

March 15, 1966

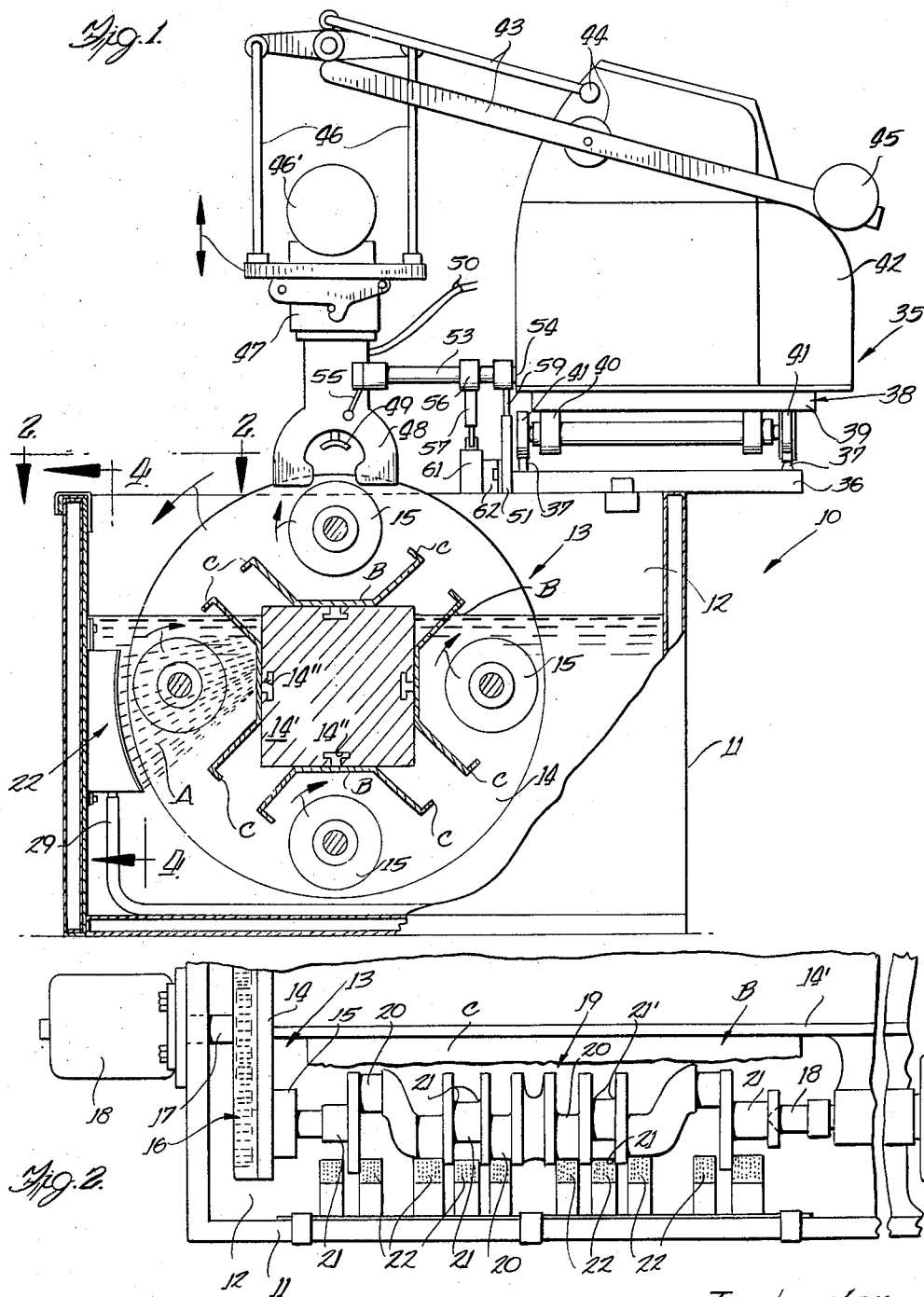
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3,240,480

