined speed; the elements as they advance each passing first through a heating zone and subsequently through a quenching or cooling zone.

A further object of the invention is to embody in the apparatus novel means to regulate or vary the rate of feed of the machine elements through the heating and quenching zones, whereby to control the depth of surface hardening of said elements.

An additional object of the invention is to provide case hardening apparatus which is operative not only to continuously feed like machine elements through heating and quenching zones, but also is operative to simultaneously rotate the elements as they pass through said zones, whereby to assure even and rapid heating and cooling of the elements.

It is also an object of this invention to provide continuous feed case hardening apparatus which includes a unique form of lineal feed mechanism for the like machine elements being treated; the elements passing through the apparatus in end to end engagement and as a vertical stack; the lineal feed mechanism being disposed clear of and shielded from the heating and quenching zones.

A further object of the invention is to produce a simple and inexpensive method and apparatus and yet one which will be exceedingly effective for the purpose for which it is designed.

These objects I accomplish by means of such structure and relative arrangement of parts as will fully appear by a perusal of the following specification and claims.

In the drawings similar characters of reference indicate corresponding parts in the several views:

Figure 1 is an enlarged elevation of the improved case hardening apparatus.

Figure 2 is an enlarged fragmentary sectional elevation of the bearing assembly and the lineal feed mechanism.

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Figure 3 is an enlarged fragmentary section on line 3—3 of Fig. 1.

Figure 4 is an enlarged fragmentary sectional elevation of the heating and quenching rings shown in their relation to the upper or stationary guide bars.

Figure 5 is an enlarged top plan of the heating ring showing a machine pin being heated.

Referring now more particularly to the characters of reference on the drawings, the case hardening apparatus comprises a fixed base 1 having an upstanding relatively short tubular post 2 secured thereto in rigid relation; the base 1 having a circular opening 3 matching with the bore of the post and of slightly greater diameter. A horizontal turntable 4 is disposed above the base 1 intermediate the ends of post 2, the latter projecting centrally through the turntable. The turntable is rotatably mounted in connection with post 2 and held against downward axial displacement by means of a suitable bearing assembly indicated generally at 5 which is enclosed within a sleeve-like housing 6. A cap 7 is fixed concentrically on the top of the turntable and encloses the upper end of post 2 and the adjacent portion of the enclosed bearing assembly, the top of cap 7 being flat and forming a horizontal platform 8. A circular opening 9 in such platform matches the bore of post 2 and is of a diameter at least that of the bore of said post.

A plurality of upstanding guide bars 10 are mounted symmetrically and in circumferentially spaced relation on platform 8 and about opening 9, such guide bars 10 being rectangular in cross section and disposed so that the inner faces 11 of opposed bars are parallel; the spacing of opposed bars being substantially the diameter of the cylindrical pins 12 which the apparatus is designed to receive and treat. Adjacent their upper ends the guide bars 10 are secured together by means of a surrounding connecting ring 13.

In vertically spaced relation above the guide bars 10, which of course move with the turntable, there is mounted another assembly of relatively short stationary guide bars 14 which are arranged in the same relation to each other as the guide bars 10, and about the same vertical axis. The guide bars 14 are supported adjacent their upper ends by a bracket 15 which overhangs the apparatus from a fixed frame 16, and are connected adjacent their lower ends by a surrounding ring 17.

The relatively short stationary guide bars 14 are hollow or chambered, being interconnected top and bottom by piping, indicated generally at 18 and 19 respectively; water being fed from a feed pipe 20 into piping 19 and escaping from piping 18 through an outlet pipe 21, thus water cooling bars 14.

A flame ring assembly indicated generally at 22 in Fig. 1, and shown in plan in Fig. 5, is disposed horizontally intermediate adjacent ends of guide bars 10 and 14 and is disposed concentric with the vertical axis of the apparatus, the ring opening 23 being substantially of greater diameter than the diameter of the pins 12 which are to be treated. The flame ring assembly 22 may be of any suitable form and is here shown as comprising hollow and interconnected segments 24, each of which includes a plurality of inwardly opening jets 25 from which flames 26 play in a radial direction. The flame ring is supported from fixed frame 16 by means shown in the present embodiment as tubular supporting arms 27; the fuel being fed to the ring through conduits 28.

A quenching ring 29 having a bore substantially the diameter of the flame ring is suspended from and below the latter by means of a plurality of circumferentially spaced fingers 30, this quenching ring being hollow and having a multiplicity of jet openings 31 entering the bore from the interior at a slight downward slope. Cold water under pressure is supplied to the quenching ring in regulated quantity by means of a pipe 32. It is understood of course that the supply of gaseous fuel, together with the supply of water for guide bars 14 and quenching ring 29, will have suitable means (not shown) to regulate the flow. When the apparatus is in operation a stack of the cylindrical pins 12 which are to be treated, pass downwardly in guided relation between bars 14, through the flame and quenching ring and then continue downwardly between and are guided by bars 10, finally discharging out of the bottom of the apparatus through tubular post 2. In order to regulate the lineal speed of the pins through the apparatus the following lineal feed control mechanism is employed:

