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INDUCING HEAD

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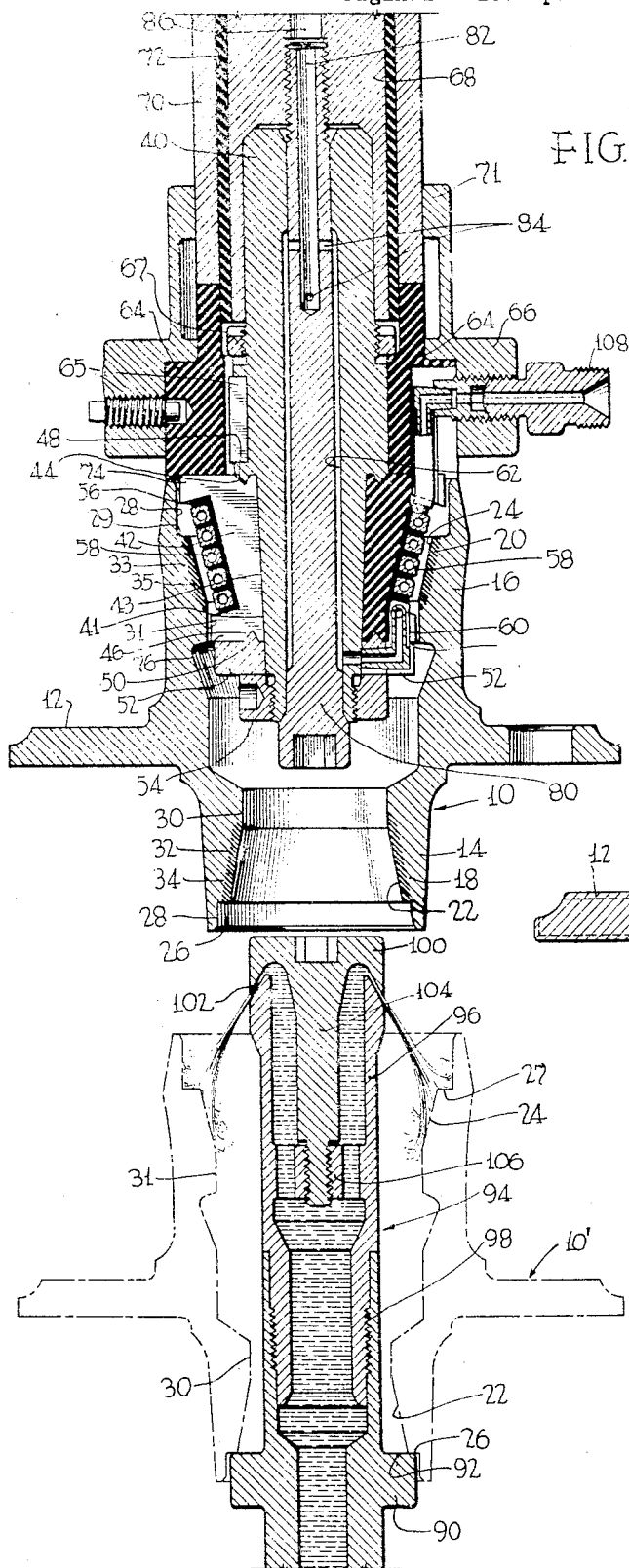


FIG. 1

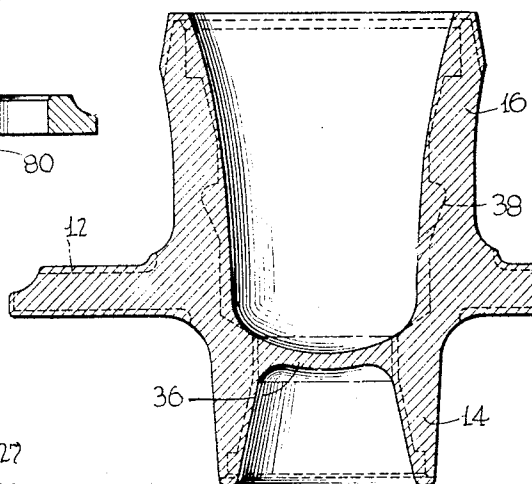


FIG. 2

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INDUCING HEAD

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331,735. Divided and this application January
22, 1942, Serial No. 427,754

15 Claims. (Cl. 219-13)

This invention relates to induction heating heads, their mounting and the cooling, connection and mounting of a coil carried by the head. Where such type head is adapted for slidable cooperation with a cylindrical workpiece, it becomes desirable to remove the head from its support and replace the same with a head of different size where work of a different size is to be heated.

An object of this invention is to provide a head which is adapted to be readily and quickly removed from its support. Another object is to provide a head telescopically supported yet free of any tendency to fit more tightly at one time than another due to the expansion of its support from heat. A further object is to provide a head that may be quickly removed without the tedium of separately disconnecting all electrical and coil cooling fluid connections. Yet another object is to provide one connection which is simultaneously a mechanical support, an electrical contact, and a coil cooling fluid connection.

According to this invention an inducing head is provided with a support member by means of which the head is slidably connected telescopically within an inner conductor of a supporting arbor, by means of an axial elongated bolt passing through said member. A coil cooling fluid passage is formed between such bolt and member and a resilient brush connects the head with an outer conductor of the arbor.

The above and other novel features of the invention will appear more fully hereinafter from the following detailed description when taken in conjunction with the accompanying drawing illustrating a form of the invention and the method by which the same may be produced. It is expressly understood, however, that the drawing is employed for purposes of illustration only and is not designed as a definition upon the limits of the invention, reference being had for this purpose to the appended claims.

