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APPARATUS FOR ELECTRIC HEATING

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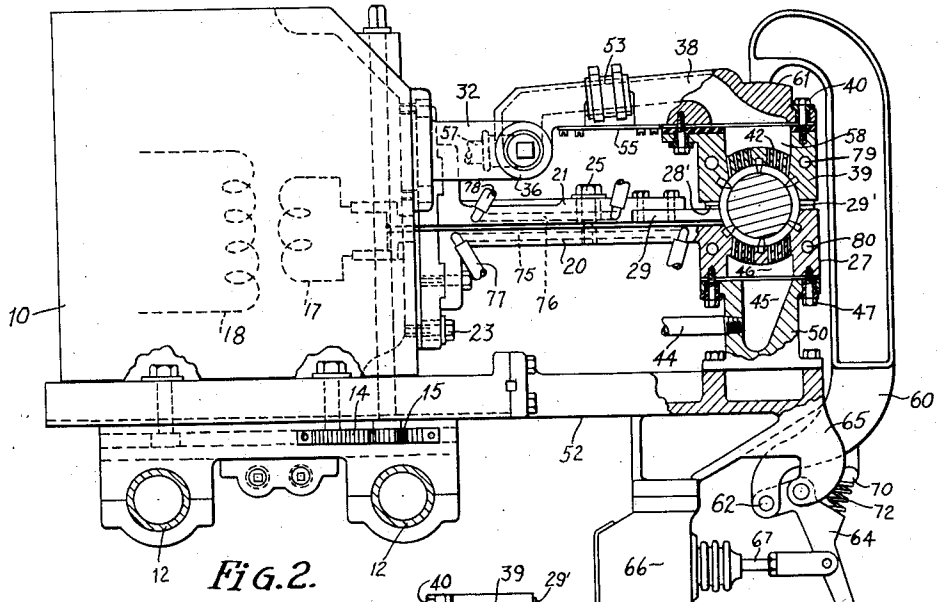


Fig. 2.

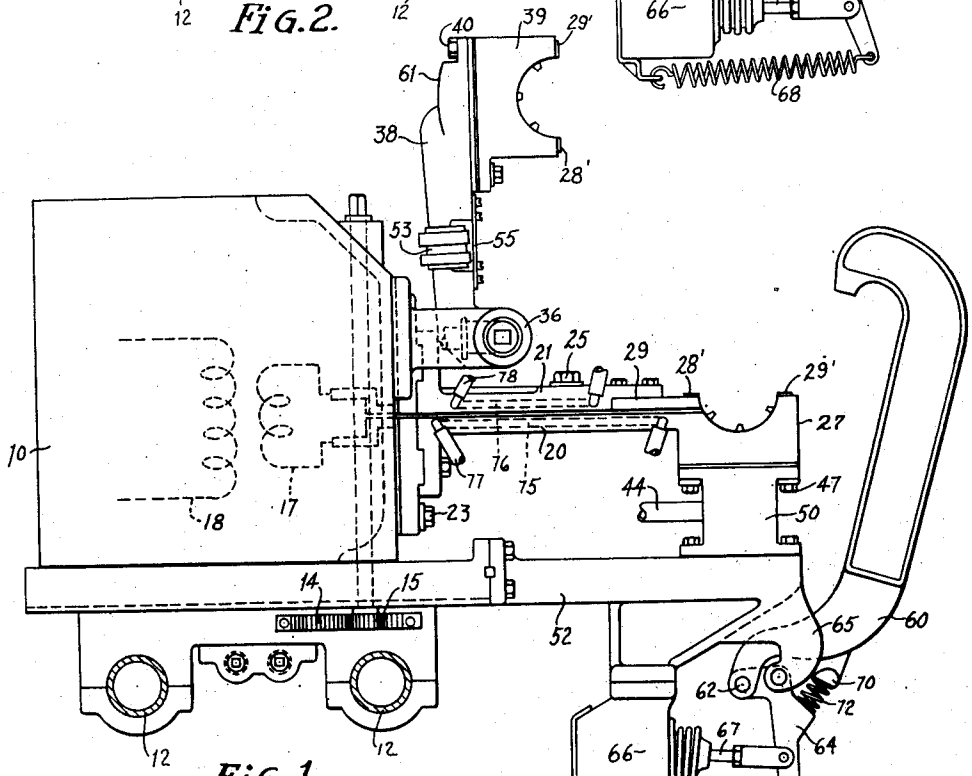


Fig. 1.

