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F. S. DENNEEN ET AL

2,255,103

EQUIPMENT FOR ELECTRIC HEATING

Filed Oct. 15, 1938

2 Sheets-Sheet 1

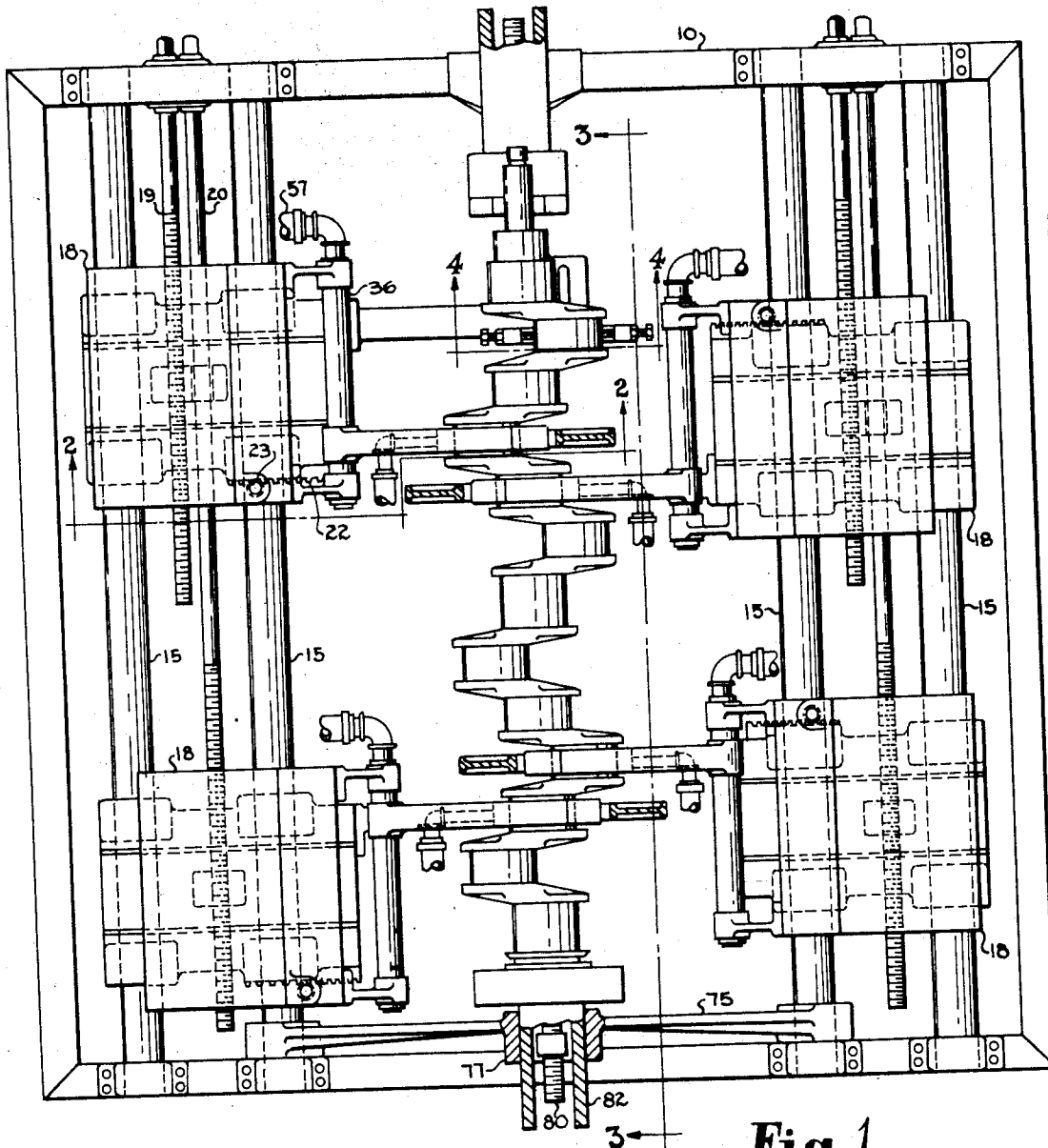