A plurality of V-pulleys 33 are arranged in vertical banks on opposite sides of the stack of pins; the pulleys of each bank being supported between transversely spaced plates 34 which upstand from platform 8. The pulleys are mounted for rotation about horizontal axes and are disposed with their peripheries in opposed relation; adjacent portions of these pulleys projecting centrally from between guide bars 10 toward but being slightly clear of the stack of pins. Each vertical bank includes an endless V-belt 35 which passes about the endmost pulleys and whose inner reach 36 rides the intermediate pulleys; said inner reach being vertical and on the outside frictionally engaging the pins 12 of the vertical stack in holding relation. An automatic belt tightener, indicated generally at 37, cooperates with the other reach of each belt outwardly of the corresponding bank of pulleys. It will be seen that with rotation of pulleys 33 in a direction to move the inner reaches 36 in a downward direction, the stack of pins 12 which are frictionally engaged and normally supported by said reaches will be lowered and pins discharged from the stack at a corresponding lineal speed.

The vertical banks of pulleys of the lineal feed mechanism are driven in the following manner:

The shafts of the lowermost pulleys of each bank are fitted with drive pulleys 38 exteriorly of one plate 34. The pulleys are driven in opposite directions by a reverse drive belt 39 which passes about a drive pulley 40 of a variable speed reduction gear unit 41 mounted on turntable 4 to one side of the platform 8; there being a suitable belt tightener 42 cooperating with belt 39. The speed reduction unit 41 includes a pulley 43 driven by an endless belt 44 from an electric motor 45 mounted on the turntable on the opposite side of cap 7, the motor 45 deriving its current from an independent power circuit 46 and through the medium of means such as a collector ring assembly on the turntable indicated at 47.

In order to assure proper frictional engagement of the reaches 36 of belts 35 with the downwardly moving pins 12 of the vertical stack, the vertical banks of pulleys are mounted for adjustment on platform 8 in an inner direction by any suitable means such as that shown at 48.

The vertical banks of pulleys terminate at their upper ends a considerable distance below the quenching ring 29, and to prevent water from such ring from splashing on the lineal feed mechanism the following drain assembly is employed. A tank 49 surrounds the assembly of guide bars 10 above the vertical banks of pulleys, the upper end of such tank including a concave drip pan 50 having a central opening 51. At the bottom, the tank 49 likewise has an opening 52 through which the guide bars 10 pass; such opening 52 being surrounded by a drip catching annular flange 53 whose upper face is disposed below and in position to catch water from falling through opening 51 and is angled to deflect such water into the tank. From the tank, water drains out through a downwardly inclined draining pipe 54. The tank 49 is non-rotatable and is mounted in fixed position by suitable means such as an arm 55 which extends from the rigid frame 16.

In order to rotate the turntable and consequently the lineal feed mechanism and pins 12 engaged thereby, said turntable is formed as a pulley engaged by a drive belt 56 which extends to a stationary variable speed electric motor (not shown).

In operation, the stack of pins 12 to be case-hardened passes downwardly through the apparatus at a speed of approximately seven to eight inches per minute, while rotating at approximately 150 R. P. M.; the heating and subsequent quenching under controlled lineal speed assuring that the desired case-hardening is accomplished. By varying the speed of travel, the effective depth of the case-hardening can be governed. Pins (SAE 1045 steel) treated in this operation are hardened to a depth of approximately .045 to .050 effective depth, providing a very hard thin surface and leaving a very tough core.

It will be seen that each flame 26 will heat a path on each lowering rotating pin in the form of a helix with a pitch of .047 to .052 inch, and as a result a full and even heating of each pin is accomplished, which results in a more uniform case hardening than is otherwise possible.

From the foregoing description it will be readily seen that I have produced such a method and apparatus as substantially fulfills the objects of the invention as set forth herein.

While this specification sets forth in detail the present and preferred construction of the apparatus and method of operation, still in practice such deviations from such detail may be resorted to as do not form a departure from the spirit

of the invention, as defined by the appended claims.

Having thus described my invention, what I claim as new and useful and desire to secure by Letters Patent is:

1. Case hardening apparatus comprising means to guide the downward movement of a vertical stack of like machine elements, means to control gravitational displacement of said stack to a predetermined speed, means forming a heating zone through which the elements pass during their downward movement, and means forming a quenching zone through which the elements subsequently pass during such movement; said control means being disposed below said zones, and a shield surrounding the guide means intermediate said quenching zone and said control means.

2. Case hardening apparatus comprising vertically spaced upper and lower guide assemblies for a stack of machine elements, means mounting the lower assembly for rotation about a vertical axis, means mounting the upper assembly stationary, means cooperating with the stack in supporting relation and regulating the speed of downward movement thereof, and heating and quenching units mounted between said assemblies and through which units the elements successively move.

3. Case hardening apparatus as in claim 2 in which said upper assembly includes upstanding guide bars; said bars being hollow and water cooled from within.

4. Case hardening apparatus as in claim 2 including a drip pan unit surrounding the stack below the quenching unit and above said stack supporting and speed regulating means.

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