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APPARATUS FOR ELECTRIC HEATING

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Original application October 15, 1938, Serial No. 235,256, now Patent No. 2,255,103, dated September 9, 1941. Divided and this application January 16, 1941, Serial No. 374,692

6 Claims. (Cl. 219—13)

The present application is a division of our co-pending case, Serial No. 235,256, filed October 15, 1938, now Patent No. 2,255,103, dated September 9, 1941, and comprises certain mechanism shown and described in our co-pending application Ser. No. 56,870, filed December 31, 1935, now Patent No. 2,293,048, and like these co-pending cases is directed to equipment for electric heating.

This application is concerned with a unit assembly to be used in the inductive heat treatment of shafts and the like wherein a preselected surface zone of an article is inductively heated to a hardening temperature and is thereafter quenched to quickly cool the zone and retain the hardened structure.

The general object of the invention has been to devise apparatus of the character described wherein a compact, complete assembly is provided. A further object has been to provide as a single operating unit a frame embodying a transformer, an inductor and quenching apparatus which may be operated as a unit to treat the desired articles. A further object of the invention has been to provide means for maintaining in predetermined spaced relation the article to be heated and the inductive heating and quenching units by which the desired result is obtained. Other objects of the invention will become apparent from the following description when read in the light of the accompanying drawing and the important features thereof are summarized in the claims.

In general the invention comprises a frame on which is mounted a combined induction heating and quenching member formed in a plurality of parts. These parts may be separated to permit adjustment of an article to be treated, after which the parts may be brought to the desired heating position and clamped by a mechanically actuated clamping device. Incorporated with the apparatus is a transformer for supplying periodically varying current to the inductor, together with a supply of quenching fluid by which coolant is discharged from the quenching orifices onto the heated article zone.

To the accomplishment of the foregoing and related ends, said invention, then, consists of the means hereinafter described and particularly pointed out in the claims; the annexed drawing and the following description setting forth in detail one product constituting, however, but one of various applications of the principle of the invention.

In said annexed drawing—

Fig. 1 is a side elevation of our improved apparatus showing the parts in an open position; and

Fig. 2 is a section in a plane parallel to Fig. 1 showing the parts in a closed position.

The heat treating unit is mounted on a sub-frame 10 and comprises a heating and quenching unit, a transformer and the necessary operating connections therefor. The frame may be adjustably positioned and retained along supporting guideways 12 as shown and described in our co-pending application above. To permit adjustment of the equipment for different size articles the heat treating unit is slidable transversely to the guideways 12 in slideways of the sub-frame 10. To this end a rack 14 is provided on the lower portion of the unit and this is engaged by a pinion 15 rotatably carried in the corresponding sub-frame 10.

The heat treating unit includes a transformer to provide the desired operating current to the inductor member. This transformer comprises a secondary 17 and a primary 18 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.

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, we provide a pair of spaced bars 20 and 21 which are located in the transformer case by bolts 23 and are maintained as a unit by a bolt 25 which is electrically insulated from the bars. These bars are connected to the transformer terminals. At its outward end the bar 20 is formed to provide a circular segment 27 of the complete inductor. The bar 21 terminates at its end in a contact block 29 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

32 are bolted to the said case and support a hollow pipe 36 employed, as hereafter described, to supply quenching fluid to the inductor. Pivotally carried by the pipe in the brackets 32 is an arm comprising member 38, which member in turn carries an inductor section 39 adapted to cooperate with the inductor section 27 to form an encircling unit for inductively heating a journal positioned therebetween. The inductor segment 39 is bolted to the arm member 38 at 40 in such manner that it is electrically insulated therefrom.

Current from the transformer secondary passes through the bar 20 and the inductor segment 27 and then through the inductor segment 39 and back through the bars 29 and 21. To accomplish this complete circuit a pair of similar silver contact blocks 29' and 29' are mounted on the bar 29 and the inner edge of the inductor 39 and on the inductor 27 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 its supporting arm. 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 its 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 member 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 element, 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 member 38 and its associated inductor segment 39 may be pivoted to the position shown in Fig. 1 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 position shown in Fig. 2 it is positively clamped in cooperating relation with the inductor segment 27.

This clamping is accomplished by a C clamp 60 which at one end engages a shoulder 61 on the arm member 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 of 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 position of Fig. 1 to the position of Fig. 2, 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.

Since the currents passing through the leads 20 and 21 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 75 and 76 to provide passages for cooling water which is supplied through fittings, such as 77 and 78. The water is delivered to these fittings by flexible hose lines. Similarly, passages 79 and 80 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 articles which are to be subjected to heat treatment.

Other forms may be employed embodying the features of our invention instead of the one here explained, change being made in the form or construction, provided the elements stated by any of the following claims or the equivalent of such stated elements be employed.