Fig. 1

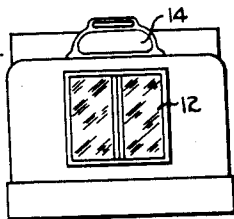


Fig. 6

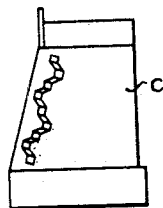


Fig. 5

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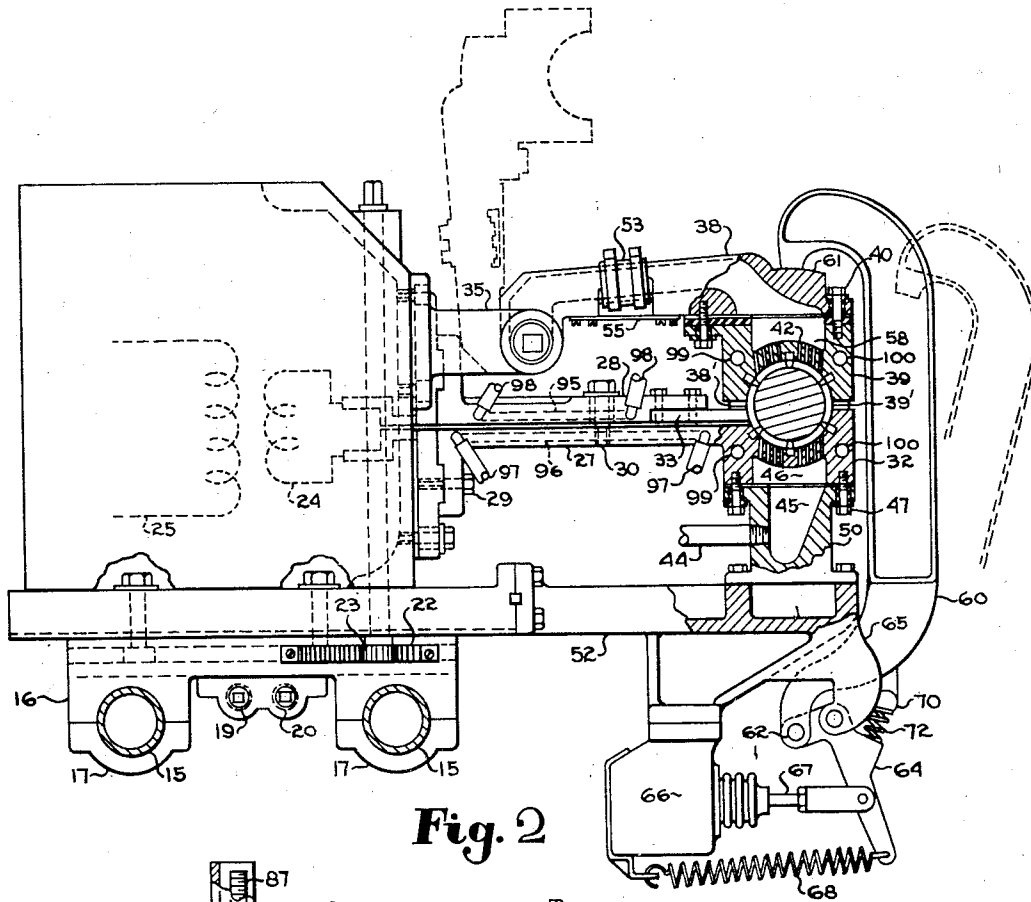


