Sept. 26, 1944. H. E. SOMES 2,359,272

INDUCTION HEATING HEAD

Original Filed Oct. 18, 1941

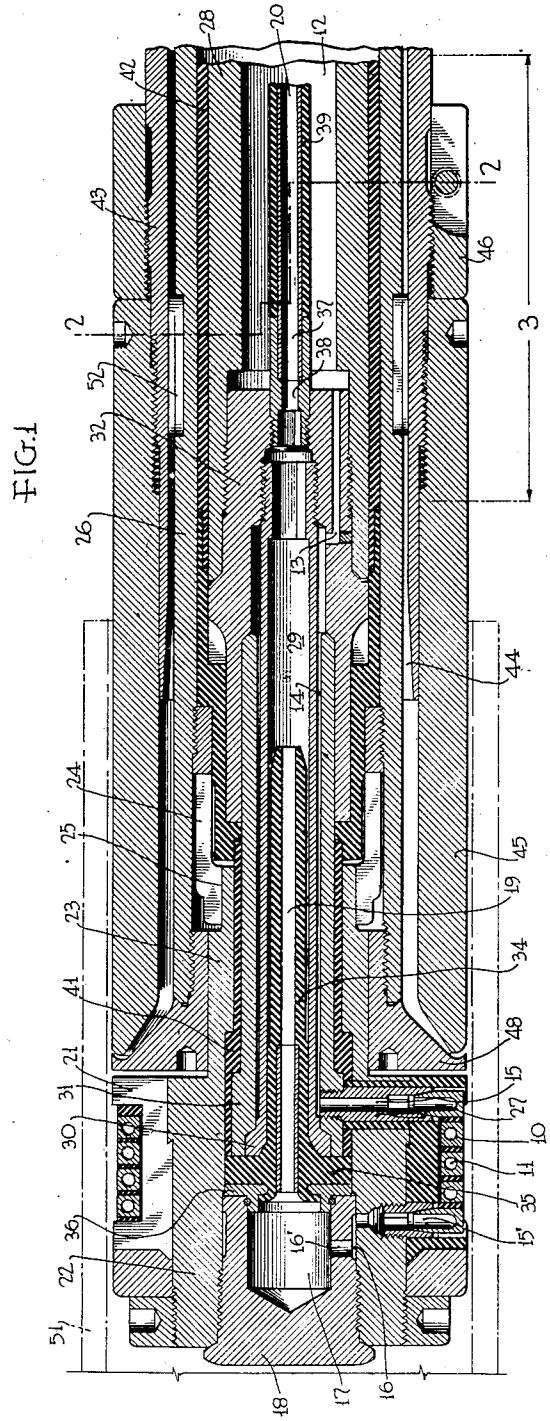

FIG. 1

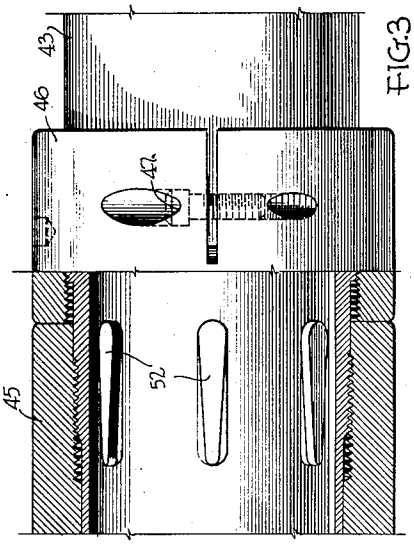

FIG. 3

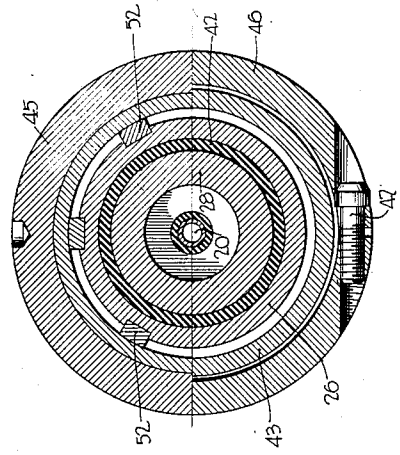

FIG. 2

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INDUCTION HEATING HEAD

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Original application October 18, 1941, Serial No. 415,580. Divided and this application June 11, 1942, Serial No. 446,568

9 Claims. (Cl. 219—13)

This application is a division of my application Serial No. 415,580, filed October 18, 1941.