HEAT TREATING APPARATUS FOR CRANKSHAFTS

Filed Dec. 26, 1962

3 Sheets-Sheet 1



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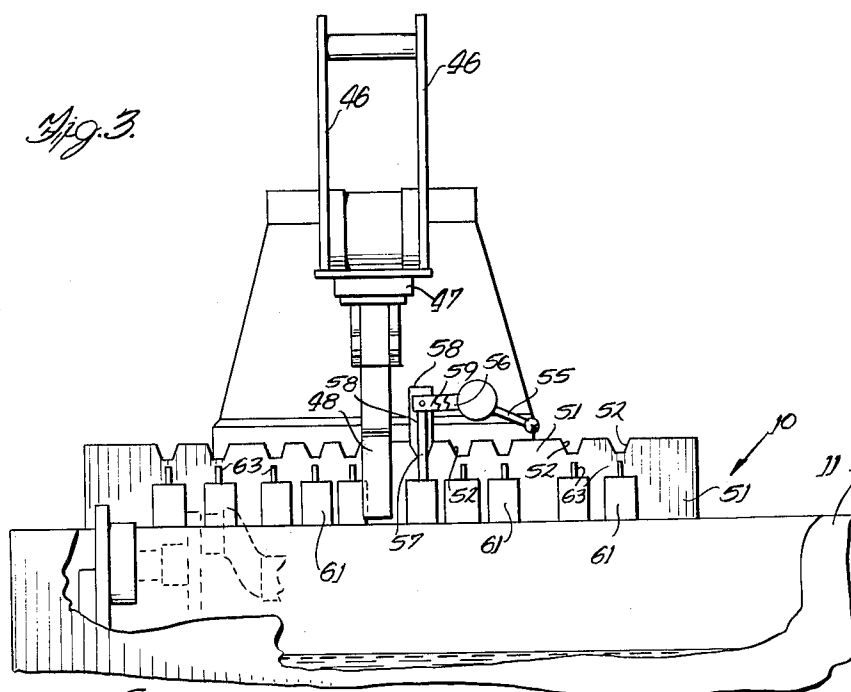
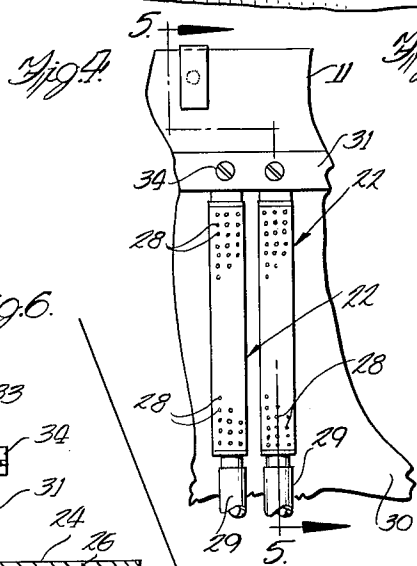
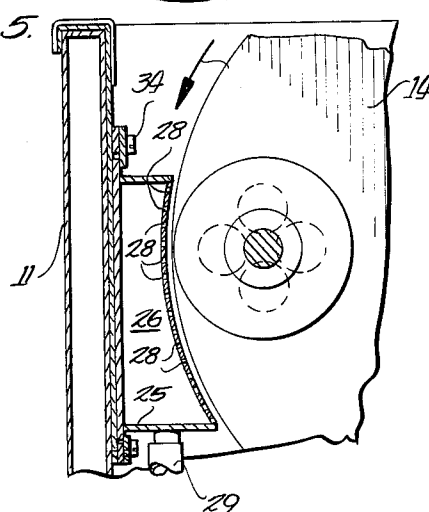
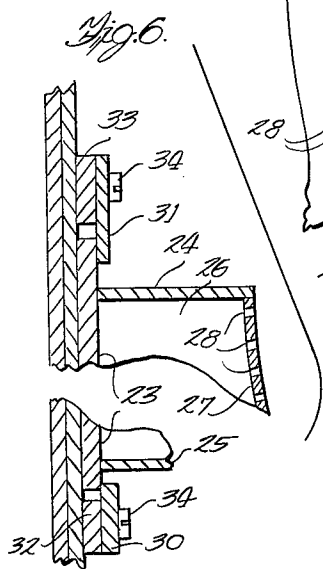
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3,240,480

