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APPARATUS FOR HARDENING SHAFTS AND THE LIKE

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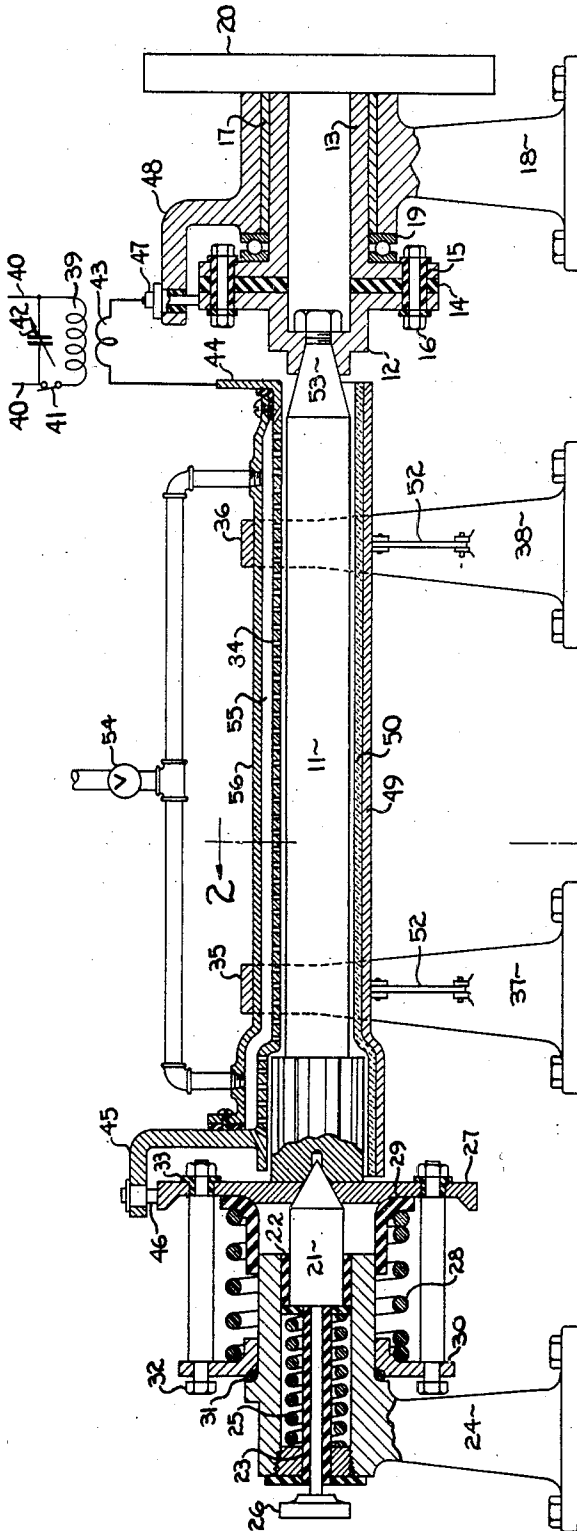


Fig. 1

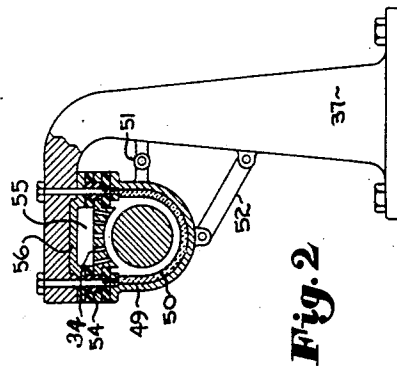


Fig. 2

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APPARATUS FOR HARDENING SHAFTS AND
THE LIKE

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Original application December 14, 1935, Serial No. 54,388, now Patent No. 2,202,759, dated May 28, 1940. Divided and this application May 27, 1940, Serial No. 337,425

4 Claims. (Cl. 219—13)

The present application is a division of our application Serial No. 54,388, filed December 14, 1935, (now Patent No. 2,202,759, dated May 28, 1940) and entitled "Heat treatment of shafts and the like" and is directed mainly to simultaneously hardening all of an axially extending surface zone of a substantially cylindrical article which otherwise would require to be hardened progressively. This invention provides a single inductor of such form as to heat a surface zone of a shaft or other similar article which varies in diameter and which by former means would be hardened by using an inductor of varying form or by using two or more inductors. Considerable time and expensive equipment can be saved by use of the apparatus herein described.