This invention relates to apparatus for heat treating metal products and particularly to an induction heating head for use in such treatment.

An object is to provide an induction heating head especially constructed and arranged for horizontal operation in heating the inner surfaces of hollow workpieces, although it will be apparent that the invention includes features adapted to either vertical or horizontal work.

A further object is to provide an induction heating head constructed and arranged to permit the heating coil being quickly removed from a supporting arbor and replaced by a coil of different size.

A further object is to provide an induction heating head constructed and arranged to convey coolant to and from the heating coil without discharging any of the coolant fluid outside of the head.

These and other objects which will be apparent are attained by the present invention which is illustrated in the accompanying drawing, in which

Figure 1 is a longitudinal sectional view through an induction heating head constructed in accordance with one embodiment of this invention, the supporting arbor being broken off;

Figure 2 is a transverse section on the line 2—2 of Figure 1; and

Figure 3 is an elevation, partly in section, of the axial length designated 3 in Figure 1.

In general, the invention comprises an induction heating head supported upon a mandrel having separate, concentric coolant passages through which a suitable coolant flows to and from a hollow heating coil removably mounted upon the end of the mandrel. Thermal insulating means is provided between the separate passages to prevent the temperature of the coolant flowing to the coil being raised by the heated fluid which has passed through the heating coil and is being conveyed away therefrom.

The illustrated embodiment shows an inducing conductor 10 having a number of convolutions and provided with an inner passage 11 for cooling. Water or other appropriate coolant is supplied through the passage 12 in the hollow arbor, thence through passages 13 and 14 to a radial passage 15, through the several turns of the inducing conductor and thence through a radial hollow connector plug 15'. From the plug 15' the coolant flows through a slot 16, radial bore 16' and chamber 17 formed in an end plug 18, and back through inner heat insulated passages 19 and 20. The passage for conveying the coolant away from the heating coil is thermally insulated. Radial laminations 21 enclose the inducing conductor as is well known in the art, and these laminations are mounted on an annular coil support 22 having an annular extension 23 engaging electrical contacts formed by circumferentially spaced, yieldable fingers 24 contacting an outer surface 25 of reduced diameter on the inner end of such extension 23 and connected to an inner annular arbor portion 26. The other end of the conductor coil is electrically connected through the insulated, hollow connector 27 with an insulated arbor member 28.

In order to permit ready replacement of one head with another of different diameter, to accommodate different sizes of workpieces, the present invention provides a construction permitting such change upon removing two threaded connections. The coil support 22 is secured in place by an elongated hollow bolt 29 having a head 30 engaging in and closing the end of a hollow sleeve 31, and an inner end threaded to the reduced bore of an annular arbor member 32 which is in turn threaded to the insulated arbor portion 28. The inner end of the sleeve 31 slidably engages the bore of the arbor member 32. The greater portion of the elongated bolt 29 is of somewhat reduced diameter to provide for the coolant conveying passage 14. The coolant conveying passage 19 formed within the hollow bolt is thermally insulated from the outer annular passage 14 by a tubular insulating member 34 fitting within the bolt and extending for a substantial distance therethrough. The insulating member has a head 35 bearing against the outer end of the bolt and expanded over the head of a retaining ring 36 keyed to the inner annular end of the chambered plug 18 which is rotatable relatively to the ring so that rotation of the plug will have no twisting effect upon the head 35 of the insulating member 34. The central coolant passageway 20 is formed by a hollow member 37 connected to the annular arbor member 32 by a hollow connector 38 threaded into the arbor member and frictionally receiving the end of the tube 37. The greater length of the tube 37 is enclosed within a thermal insulating sleeve 39 to prevent transfer of heat between the outgoing and incoming coolant.