HEAT TREATING APPARATUS FOR CRANKSHAFTS

Filed Dec. 26, 1962

3 Sheets-Sheet 2



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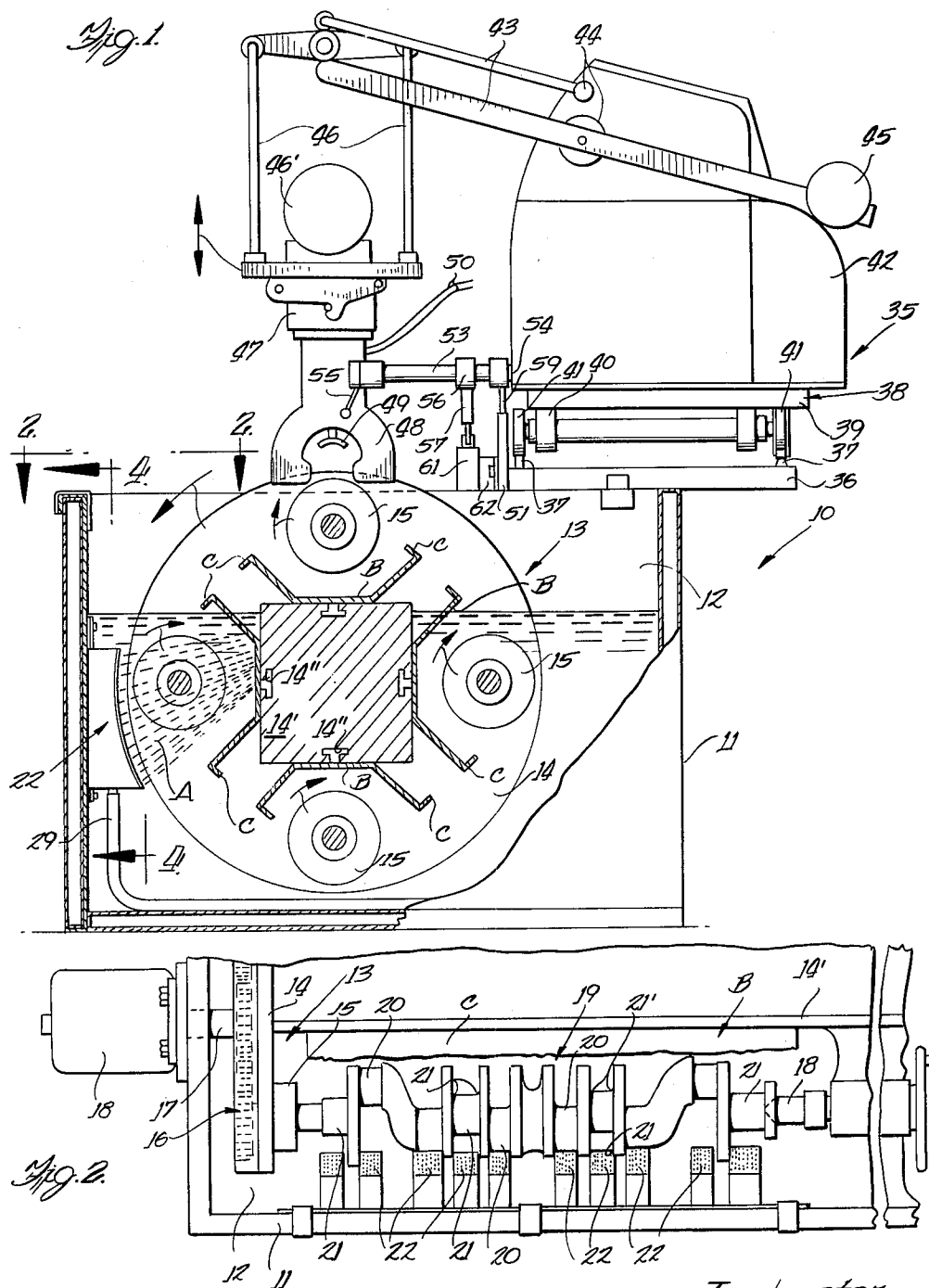
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3,240,480

HEAT TREATING APPARATUS FOR CRANKSHAFTS

Filed Dec. 26, 1962

3 Sheets-Sheet 3



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3,240,480 HEAT TREATING APPARATUS FOR CRANKSHAFTS

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Filed Dec. 26, 1962, Ser. No. 247,168
8 Claims. (Cl. 266—4)

This invention relates to a heat treating apparatus particularly adapted for the hardening of crankshafts. More specifically the invention relates to an improved heat treating apparatus for hardening the bearings and fillets of crankshafts and the like.

In the art of crankshafts hardening by induction heating apparatus, the bearing surface has been generally quenched by such means as an integral quench coil wherein the quench openings and quench liquid are integral with the inductor coil, or apparatus has been provided wherein the crankshaft immediately after heating is lowered into a quench bath within a quench tank. In certain cases the quench bath also includes members known as quench blocks which are supported within the bath. Such quench blocks are provided with suitable orifices and such blocks are connected to a liquid pressure source whereupon the bath is kept in circulation by the streams emanating from the orifices. Such orifices may also take the form of nozzles as described in the G. Seulen et al. Patent No. 2,787,566 issued April 2, 1957.

Previous devices of the type mentioned have been satisfactory to a degree in the hardening of bearing surfaces. On occasion they have been satisfactory where limited fillet hardening is accomplished. Thus several of the fillet areas of a crankshaft may have been satisfactorily hardened but no one in the field heretofore has successfully hardened all of the fillet areas of a crankshaft without distorting or cracking the crankshaft to a degree where it is unusable for its intended purpose. The hardening of all fillet areas of a crankshaft is becoming increasingly important in view of the increasing horsepower requirements of internal combustion engines. As a result linear bending movements about the axis of the crankshafts generally causes rapid breakage of the crankshaft particularly in the fillet areas, thus a process and apparatus suitable for satisfactorily hardening all fillet areas of a crankshaft without detrimental distortion or cracking has been one of the compelling needs of the industry. It is the prime object of this invention therefore to provide an improved apparatus and process which satisfies this need.

Another prime object is to provide an improved apparatus and process for hardening all fillet areas of bearings of a crankshaft without appreciable distortion or cracking of the crankshaft.

It is another object of this invention to provide an improved induction heating apparatus for hardening crankshafts, bearings and fillets on a production basis.

Another object of this invention is to provide an improved induction heating machine for hardening of crankshaft bearing surfaces, the said machine including quenching means readily accommodating different crankshafts for hardening the same on a production basis.

Another object is to provide an improved process wherein each bearing of a crankshaft is subjected to a high velocity jet type quench from a quench block which is designed for each particular bearing.

Another object is to provide an improved induction hardening apparatus having a novel quenching system whereby quench fluid under pressure may be selectively directed to a particular crankshaft bearing and fillet areas as desired.