Fig. 2

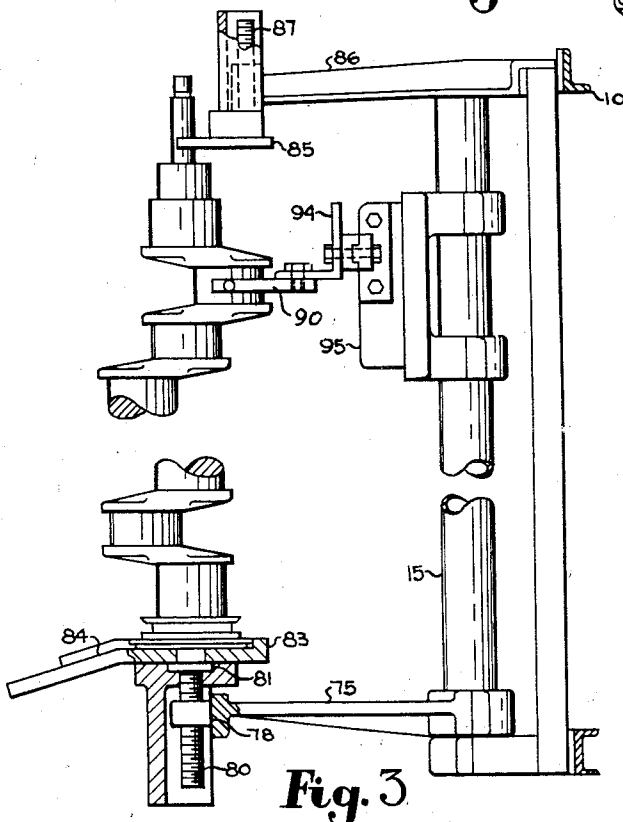


Fig. 3

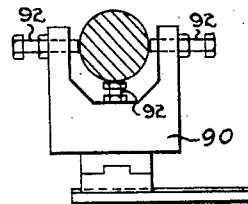


Fig. 4

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UNITED STATES PATENT OFFICE

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EQUIPMENT FOR ELECTRIC HEATING

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Application October 15, 1938, Serial No. 235,256

6 Claims. (Cl. 219—13)

This invention relates to mechanical handling and work supporting equipment employed, for instance, in heat treating the journals of a shaft or the like, and is more particularly directed to an equipment used to support the hardening units for inductively hardening crankshafts and eccentrics.

Heat treating the surface zones of shafts has become a well established branch of industry and the quantity of shafts to be treated renders it essential to provide mechanical apparatus to act in conjunction with the heat treating devices, in order to treat shafts of various sizes at a rapid rate. It is desirable to be able to mount a shaft and successively heat-treat the various journals thereon without excessive manual handling of the shaft or placing it in another apparatus. It is also desirable to provide an adjustable mounting for a plurality of heating and quenching units adjacent a shaft mounting, in order to expedite the heat treatment and reduce the time interval required.

The general object of our invention therefore has been to devise an apparatus for mechanically handling different sized shafts to be hardened, as well as to provide heating and quenching units which may be located to register with successive journals to be hardened. Other objects of the invention will become apparent from the following description when read in the light of the accompanying drawings and the important features thereof are summarized in the claims.

Briefly, our invention is embodied in a framework which is adapted to support a shaft in a generally vertical position in the middle part thereof. On each side of the supported shaft are guideways which carry a plurality of complete heat treating units. These units principally comprise a compound inductor and quenching device and a transformer to supply current to the inductor. These cooperating elements are in turn mounted on sub-frames individually slideable in the guideways and are bodily shiftable transversely of the guideways. As hereinafter explained in detail, the mechanism will accommodate shafts of different lengths, different degrees of throw and with different spacing between adjacent journals.

To the accomplishment of the foregoing and related ends, said invention, then, consists of the means hereinafter fully described and particularly pointed out in the claims; the annexed drawings and the following description setting forth in detail certain mechanism constituting, however, but one of various mechanical means in which the principle of the invention may be used.

In said annexed drawings—

Fig. 1 is a front elevation partly in section of our improved hardening apparatus;

Figs. 2, 3 and 4 are sections through Fig. 1,

as indicated by the lines 2—2, 3—3 and 4—4 thereon; and

Figs. 5 and 6 are a side and front elevation, respectively, on a greatly reduced scale showing the cabinet employed in our invention.

In general, our invention comprises a vertical framework with a support to hold a shaft or the like vertically in the mid-portion of the frame. The support holds the shaft slightly tilted to maintain it in place under the influence of gravity. A guideway is provided parallel to the supported shaft on each side thereof and slideably mounted on each guideway are two composite heating and quenching units. To heat treat successive parts of the shaft, the sub-frames supporting the inductors and quench units moved up and down along the guideways and the units themselves are moved transversely of the guideways. By means of adjustments hereafter described, various sizes of shafts may be handled.