The hollow passage forming sleeve 31 has a shouldered end fitting within a similarly formed end of a sleeve 41 of electrically insulating ma-

terial interposed between the sleeve 31 and the extension 23 of the coil support. Similarly, the arbor members 28 and 32 are electrically insulated from the surrounding arbor members by an insulating sleeve 42 forming an extension of the sleeve 41.

The annular arbor portion 26 is surrounded by an outer arbor portion 43 of greater diameter which forms therewith a passage 44 for quenching fluid. The passage 44 is continued by an outer sleeve 45 threaded to the arbor portion 43 and secured in position by a partially split lock nut 46 having a locking bolt 47 for drawing the two parts of the nut together. An annular nozzle member 48 is threaded in the end of the inner arbor portion 26 and formed so as to cooperate with the adjacent end of the outer sleeve 45 to provide a quench nozzle at such an angle that the quenching fluid is directed outwardly at an angle away from the adjacent heating coil.

The construction is such that the heating head is easily replaceable upon removing two threaded connections. When the plug 18 is unscrewed, the annular ring 36 which is keyed thereto together with the hollow thermal insulating member 34 can be pulled out of the head with the plug. The hollow bolt 30 can then be unscrewed and removed permitting removal of the hollow sleeve 31. This permits removal of the heating head comprising the coil supporting member 22 and coil 10, the insulation 41 being removed therewith.

The quench head is also readily removable for replacement by a head of different diameter. To do so, the nozzle member 48 is unthreaded whereupon the sleeve 45 can be unthreaded after first releasing the lock nut 46. A new sleeve 45 of different diameter and a nozzle member 48 of different radial depth can then be substituted to accommodate a workpiece 51 of different diameter. At the same time a heating head of the desired diameter can be placed in position and the holding members consisting of the hollow bolt 30, plug 18 and associated parts can then be replaced and secured in position.

In order to accurately position and support the end of the outer arbor portion 43, a plurality of circumferentially spaced supporting blocks 52 are keyed in the outer face of the inner arbor portion 26 and engage the inner face of the outer portion 43. Inasmuch as these spacers are located in the quenching liquid passage, they are formed of streamline contour in order to avoid producing turbulence in the fluid. This fluid may be either liquid or gas as described in my above mentioned application.

It will be apparent that incoming coolant flowing through the passages 12, 13, 14, etc., is protected against the heating effect of the outgoing coolant flowing through the hollow bolt 29 and passage 20 by the thermal insulating members above described. There is no discharge of coolant outside the heating head and none is brought into contact with the surrounding workpiece.

Although I have described one embodiment only of the invention in specific detail, it will be apparent that the invention is not limited thereto but can be variously modified and adapted within the scope of the appended claims.

What is claimed is:

1. The combination in an induction head for heat treating, of a supporting and current conducting arbor, a tubular induction heating coil, a coil support including a current conducting extension, means for electrically connecting said extension to said arbor including circumferentially spaced contacts mounted on said arbor and slidably engaging said extension, a hollow clamping bolt extending through said support and extension and engageable with said arbor for clamping said coil and support thereto, and means forming a coolant conveying passage between said tubular coil and said hollow bolt.

2. The combination in an induction head for heat treating, of a supporting and current conducting arbor, a tubular induction heating coil, a coil support including a current conducting extension, means for electrically connecting said extension to said arbor including circumferentially spaced contacts mounted on said arbor and slidably engaging said extension, a hollow clamping bolt extending through said support and extension and engageable with said arbor for clamping said coil support thereto, means forming a coolant conveying passage between said tubular coil and said hollow bolt, and a tube of thermal insulating material extending through said bolt to form a non-conducting wall around the coolant passage therein.