A still further object is to provide an improved hardening apparatus having a quench tank including a plurality

of quench blocks which are individually adjustable to accommodate different types of crankshafts and which may be actuated to selectively direct quenching fluid under pressure to a crankshaft bearing as desired after it leaves a heating station.

Still another object is to provide an improved quench system for an induction hardening machine for crankshafts, the said machine including a quench tank having a plurality of individual quench blocks, one for each bearing to be heated and which is operated simultaneously with the heating of a bearing of one crankshaft so as to selectively quench a bearing of another crankshaft which has been previously heated in a heating station.

Another object is to provide an improved quenching system adapted for an induction hardening apparatus of the type shown in the G. Seulen et al. Patent No. 2,787,566, patented April 2, 1957.

These and other objects will become more readily apparent from a reading of the description when examined in connection with the accompanying sheets of drawings.

In the drawings:

FIGURE 1 is a side elevational view, partially in section, of an induction hardening apparatus;

FIGURE 2 is a partial plan view taken substantially along the line 2—2 of FIGURE 1;

FIGURE 3 is a front elevational view, of the apparatus shown in FIGURE 1, showing certain portions of a quench apparatus broken away to better illustrate the invention;

FIGURE 4 is a cross-sectional view taken substantially along the line 4—4 of FIGURE 1;

FIGURE 5 is a cross-sectional view taken substantially along the line 5—5 of FIGURE 4;

FIGURE 6 is an enlarged cross-sectional view similar to FIGURE 5, showing an attachment of a quench block;

FIGURE 7 is a schematic view of an electric-air system for controlling quench fluid in a quench system;

FIGURE 8 is a detail view of a detent mechanism;

FIGURE 9 is a detail view showing a quench block with a high velocity quench flow impinging on a bearing of a crankshaft;

FIGURE 10 is a detail view of a conventional quench block in operation for quenching a bearing; and

FIGURE 11 is a detail schematic view showing a high velocity jet flow in relation to a crankshaft which is being quenched.

Referring now to the drawings, a crankshaft induction heating and hardening apparatus is generally designated by the reference 10. The apparatus 10 includes a quench tank 11 having a quench chamber 12. A crankshaft carrier 13 is disposed within the chamber 12 and comprises a rotatable casing 14 having supported thereon four work rotating members or face plates 15. The casing 14 also includes for rotation therewith a rectangular support block 14' extending lengthwise within the tank and being suitably supported on its right end by bearings (not shown). Like the construction disclosed in the aforementioned patent the casing 14 contains enclosed suitable planetary gear means generally designated at 16. Upon rotation of the shaft 17 the casing 14 and block 14' rotates, and by means of gear means 16 each of the work rotating members 15 also is rotated as best shown in the arrows in FIGURE 1. A suitable power unit 18 is supported on the quench tank 11 for imparting rotating movement to the shaft 17 and the casing 14 and to the work rotating members 15. A crankshaft 19 is generally designated at 19, the said crankshaft 19 having one end rigidly supported on one of the work rotating members 15 and having its other end pivotally supported on a lathe-type center means 18' suitably supported on the support block 14' within T-slots 14'' to permit lengthwise adjustment of the center means 18' as desired. Four crankshafts are thus supported for hardening. The crank-

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shafts 19 comprise conventional bearing members to be hardened. The bearings for the purpose of this specification will include the known terminology of "pin bearings 20," and "main bearings 21," (also known as "journals"). Since the application is concerned particularly, also with fillet hardening, fillets 21' at the ends of the pin and main bearings will also be included in the term "bearings." The fillets 21' are the curved areas at the ends of the bearings which extend into the surfaces of members known as "cheeks 20" best shown in FIGURE 9.

As best shown in FIGURES 1, 2, 4, 5, 9 and 11 a plurality of quench blocks 22 are supported within the chamber 12. Each quench block 22 comprises a rear plate 23, an upper wall 24, a lower wall 25 and sidewalls 26. A front arcuate-shaped wall 27 includes a plurality of quench orifices 28. Each of the quench blocks 23 has connected to the lower wall 25 a conduit 29 to provide quench fluid to the interior of each of the blocks 22.

The quench blocks 22 are supported within the tank 11 by means of lower guide straps 30 extending horizontally within the tank and upper guide straps 31. The lower straps 30 are spaced from the inner wall of the tank 11 by means of spacer strips 32 and the upper guides 31 are spaced from the tank by means of spacer strips 33. This is best shown in FIGURE 6 and the guide straps 30 and 31 are secured by means of screws 34 to engage upper and lower edges of the back plates 23 to securely retain the quench blocks on the tank 11. By merely loosening the screws 34 the quench blocks 24 may be adjusted horizontally to the position desired, in order to accommodate longer or shorter crankshafts where the bearing lengths are of the same dimension.