In view of these conditions, the chief object of the present invention is to provide means for hardening substantially the entire cylindrical surface zone of a shaft or tube simultaneously. A further object is to provide means of hardening such surface zone rapidly and with a minimum loss of heat. Another object is to provide apparatus which may be readily changed over for heat treating articles of other dimensions. An additional object is to provide apparatus which is inexpensive to construct and to operate.

With these and other objects in view, said invention consists of the means hereinafter described for heat treating an article of the general class shown and described herein. It will be understood that the following description is not intended to limit the scope of this invention and that the invention may appear in many embodiments differing in detail from this disclosure, but within the scope of the appended claims.

The annexed drawing and following description set forth in detail certain mechanism embodying the invention, such disclosed means, however, constituting but one of the various forms in which the principle of our invention may be used.

In said annexed drawing:

Fig. 1 illustrates the preferred form of our apparatus. Fig. 2 is a section taken substantially on line 2—2 of Fig. 1.

In the above figures, the shaft 11 to be heat treated is supported at its one end by the flange 12 which usually is made of copper. This flange is carried by the tubular journal 13 which is insulated therefrom by the fibre disc 14 and by bushings 15 surrounding the assembly bolts 16. This journal has a supporting bearing 17 in the pedestal 18 and is held axially between thrust

bearing 19 and pulley 20, the latter being employed as driving means for rotating the journal and the shaft 11.

At its other end the shaft is supported on the center 21 which, thru insulating bushings 22 and 23, is carried by the pedestal 24. The spring 25 serves as means for maintaining the center in engagement with shaft 11 and the knob or collar 26 serves as means for limiting the inward movement of this center when the shaft is removed. The copper disc 27 which is centrally located and supported by the bearing seat 29 is held in current conducting contact with the end of shaft 11 by spring 28 which is supported at its one end on the insulating bearing seat 29 carried by the disc 27 and at its other end by seat 30 having a ball thrust bearing 31 engaging an annular thrust surface on the supporting pedestal 24. The bolts 32 having insulating bushings 33, serve as means for limiting the expansion of spring 28 when the shaft 11 is removed.

The longitudinally extending conductor 34 which is insulatedly supported at 35 and 36 by pedestals 37 and 38 is spaced substantially uniformly from the shaft 11 and usually in close proximity therewith so as to serve as an inductor of high frequency current in the shaft when high frequency current is caused to flow in this conductor. By selectively changing the thickness of the insulation between inductor 34 and supporting pedestals 37 and 38 the distance between the inductor and shaft 11 is adjusted. The high frequency current is supplied by the transformer, having a primary 39 connected across the power lines 40 from a high frequency generator. The circuit thru the primary of the transformer is closed by means of switch 41. The condenser 42, which is usually adjustable, serves as means for tuning the circuit for the most satisfactory heating condition. Current from one end of the secondary 43 is supplied to the inductor 34 at terminal 44, the other terminal of this inductor being at 45 which carries the brush 46 contacting with the rim of flange 27. The other end of secondary 43 is connected to brush 47 which is insulatedly carried by bracket 48 of pedestal 18. It will be evident that current from the secondary 43 will thus pass axially thru inductor 34 in close proximity with a surface of the shaft 11 and will then pass thru brush 46 and disc 27 into the end of shaft 11, this shaft serving as a return circuit to flange 12 on which brush 47 bears.

As the heat generated in the shaft 11 will be concentrated in that axially extending sur-

face portion adjacent to the inductor 34, rotation or oscillation will be required to distribute this heat uniformly over the entire cylindrical surface. A belt engaging pulley 20 provides for such rotation. Of course, for very large shafts or irregularly formed articles whose rotation or oscillation would be difficult, the inductor may be so formed and suspended as to be rotated or oscillated, while the shaft or article remains fixed.