Referring now to Fig. 1, we provide a framework built up of structural steel angle iron members 10 welded or riveted together to form a support for the active portions of the equipment comprising our invention. As shown in Fig. 5, the framework is of considerable depth to form a box-like structure. A sheet metal case C is formed to surround the entire equipment and protect the mechanism therein from dirt and confine the forcibly sprayed quench hereafter described to the interior.

As shown in Fig. 6, the front of the equipment case is provided with an enlarged central opening which may be closed by a pair of slidable glass doors 12; the glass sealing the interior and still permitting the examination of the material under treatment by a workman. Above the doors 12 is an instrument panel 14 which carries the necessary controls and meters for determining the conditions under which the machine will operate. Secured to each side of the lower face of the frame is a pair of tubular structural members 15 which serve as slideways for the heat treating equipment hereinafter described. Each pair of tubular members is supported in a common pad 16 by caps 17. The pads are riveted or otherwise secured to the top and bottom of the front face of the frame.

Two heat treating units slide up and down along each tubular slideway, as best shown in Figs. 1 and 2. The units proper are each mounted on a sub-frame 18 and comprise a heating and quenching unit, a transformer and the necessary operating connections therefor. The sub-frames may be adjustably position and retained along the guideways by respective threaded rods 19 and 20, the former threadingly engaging the upper sub-frame and the latter threadingly engaging the lower sub-frame. A wrench connection at the top of each rod 19 and 20 permits

its rotation in the frame and corresponding movement of the sub-frame along the tubular members.

To permit adjustment of the equipment for different size articles each heat treating unit is slidable transversely to the guideways 15 in slide-ways of the respective sub-frame 18. To this end a rack 22 is provided on the lower portion of each unit and this is engaged by a pinion 23 rotatably carried in the corresponding sub-frame 18. From the description thus far it is apparent that, depending on the position of the threaded rods, and the respective pinion 23, any desired position of the heat treating unit may be attained within the operating limits of the mechanism.

The heat treating unit, which is slidable transversely of the guideways 15, includes a transformer to provide the desired operating current to the inductor member. As shown in Fig. 2, this transformer comprises a secondary 24 and a primary 25 connected to a suitable source of periodically varying current. The secondary in turn is provided with leads which connect with the inductor element adapted to lie in predetermined spaced relation with the article to be hardened. One inductor element is provided for each transformer and the unit carried by respective sub-frames 18 may each be operated independently of the other.

Each inductor is made in two parts and may be opened to receive within it the journal of the shaft to be hardened, after which the inductor is closed and clamped by power means hereafter described and the actual heat treatment effected. As shown in Fig. 2, we provide a pair of spaced bars 27 and 28 which are located in the transformer case by bolts 29 and are maintained as a unit by a bolt 30 which is electrically insulated from the bars. At its outward end the bar 27 is formed to provide a circular segment 32 of the complete inductor. The bar 28 terminates at its end in a contact block 33 bolted thereto.

The inductor unit is completed by a unit pivotally carried on the transformer case. To this end a pair of outwardly extending brackets 35 are bolted to the said case and support a hollow pipe 36 employed, as hereafter described, to supply quenching fluid to the inductor. Pivotaly carried by the pipe in the extension 35 is an arm 38 which in turn carries an inductor section 39 adapted to cooperate with the inductor section 32 to form an encircling unit for inductively heating a journal positioned therebetween. The inductor segment 39 is bolted to the arm 38 at 40 in such manner that it is electrically insulated therefrom.

Current from the transformer secondary passes through the bar 27 and the inductor segment 32 and then through the inductor segment 39 and back through the bars 33 and 28. To accomplish this complete circuit a pair of similar silver contact blocks 38' and 39' are mounted on the bar 33 and the inner edge of the inductor 39 and on the inductor 32 and outer edge of inductor 39, respectively, to complete an electrical engagement with the inductor 39 when the same is closed about a journal. Current is then passed from the transformer through the inductor and, in a manner well known in the art, raises the adjacent surface zone of the crankshaft to a hardening temperature, after which the same is quenched.