As best shown in FIGURES 1 and 3 the induction heating mechanism is generally designated by the reference character 35. The heating mechanism 35 is supported on a suitable platform 36 carried on the quench tank 11. The platform 36 includes a pair of horizontally extending track members 37 on which a carrier 38 is positioned. The carrier 38 comprises a carriage 39 which by means of bracket structures 40 suitably support four track wheels 41, only two of which are shown, which are supported on the track members 37 so that the carriage 39 may be moved horizontally along the tank 11. A housing is designated at 42. A parallelogram linkage 43 is pivoted on the upper end of the housing 42 and is pivotally connected to said housing as indicated at 44. A counterweight 45 is suitably supported on the linkage 43. A second parallelogram linkage 46 is pivotally connected to the linkage 43 and extends downwardly for supporting an inductor unit generally designated at 47. The inductor unit 47 is provided with a pocket like inductor portion 48 having supported therein an induction coil 49. A transformer is designated by 46'.

The inductor portion 48 is lowered over a main bearing to be heated with the coil 49 in heating relation. When heating a pin bearing, during rotation of the crankshaft the inductor portion follows the orbital path of the pin bearing. The inductor 47 may be of a construction similar to that shown in the G. Seulen et al. Patent No. 2,743,345, patented April 24, 1956. Electric wires 50 suitably connect the transformer 46' to conventional generator components not shown.

As best shown in FIGURES 1 and 3 an indexing plate 51 is supported by the platform 36. The indexing plate 51 comprises a plurality of horizontally spaced apertures 52 providing a plurality of horizontally spaced stops. A shaft 53 is suitably rotated as indicated at 54 on the housing 42 and includes a handle 55 to permit such rotating movement. The shaft 53 has connected thereto an arm 56 which has connected thereto a switch engaging member 57 projecting downwardly.

As best shown in FIGURES 3 and 8 a detent member 58 has a lower portion conforming to the shape of the notches 52, the said detent member 58 being pivotally

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connected to an arm 59 in turn connected to the shaft 53 for rotation therewith. The detent member 58 is pivotally connected as indicated at 60 to the arm 59. A plurality of switch elements 61, one for each notch 52, are disposed below the said notches 52 and are suitably connected by means of brackets 62 to the indexing plate 51 as indicated in FIGURE 1. Each switch element 61 includes a switch actuating plunger 63.

Referring now to the schematic view shown in FIGURE 7, each switch 61 is suitably connected by means of wires 64 and 65 to an electrical source and in turn has wire 66 and 67 connected to a solenoid valve 68. An air conduit is indicated at 69, the said conduit 69 extending to a suitable air supply under pressure. The conduit 69 is in turn connected to a branch conduit 70 leading to the solenoid valve 68. A conduit 71 leads from the solenoid valve 68 for communicating with a check valve casing 72. The check valve casing 72 has a suitable port 73 normally closed by means of a spring-urged ball valve 74. The casing 72 exhausts through an outlet port 75. The casing 72 is also provided with a suitable bleed orifice 76, the discharge through which may be controlled by means of a needle valve 77. The exhaust port 75 communicates with a conduit 78 in turn communicating with an accumulator 79.

An air control valve is designated at 80 and is connected to a conduit 81 communicating with accumulator 79, the said conduit 81 also communicating with a chamber 82. A spool valve 83 is slidingly positioned within the casing 80 and includes lands 84 and 85. Spring means 86 urges the spool valve 83 in the direction toward the conduit 81. An inlet port 87 communicates with the air lines 69 and an outlet port 88 is connected to a conduit 89 in turn connected to a conduit 90 communicating with a diaphragm valve generally designated at 91. The air control valve 80 also is provided with a port 88' adapted to exhaust air to the atmosphere.

The diaphragm valve 91 comprises a diaphragm 92 which by means of spring 93 normally holds a valve 94 in closed position against valve seat 95. During air pressure against the diaphragm 92 the valve 94 is opened to permit quench fluid to be directed under pressure from a conduit 96 to a conduit fitting 97 in turn communicating with conduit 29 leading to the quench block 22. Each conduit 96 may receive quench fluid from the tank 11 and by means of a suitable pump (not shown) direct the quench fluid under high pressures to the quench blocks. Or the conduits 96 may be connected to a separate source of quench fluid under pressure, if desired. A separate switch 61, solenoid valve 68, accumulator 79 and the other stated components which include a separate quench block is provided for each bearing of each crankshaft, and each system is separate in operation.

THE OPERATION

In the operation the work rotating members 15 of the crankshaft carrier 13 are loaded with crankshafts which are to be treated. The crankshaft 19 at the top of the face plate 14, as shown in FIGURE 1, is then in position to have a pin bearing 20 or main bearing 21 heated, the induction coil being designed to also heat the fillets 21', the said fillets being included in the term "bearing." Since the inductor carriage 38 is horizontally movable upon the tracks 37 the inductor 47 with the carriage is moved into registry with one of the bearings. This may be accomplished by a suitable motor or manually by the operator moving the carriage 38 on its tracks. Each of the bearings for the particular crankshaft to be treated is in alignment or registry with a respective one of the indexing apertures or stops 52. The indexing plate 51, which has been designed for the particular crankshaft, having been secured in position the operator now moves the inductor 47 and carriage to one of the apertures corresponding to the bearing to be treated and he thereupon rotates the shaft 53 whereupon the detent member 58 is

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moved downwardly to engage the desired notch or aperture 52 in alignment with the bearing whereupon the carriage 39 is now retained against horizontal movement. The induction coil is now in accurate registry with the bearing and it is now moved downwardly over the bearing and by its own weight is retained thereon during rotation of the crankshaft. The work rotating members 15 are rotating and induction heating is now imparted to the circumferential surface of the bearing.