3. The combination in an induction head for heat treating, of a supporting hollow arbor, a tubular induction heating coil, an annular coil support, a hollow clamping bolt extending through said support and engaging said arbor for securing said coil support to said arbor and forming with said arbor a coolant return passage, means providing a coolant supply passage surrounding said bolt and arbor, means connecting said supply passage to one end of said coil, a sleeve of thermal insulating material extending through said bolt to form a non-conducting wall around said return passage, and a chambered member closing said annular coil support and connecting the other end of said tubular coil to said hollow bolt, and means for connecting said insulating material to said chambered member for removal therewith.

4. The combination in an induction head for heat treating of a supporting hollow arbor, a tubular induction heating coil, an annular coil support, a hollow clamping bolt extending through said coil support and engaging said arbor for securing said coil support to said arbor and forming with said arbor a coolant return passage, means providing a coolant supply passage surrounding said bolt and arbor, means connecting said supply passage to one end of said coil, a sleeve of thermal insulating material extending through said bolt to form a non-conducting wall around said return passage, a chambered member closing said annular coil support threaded to said coil support and forming a passage between the other end of said tubular coil and said hollow bolt, and means connecting said insulating material to said closure whereby removal of said closure withdraws said insulating material from said bolt.

5. In an induction heating head, an annular coil support, a current conducting coil carried by said support and having a coolant conducting passage therethrough, said support having axially spaced passages extending through the wall thereof and connected with said coil passage for conducting coolant thereto and therefrom, and circumferentially spaced concentric tubular members within said support, said members at one end being connected together in fluid-tight engagement, one of said axially spaced passages being in communication with the space between

said members and the other of said axially spaced passages being in communication with the interior of the innermost of said members.

6. In an induction heating head, an annular support, concentric circumferentially spaced tubular members within said support, said members being engaged together at one end within said support in fluid-tight relation, a closure member threaded within said support for closing the bore thereof and having a passageway through the wall thereof in communication with the interior of the innermost of said tubular members, and a current conductor surrounding said support, said conductor having a coolant conducting passageway therethrough in communication at one end through the wall of said support with the space between said members and in communication at its other end through the wall of said support with said closure member passageway.

7. In an induction heating head, annular coil support, concentric circumferentially spaced tubular members within said support engaged together at one end within said support in fluid-tight relation to constitute an outer closed-end passage, a sleeve of thermal insulating material within the innermost of said members, said sleeve constituting an inner open-end passage thermally insulated from said outer passage, a closure member within said annular support closing the bore thereof and having a passageway through the wall thereof in communication with the interior of said sleeve, and a current conductor surrounding said support, said conductor having a coolant conducting passageway therethrough in communication at one end through the wall of said support and the innermost of said members with said outer passage and at the other end through said support wall with said closure member passage.

8. In an induction heating head, an annular support having a bore, a current conductor surrounding said support, means within said support defining concentric outer and inner passages, said inner passage opening at one end into the bore of said support, a sleeve of heat insulating material within said inner passage, a removable closure member for the bore of said support, and means connecting said sleeve and closure member for removal of said sleeve with said closure member, said conductor having a coolant passageway in communication at one end with said outer passage and at its other end through said closure member with the interior of said sleeve.

9. The combination in an induction heating apparatus, of an annular support, a current conductor surrounding said support and having a coolant conducting passage therethrough, concentric tubular members circumferentially spaced from each other, said members being connected together at one end within said support in fluid-tight engagement, said passage being in communication with the space between said members and with the interior of the innermost of said members, a tubular arbor, and a conduit within and spaced from the internal wall of said arbor, the innermost of said members having a threaded connection with said arbor for securing said support to said arbor and being in coolant conducting communication with said conduit, and the space between said members being in coolant conducting communication with the space between the inner wall of said arbor and said conduit.

HOWARD E. SOMES.