Quench is supplied and forcibly directed against the heated surface through a plurality of orifices 42 formed in each section of the inductor

block proper. The lower block is supplied through a pipe 44 which discharges to the interior of a chamber 45 in communication with a corresponding chamber 46 formed in the inductor block and which is connected to the work adjacent face of the block by the orifices 42. To further reinforce the mounting of the inductor block the same is bolted as at 47 to the member 50, in which the chamber 45 is formed. The member 50 in turn is bolted to an extension 52 of the transformer unit.

Quench is supplied to the inductor section 39 through the arm 38. This arm which is hollow, is formed in two sections which are joined by a rubber hose connection 53. The inductor is properly spaced from the pivot about the pipe 36 by a radius plate 55. Quench is supplied to the pipe 36 through a supply conduit 57 and then passes through the hollow interior of the arm 38 to a chamber 58 formed in the block 39 and in communication with the work adjacent face thereof through the orifices 42.

After the work has been raised to the proper temperature by the inductive heating elements quench is simultaneously supplied through the pipes 44 and 57 and the related passages and is forcibly discharged against the work to rapidly cool the same.

The arm 38 and its associated inductor segment 39 may be pivoted to the dotted line position shown in Fig. 2 to permit freely locating a shaft to be hardened in heating relation therewith. After the work has been positioned and the arm 38 is swung to the solid line position of Fig. 2 it is positively clamped in cooperating relation with the inductor segment 32.

This clamping is accomplished by a C clamp 60 which at one end engages a shoulder 61 on the arm 38 and at the other end is pivoted as at 62 to a bell crank 64. The bell crank in turn is pivotally carried by arms 65 integral with the extension 52 from the transformer case. The free end of the bell crank 64 is connected to an air piston mechanism 66 by a link 67. The piston mechanism in turn is integrally carried by the extension 52. A tension spring 68 connects the end of the bell crank to the frame of the unit to normally act to release the C-clamp from exerting pressure on the shoulder 61. The opening movement of the clamp relative to the bell crank is limited by a boss 70 carried by the C clamp and a compression spring 72 interposed between the boss and a corresponding boss on the bell crank. After the inductors have been positioned with respect to each other and the C clamp is moved from the dotted line position of Fig. 2 to the solid line position, the application of air to the mechanism 66 pushes the bell crank away from it and draws the C clamp downwardly about its pivot 62 to clamp the inductors together.

The crankshaft to be hardened is carried in the frame by supporting mechanism which is adjustable to accommodate various size shafts. This adjustment, with the possible adjustments of the sub-frame 18 and the transformer carried thereby, permits the use of apparatus of our invention with many different kinds of shafts and, for instance, by racking the inductors to the center line of the frame a perfectly straight shaft may be handled.

The weight of a shaft undergoing hardening is carried by a pair of brackets 75 secured to the lower portion of the inner tubular members 15. These brackets extend outwardly, as shown in

Figs. 1 and 3 and merge to form a head 77, which in turn carries a boss 78 with a hole adapted to threadingly receive a screw 80. The screw is provided at its upper portion with a shoulder 81 which supports a plate 83 on which the shaft end rests. A hollow bracket 82 surrounds the screw 80 to protect the same and aids in positioning the shoulder 81 thereof. A U-shaped guide plate 84 rests on the plate 83 to facilitate locating the shaft in a central position thereon. By rotation of the screw 80 the plate 83 may be adjusted vertically of the framework to correspondingly position a shaft thereon.

The supported shaft is tilted toward the rear of the apparatus, as shown in Fig. 5, to retain it in position by gravity. As shown in Fig. 3, the upper end of the shaft lies within a V-plate 85, which is adjustably carried on a frame bracket 86 by a screw 87 in a manner similar to that described in connection with the support for the lower end of the shaft. The bracket 86 in turn is rigidly secured to the top cross-member 10 of the frame. To prevent rotation of the shaft and properly position the eccentric portions thereof for cooperation with the hardening unit, a locator 90 is provided. This locator has a U-shaped recess and is provided with three screws 92 which are adjusted to accommodate the size and throw of the crank pin. The locator is bolted to an angle member 94 and this in turn is bolted to a bracket 95, which may be clamped as shown in Fig. 3 to a tubular frame member 15. The member 90 is vertically adjustable with respect to this tubular member 15 to accommodate shafts having various crank pin locations.