With the detent member 58 in its engaged position as shown in FIGURE 3 the switch engaging member 57 depresses the plunger 63 of the switch 61, adjacent the particular aperture 52, closing the switch 61 to electrically operate the solenoid valve 68. The solenoid valve 68 is now actuated to communicate the air pressure line 70 with the air pressure line 71 whereupon air under pressure displaces the check valve 74 permitting air pressure to build up within the accumulator 79. As a predetermined pressure is reached in the accumulator 79, the pressure in chamber 82 causes the valve 83 to move against spring 86, thereby moving the land 85 from the ports 87 and 88 whereupon air under pressure flows through the conduit 90 to the diaphragm valve 91. The diaphragm valve 91 is now under pressure causing the diaphragm 92 to move to the right opening the valve 94 and permitting the inflow of quenching fluid under pressure to the connection 97 and conduit 29 of the particular quench block 22 which is in position to quench the particular bearing which has just been heated in the heating station.

In this position now the land 84 has moved in the position to cover the exhaust port 88'. Quench fluid now under high pressure, as shown in FIGURE 1, is directed to the quench block for the particular bearing.

When the particular bearing (which includes the fillets or fillet areas 21') have been heated to a predetermined degree the inductor is then raised and the carrier 13 is rotated counterclockwise so that the heated bearing is positioned in the quench tank in close proximity to the adjacent quench block within a quench zone A whereby high pressure quench fluid is directed against the bearing and also particularly into the fillet areas which have been heated. Another crankshaft has now been placed in position for heating and the inductor is again lowered into heating relation with respect to the bearing to be heated. The inductor carriage 38 is in this position until the same bearings of the four crankshafts have been heated and quenched.

While the last of the four bearings is being quenched, the operator now rotates the arm 55 to lift the detent member 58 from its aperture 52 whereupon the switch engaging member 57 is moved upwardly and the switch 61 is de-energized. The solenoid valve 68 now blocks communication between conduits 70 and 71 whereupon the ball valve 74 closes the opening 73. Air from the accumulator 79 now bleeds out of bleed orifice 76 whereupon pressure in the chamber gradually is reduced and the spring 86 with snap action moves the valve 83 again to the position shown in FIGURE 7 closing ports 87, 88. Since the pressure reduction in accumulator 79 is gradual the quench liquid will continue to flow for a predetermined time period after the last of the four bearings has been heated and quenched.

The operator now selects another position by moving the inductor carriage 39 laterally to a desired bearing position whereupon the detent member 58 is again engaged in one of the apertures of the indexing plate 52 and the switch engaging member is positioned to again energize the adjacent switch 61 at the new position. Thus with the gradual diminishment of pressure in the accumulator it is possible to keep the quench flowing while the operator selects a new position for heating. When the heating and quenching of the crankshafts is completed, the operator then removes the detent member from the indexing apertures and when air pressure in the di-

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aphragm valve has been sufficiently diminished the valve 94 is closed and quench ceases. As indicated above each quench block has a separate electric-air central system.

The foregoing description explains portion of the process of the heating and quenching. As indicated previously it is important that a separate quench block is designed for each different length bearing. Calling attention to FIGURE 9, and the orifices 28 of the quench block 22 shown, it is apparent that they are so disposed as to direct the quench fluid not only on the straight bearing surfaces but also particularly into the fillet areas 21'. The location of these orifices 28 must be such that the jet stream emanating therefrom must directly impinge on the fillet areas and must not be diverted, or slowed in its velocity by misdirected streams or cross jets interrupting the direct flow.

What happens with a conventional quench block designed for various length bearings is clearly shown in FIGURE 10, wherein orifices 28' extend along the length of a quench block 22'. In this case the orifices directly in line with the inner edges of the cheeks 20' causes streams of liquid which will impinge on the inner edges of the cheeks and which then will be deflected toward the middle area of the bearing and the fillets 21 will be starved of quench fluid. Thus they will not be properly quenched, causing possible cracking or distortion.

Thus it is important that the disposition of the orifices is such that quench liquid is directed within an area where direct impingement of the streams takes place without any appreciable drop in velocity which would normally occur with the conventional constructions.

Referring particularly to FIGURE 11, the high velocity jet streams through the orifices 28 are so directed as to completely envelop the heated crankshaft bearing in its orbital path. A baffle B is supported on each of the four surfaces of the block 14' to rotate therewith. The baffle B provides a high velocity zone A, in which the crankshaft is rotating so that continued impingement occurs in the bath and thus provides proper quenching. The quench zone is sufficiently wide as to envelop a pin bearing in its entire orbital path so that impingement of the jet streams occur on all surfaces of the bearing. The flange portions C on the baffles B prevent the jets from spraying from the surface of the bath into the heating station.