Since the rotation of the shaft will successively expose the heated portions to an otherwise cold atmosphere surrounding all parts of the shaft, save that in the immediate vicinity of the inductor, much heat will be lost to this atmosphere with an increase in the power and time required for heating. To avoid or materially reduce this loss, an enclosure 40 is provided which has a refractory lining 50. This enclosure is hinged at 51 so that it can be lowered to remove or insert the shaft 11, the quickly detachable brace 52 serving as means for holding this enclosure in operating position.

In using this apparatus, the flange 27 and center 21 are retracted thereby compressing springs 25 and 28. The shaft 11 is inserted with its tapered end 53 engaging the central tapered hole in flange 12. The flange 27 and center 21 are released and the pressure of spring 28 brings the flange 27 into current conducting contact with the end of the shaft and this pressure is sufficient to provide driving engagement of end 53 in the flange 12. The enclosure 40 is brought into position. The belt then causes pulley 20 to rotate at a relatively high rate of speed. Switch 41 is closed and current of high density and high frequency flows axially in inductor 34 and returns thru the shaft 11 rapidly bringing the surface of the shaft to hardening temperature, the rotation of the shaft distributing the heat uniformly over the entire surface of the shaft or over such parts as are embraced by conductor 34. Upon reaching quenching temperature switch 41 is opened and valve 54 is turned permitting quenching fluid to flow under considerable pressure into the space 55 within the insulated jacket shell 56 from where it is projected uniformly over the heated surfaces of the shaft. Preferably, at the instant of quenching braces 52 are removed and enclosure 40 is permitted to drop down and thus provide means for the escape of the quench.

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 distinctively claim as our invention:

1. In apparatus for hardening a surface zone of a cylindrical article, the article being adapted to be hardened by heating and quenching, an axially extending inductor having a current conducting section lying in closely spaced relationship with the article, the current conducting section being shaped to conform with a part of the article, a heat resisting shield conforming substantially with the contour of the article and

extending around a part of the article, said shield cooperating with the inductor to form a heat retaining enclosure for the article, the inductor forming a part of a wall of the enclosure, means for supplying periodically varying current to the inductor to induce heating current in the article, and means to rotate the article within the enclosure, said rotating means comprising a conductor adapted to connect the inductor with the article.

2. In apparatus for heating an article, the article being adapted to be rotated on an axis, means for rotatably supporting the article, a conductor extending axially along the article, means for delivering current from a source to an end of the conductor, sliding contact means for delivering current from the conductor to the article supporting means at an opposite end of the conductor, sliding contact means for connecting the article to the source, the article supporting means having a member adapted to be retracted to release the article, a part of said supporting means serving as a conductor to deliver current to the article, and a source for supplying said current.

3. In apparatus for heating an article, the article being adapted to be rotated on an axis, means for rotatably supporting the article, an enclosure for the article, a conductor extending axially and forming a fixed wall of the enclosure, the conductor having an adjoining jacket space, a heat retaining shell serving as a movable wall of the enclosure, movable means supporting the shell, said movable means being adapted to move the shell to open the enclosure, contact means exterior of the enclosure for delivering current from a source to one end of the conductor, sliding contact means for delivering current from the conductor to the article supporting means at an opposite end of the conductor, sliding contact means for connecting the article to the source, the article supporting means having a member adapted to be retracted to release the article, a part of said supporting means serving as a conductor to deliver current to the article, and a source for supplying said current.

4. In apparatus for heating a rotatable article, means for rotatably supporting the article at substantially oppositely disposed parts, resilient means for holding the supporting means in current conducting engagement with the article, said resilient means being retractable to release the article, an inductor being supported to lie in closely spaced relation with the article, the inductor extending substantially from one of the oppositely disposed parts to the other, means for delivering periodically varying current to the inductor to induce heating current in the article to heat the article, means to rotate the article supporting means, means for maintaining current conducting engagement of the article supporting means with the inductor, and means for maintaining electrical contact with the article at a point remote from the said means for maintaining current conducting engagement while the supporting means rotates to cause current to flow in series in the inductor and in the article.

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