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

1. In apparatus of the class described, a heating unit comprising a transformer and a pair of complementary inductor segments, one of the inductor segments being substantially fixedly connected to one terminal of the transformer and the other segment being hingedly connected adjacent to another terminal of said transformer, the hinge comprising means for delivering cooling fluid to the hinged segment, the hinged segment having a current conducting contact surface adapted to engage a current conducting contact surface of the fixed segment to cause current from the transformer to flow in series through the segments when the said surfaces are in contact, clamping means adapted to bring the segments together to establish current conducting engagement of the contact surfaces, the clamping means comprising a clamp and a power actuated element adapted to first automatically move a part of the clamp in one direction to bring the said part into clamping position adjacent to one of the segments and then to move the said part of the clamp in a direction substantially at right angles to the direction of the first movement to bring a part of the clamp into pressure engagement with a part of the last named segment and to continue the movement at right angles to cause the contact surface of the hinged segment to press firmly against the contact surface of the fixed segment to complete the series circuit through the segments for current from the transformer.

2. In apparatus of the class described, a heating unit comprising a transformer and a pair of complementary inductor segments, one of the segments substantially forming a fixed terminal of the transformer and the other segment being

moveably supported to engage another terminal of said transformer, the moveable segment having a current conducting contact surface adapted to engage a current conducting contact surface of the fixed segment to cause current from the transformer to flow in series through the segments when the said surfaces are in contact, clamping means adapted to establish current conducting engagement of the contact surfaces, the clamping means comprising a clamp and a power actuated element adapted to first move a part of the clamp in one direction to bring the said part into clamping position adjacent to one of the segments and then to move the said part of the clamp in a direction substantially at right angles to the direction of the first movement to bring the part of the clamp into pressure engagement with a part of the last named segment and to continue the movement at right angles to cause the contact surface of the moveable segment to press firmly against the contact surface of the fixed segment to complete the series circuit through the segments.

3. In apparatus of the class described, a heating unit including a transformer, the transformer having two substantially parallel terminals extending therefrom, one of the terminals having a part serving as a fixed inductor segment, the fixed inductor segment having a current conducting contact surface, the other terminal having a replaceable member with a current conducting contact surface thereon, a moveable inductor segment, the moveable segment having two current conducting contact surfaces, one of said surfaces being adapted to engage the contact surface of the aforesaid fixed segment and the other contact surface being adapted to engage the contact surface of the replaceable member, means for guiding the moveable segment to bring each of the contact surfaces of the said moveable segment into proximity with a corresponding contact surface of the fixed segment and with the contact surface of the replaceable member, and clamping means to bring said proximate surfaces into pressure engagement to complete a circuit through the segments for inducing current being supplied by the transformer.

4. In apparatus of the class described, a heating unit comprising a source of inducing current and two conductors, one of the conductors having a part formed to serve as a segment of an inductor to induce heating current in a part of an article, means for locating the part of the article in proximity with the inductor, a current conducting contact surface on each of the said conductors, a moveable inductor segment adapted to cooperate with the part of the one of the aforesaid conductors serving as an inductor segment to extend around the aforesaid part of the article, the moveable inductor segment having two contact surfaces, means for supporting the moveable inductor segment and to guide said moveable inductor segment to bring each contact surface of the segment into proximity with a corresponding contact surface of the conductors, and clamping means applicable to bring the proximate surfaces into pressure engagement, the moveable inductor segment supporting means having a member adapted to be flexed to bring the proximate surfaces into parallelism when the clamping means is applied.

5. In apparatus of the class described a heating unit comprising a source of periodically varying current and a pair of complementary inductor segments, one of the inductor segments being fixed and the other moveable, conductors connecting the inductor segments to said source, the moveable inductor segment having a pair of spaced surface contacts to complete a circuit through said moveable inductor segment, means for guiding a contact surface of the moveable inductor segment in a direction substantially perpendicularly to a contact surface of the fixed inductor segment to bring the last named surfaces into proximity, clamping means for bringing the surfaces into pressure engagement, the clamping means comprising a clamp supported to move into clamping position adjacent to the moveable inductor segment, and power means to then move said clamp into engagement with an inductor segment to bring the aforesaid surfaces into pressure contact to complete a circuit through the inductor segments after the clamp has been moved into the clamping position.

6. In apparatus of the class described for heating an article, an inductor comprising two fixed members and a moveable member, each fixed member having a contact surface adapted to lie adjacent to the article, a substantially rigid base supporting the fixed members, the moveable member having contact surfaces, each contact surface of the moveable member being adapted to engage a contact surface on each of the fixed members to complete a circuit through the fixed members and the moveable member, means to guide the moveable member into a predetermined spaced relation with the article to be heated and to bring the contact surfaces of the moveable member into engagement with the contact surfaces of the fixed members, clamping means being pivotally supported on the fixed member support, said clamping means being adapted to engage the moveable member to hold the contact surfaces of the moveable member in current conducting engagement with the contact surfaces of the fixed members, and means for supplying inducing current to the inductor to heat the article.

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