It is to be particularly noted, as shown in FIGURE 11 the baffles B have upper and lower diagonally extending portions which in effect throw or deflect the high velocity stream back toward the bearing which is being quenched thereby tending to wipe and further cool the far side of the bearing.

In the process, the crankshaft design is analyzed and by experimental trial and error technique it is determined that a particular bearing to be quenched satisfactorily must be subjected to a certain impact velocity by the streams of liquid. It is also desired that the quench block be as close to the bearing as possible. Assuming now that a pin bearing is to be quenched, the dimension X in FIGURE 11, may be for instance one inch, indicating the distance of the outside surface of the pin bearing from the quench block. The letters Y may denote 2 inches each with the dimension Z being the dimension (5 inches) from the quench block to the inside surface of the pin bearing when it reaches a 180° position from the position shown in FIGURE 11. Thus for instance then the distance 5 inches is the distance of the work from the orifices of the quench block.

It has been determined experimentally that in order to achieve proper hardening by removing the heat from the part that the impart velocity at 5 inches must be at least 3 feet per second in the submerged condition of the crankshaft in the quench fluid. A quench fluid found particularly effective is polyvinyl alcohol in a concentration by weight in water of $\frac{1}{10}$ to $\frac{7}{10}$ of 1%. It is then necessary to have a pressure at the orifice of at least 7 p.s.i.

which will provide a velocity at the orifice of around 35 feet per second. It has been determined therefore that for most crankshaft bearings to be quenched the pressure at the orifice should be within a range of 7 p.s.i. to around 50 p.s.i.

Impact velocities for submerged work in the above range at a distance of 5 inches between the work and the orifice, require the approximate pressures as shown below:

Submerged:

- 7 p.s.i. at orifice=35 f.s. at orifice=3 f.s. impact velocity
- 17 p.s.i. at orifice=51 f.s. at orifice=5 f.s. impact velocity
- 30 p.s.i. at orifice=67 f.s. at orifice=7 f.s. impact velocity
- 40 p.s.i. at orifice=76 f.s. at orifice=8 f.s. impact velocity
- 50 p.s.i. at orifice=85 f.s. at orifice=9 f.s. impact velocity

The above figures with respect to pressures concern the submerged type of quench. Where the quench is solely in air, then of course, the pressures at the orifice would be less in order to achieve the same impact velocities above given. The impact velocities required as above given are for the plastic quench stated and would be somewhat different for another quench fluid, such as oil, wherein the impact velocities would be at a lower figure.

With the aforementioned method, the critical areas, such as the fillets, are precisely hardened so that all of the fillets can be hardened without detrimental distortion to the crankshaft.

The hardening cycle can be repeated for each bearing and by use of the indexing plate and stops, precision is obtained in properly locating the inductor while simultaneously actuating the quench system, with the location of the inductor at the bearing to be heated. The indexing plates are quickly interchanged for different length crankshafts, and also the quench blocks can quickly be interchanged for the desired crankshaft.

Thus it is clearly evident that an improved heating and quenching apparatus and process has been described which will achieve the stated objects of the invention. It must be understood that changes and modifications may be made without departing from the spirit of the invention or from the scope of the appended claims.

What is claimed is:

1. In an apparatus for hardening the main and pin bearings of a plurality of crankshafts; a quench tank having quench fluid contained therein; a crankshaft carrier for supporting a plurality of crankshafts with the longitudinal axes of the crankshafts spaced and parallel and each bearing of one crankshaft lying substantially in a common vertical plane containing corresponding bearings of the other crankshafts, at least one of the crankshafts being spaced above the level of quench fluid contained in said tank; an inductor carrier and inductor coil assembly movable along a path parallel to the longitudinal axes of the crankshafts to selected positions wherein said inductor coil is movable vertically with respect to said inductor carrier into heating relationship with a particular one of the bearings of the crankshaft spaced above the level of quench fluid; a plurality of quench casings disposed within said tank below the level of quench fluid, said casings each including a curved surface having a plurality of outlet apertures formed therethrough; means for adjustably securing said quench casings to said tank whereby said casings are disposed in a line parallel to the longitudinal axes of the crankshafts and the curved surface of each casing is adjacent to a respective bearing of one of the crankshafts disposed below the quench level; a source of quench fluid under pressure; a plurality of fluid conducting means, each of said fluid conducting means extending between said source of quench fluid

under pressure and a respective of one of said quench casings; valve means in each of said fluid conducting means for controlling the flow of quench fluid therethrough, each of said valve means being normally closed; valve control means for each of said valve means, each of said valve control means being conditionable to open the valve means associated therewith; and manually operable means for locking said inductor carrier and inductor coil assembly in each selected position, said manually operable means being effective incident to operation thereof to condition the valve control means of a respective one of said valve means to open same.

2. In an apparatus for hardening the main and pin bearings of a plurality of crankshafts as set forth in claim 1, wherein said manually operable means for locking said inductor carrier and inductor coil assembly in each selected position includes a fixed member carried parallel to the longitudinal axes of the crankshafts, a plurality of notches formed in said fixed member, each of said notches corresponding to a particular one of said bearings of the crankshaft disposed above the level of quench fluid, and detent means carried on said inductor carriage, said detent means being selectively engageable with any one of said notches to prevent relative movement of said inductor carrier and inductor coil assembly with respect to said fixed member.