Since the currents passing through the leads 27 and 28 are of high density, the temperature of these leads tends to rise rapidly during the heating interval. To prevent a harmful rise in temperature, these leads are drilled as at 95 and 96 to provide passages for cooling water which is supplied through fittings, such as 97 and 98. The water is delivered to these fittings by flexible hose lines. Similarly, passages 99 and 100 are provided in the inductors for cooling fluid which is supplied through suitable fittings and hose lines to cool the same.

From the foregoing description it will be apparent that we have provided an improved mechanical apparatus for handling shafts and the like which are to be subjected to heat treatment.

Other modes of applying the principle of our invention may be employed instead of the one explained, change being made as regards the mechanism herein disclosed, provided the means stated by any of the following claims or the equivalent of such stated means be employed.

We therefore particularly point out and distinctly claim as our invention:

1. In apparatus of the class described, a frame comprising four rectangularly disposed structural members, means comprising a pair of structural members forming part of and lying on opposite sides of said frame and closely adjacent and parallel to a respective side member thereof to form a pair of guideways, a pair of heat treating units one slidably mounted on each guideway, and including an inductor member extending into the central space between said guideways, and a support to maintain an elongated article parallel to said guideways and in said central space in cooperating relation with both said inductor members.

2. In apparatus of the class described, a gen-

erally rectangular frame, means comprising a pair of members forming part of said frame and lying parallel to each other and spaced apart to provide a pair of parallel guideways, a pair of sub-assemblies one slidably mounted on each guideway and each including an inductor member extending onto the central space between said guideways and a support to maintain an elongated article parallel to said guideways and in said central space in cooperating relation with said inductor members.

3. In apparatus of the class described, a frame, means comprising a pair of members forming part of said frame and lying parallel to each other and spaced apart to provide a pair of parallel guideways, a pair of sub-frames one slidably mounted on each guideway, a slideway formed in each sub-frame extending transversely of said first guideways, an inductor member slidable along each of said slideways and extending into the central space between said guideways and movable toward and from said guideways and a support to maintain an elongated article parallel to said guideways and in said central space in cooperating relation with said inductor members.

4. In apparatus of the class described, a frame, a support carried by said frame for an elongated article to be heat treated, a guideway in said frame parallel to said supported article, a sub-frame slideable along said guideway, an inductor member carried by said sub-frame and comprising two parts, one part pivotally mounted with respect to the other part to permit said inductor to lie in cooperating embracing relation with successive portions of said article, clamping means movably carried by the sub-frame independently of said inductor member to retain said separable sections of said inductor in cooperating relation with said article and means for moving said clamping means to apply clamping pressure to said inductor parts through said clamping means.

5. In apparatus of the class described, a frame, means comprising a pair of members forming part of said frame and lying parallel to each other and spaced apart so as to provide a pair of parallel guideways with a central space therebetween, a pair of sub-frames one slidably mounted on each of said parallel guideways and each having a slideway extending transversely of said parallel guideways, a pair of inductor supporting members one slidable along each of said slideways, a pair of segmental inductor members one carried by each of said inductor supporting members and each extending into the central space between said parallel guideways, one segment of each of said segmental inductor members being pivotally carried by its respective inductor supporting member and a support to maintain an elongated article parallel to said parallel guideways in said central space in cooperating relation with said segmental inductor members.

6. In apparatus of the class described, a frame, means comprising a pair of members forming part of said frame and lying parallel to each other and spaced apart to provide a pair of parallel guideways, a pair of sub-assemblies one slidably mounted on each guideway and each including an inductor member extending onto the central space between said guideways and a support to maintain an elongated article parallel to said guideways and in said central space in cooperating relation with said inductor members.

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