3. In an apparatus for hardening the main and pin bearings of a plurality of crankshafts as set forth in claim 1 wherein each of said valve means includes a diaphragm-actuated valve; each of said valve control means includes a source of air pressure, conduit means between said source of air pressure and each of said diaphragm-actuated valves, a solenoid-actuated air valve in each of said conduit means, each of said solenoid-actuated air valves normally being in its closed position, a source of electrical power, conductor means extending between said source of electrical power and each of said solenoid-actuated air valves, an electrical switch in each of said conductor means, each of said electrical switches being actuatable to energize the solenoid-actuated air valve associated therewith to effect opening of the air valve and diaphragm-actuated valve associated therewith; and said manually operable means for locking said inductor carrier and inductor coil assembly in each selected position includes an indexing plate stationarily positioned adjacent said tank and extending in a direction parallel with respect to the longitudinal axes of the crankshafts, said indexing plate having a plurality of stops, each of said stops corresponding to a particular bearing of the crankshaft disposed above the level of quench fluid, a detent member supported on said inductor carriage for relative movement, said detent member being relatively movable into engagement with one of said stops to lock said inductor carrier and inductor coil to said indexing plate, a switch-engaging member movably supported on said inductor carriage and inductor coil assembly, and means on said inductor carriage and inductor coil assembly for simultaneously moving said detent member into engagement with any one of said stops and said switch-engaging member into contact with a particular switch for operating the same.

4. In an apparatus for hardening the main and pin bearings of a plurality of crankshafts as set forth in claim 3, further including retarding means operably connected to each of said solenoid-actuated air valves and its associated diaphragm-actuated valve, each of said retarding means being operable upon opening of the electrical switch and de-energization of the conductor means associated therewith for maintaining the related diaphragm-actuated valve in an open position for a predetermined period of time after opening of said switch and de-energization of the conductor means.

5. In an apparatus for simultaneously heating a bearing of one crankshaft and quenching a previously heated bearing of another crankshaft, a quench tank having

quench fluid contained therein; means for supporting a crankshaft above the level of quench fluid contained in the tank and a second crankshaft below the level of quench fluid contained in said tank, the longitudinally extending axes of said crankshafts being substantially parallel with respect to each other; an inductor assembly movable along a path parallel to the longitudinal axes of said crankshafts to a plurality of heating stations, said inductor assembly being operable to heat a selected bearing on the crankshaft disposed above the level of quench fluid when in the selected position; a source of high pressure quench fluid within said quench tank; bearing quench means for providing fluid communication between said source of high pressure quench fluid and a localized zone adjacent each of said bearings of the crankshaft disposed below the level of quench fluid; and control means for said bearing quench means operable to direct quench fluid under pressure to a particular selected bearing of the crankshaft disposed below the level of quench fluid in said tank upon heating of a particular selected bearing of the crankshaft disposed above the level of quench fluid contained in said tank.

6. In an apparatus for hardening the main and pin bearings of a plurality of crankshafts, a quench tank having quench fluid contained therein; a crankshaft carrier for supporting a plurality of crankshafts with the longitudinal axes of the crankshafts spaced and parallel with respect to each other and each bearing of one crankshaft lying substantially in a common vertical plane containing corresponding bearings of the other crankshafts, one of said crankshafts being spaced above the level of the quench fluid contained in said tank; an inductor carrier and coil assembly movable along a path parallel to the longitudinal axes of the crankshafts, said coil being movable vertically with respect to the inductor carrier into heating relationship with a bearing of said crankshaft disposed above the level of quench fluid; and means for directing quench fluid under pressure to a particular bearing of one of the crankshafts disposed below the level of quench fluid simultaneously with the heating of a particular bearing of the crankshaft disposed above the level

of quench fluid in said quench tank, said control means being actuated by said inductor assembly.

7. In an apparatus for hardening the main and pin bearings of a crankshaft, a quench tank having quench fluid contained therein; a crankshaft carrier for supporting a crankshaft for rotation of the crankshaft about the axis of rotation thereof below said predetermined level of quench fluid; means for directing a plurality of high pressure jet streams of quench fluid toward a selected bearing of the crankshaft from one side thereof; and a baffle means carried by said means for supporting the crankshaft and disposed on the opposite side of the bearing from which said jet streams of high pressure quench fluid are directed.

8. In an apparatus for hardening the main and pin bearings of a plurality of crankshafts as set forth in claim 7, wherein said means for directing a plurality of jet streams of quench fluid under pressure to a bearing of said crankshaft includes a hollow quench casing mounted within said quench tank, said quench casing having a wall provided with a plurality of outlet orifices therethrough, and wherein said baffle means is provided with an edge flange portion for preventing jet streams from breaking through the surface of the quench fluid contained within the quench tank, said means being actuated by said conductor carrier and coil assembly.

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