In the drawing wherein similar reference characters refer to similar parts throughout the several views,

Figure 1 illustrates a section of a hub showing its hardened zones in cross section together with a diagrammatic showing of the hardening and quenching apparatus employed in the hardening step, and

Figure 2 is a section through a forged blank from which the hub may be produced together with an indication thereon as to the method of preparing the blank for the subsequent hardening step.

Referring to the drawing and more particularly Figure 1, there is illustrated a hub in section having a barrel or substantially tubular portion 10, a wheel attaching flange 12 and bearing ends 14 and 16. The bearing ends include internally projecting integral annuluses of metal 18 and 20 having tapered surfaces 22 and 24. Each tapered bearing surface is terminated abruptly at its end of greatest diameter by sharp radial shoulders 26 and 27, extending to a cylindrical bored portion 28. The other end of each tapered bearing portion merges into cylindrical portions 30 and 31 having a diameter equal to the minimum diameter of the tapered bearing, and which cylindrical portions extend axially of the hub a distance in practice less than the length of the axial length of the tapered bearing surface. The tapered bearing surface is hardened to a depth as indicated at 32 and 33 by electromagnetic induction heat treatment as will be more particularly described hereinafter. The hardened layer, however, may have a hardness of from sixty to seventy Rockwell C and be substantially uniformly hard throughout the extent and depth thereof, and the remainder of the metal of the hub may have its original characteristics except for extremely narrow transition zones 34 and 35 between the hardened zone and the remainder of the metal.

In practice such a hub can be formed from a forging of the shape illustrated in Figure 2, the excess metal of the forging being removed by machining operations. For example, the central disc 36 of the forging may be sheared away, and the internal diameter as well as the external diameter subsequently machined to the shape indicated by the dotted lines 38 of Figure 2 or the internal shape as illustrated in Figure 1 except that the bearing surfaces may be ground to a true taper subsequent to the heat treating operation. Such a forging may be a steel forging having a carbon content of from .40 to .50, a manganese content of .80 to 1.10, a phosphorus content not exceeding .05 and a sulphur content ranging between .10 and .18. The above specifications are given only as an indication of how small an amount of carbon is required in such a forging to provide the necessary analysis and basis for subsequent electromagnetic induction heat treatment. In practice, obviously the hub may be a casting as well as a forging or may be turned from solid stock, it being merely necessary that the material have sufficient carbon such that when transformed by the substantially instantaneous action of electromagnetic induction heat

treatment and immediately quench thereafter, a suitable hardness can be developed.

To subsequently harden the tapered bearing race in the manner disclosed in Figure 1 an induction heat treating head of the type diagrammatically illustrated may be employed or a double head may be employed as is disclosed in a copending application of *Somes*, Serial No. 216,931, filed July 1, 1938 (now Patent No. 2,277,372, dated March 24, 1932). Such a head as is disclosed herein comprises a central supporting member 40 upon which is mounted a plurality of radial laminations 42 noted as at 44 and 46 so as to be clamped with their inner edges 43 in tight engagement with the supporting member external surface 41 between annular ridges 48 upon the supporting member 40 and an annular ridge 50 upon an end collar 52, the latter being secured in position by a nut 54 threaded upon the support member 40. The laminations which may be of a special cobalt iron for high permeability may be provided with a coil receiving tapered window 56. A plurality of turns 58 are arranged in the window 56 and insulated from one another, the conductors preferably being tubular in form and adapted for water cooling. One end of the coil composing the turns 58 may be soldered to the end collar 52 as at 60 and a channel may be provided therethrough to the center of the supporting member from which a source of cooling fluid may be obtained. The other end of the coil 58 terminates in an insulating block 64 and is connected to an annular connecting collar 66 arranged thereabout, the insulating block 64 being keyed at 65 and held by a ring 67 to the central member 40. Electrical connections to the coil are established through the central supporting member 40 and the connecting collar 66 through an arbor composed of a central conducting member 68 having a recessed end, and an annular external sleeve 70 insulated from the central conducting member 68 by an insulating sleeve 72.

The central supporting member 40 and collar 66 are removably secured to the arbor or concentric sleeves 70 and 68 through the bolt 80, the latter being bored axially as at 82 and transversely as at 84 to provide access from the water supply channel 86 to the conduit 62 formed between the bolt 80 and supporting member 40.

The core laminations 42 are provided with pole ends 74 and 76 especially arranged so as to be complementary to the cylindrical internal faces adjoining the tapered bearing, namely 28 and 30, respectively, and as such conduct the flux generated by the inducing coil 58 to the metal around the zone immediately adjacent to the tapered surface to be hardened.

In practice heating currents are induced in the annular zone to be hardened substantially instantaneously for a time of two seconds or less preferably by the use of high power, high frequency alternating current traversing the inducing coil, the heat being confined to the zone desired to be hardened due to the proximity and skin effect of the high frequency current high power input. The temperature is thus raised to the hardening temperature or recalcence in this short period. Prior to the flow of any consequential heat from the heated zone to the unheated remainder of the metal, the induction heating coil is removed from its position adjacent the tapered surface and a quenching nozzle is immediately inserted and a quench applied so as to cool the hot metal substantially instan-

taneously to produce hardening thereof. In practice, the quench is applied substantially the instant heating is completed; the time lag incident to such operations is but a small fraction of a second.

For the purpose of quenching, a quenching head having a nozzle thereon may be arranged to be inserted into the bore of the hub from the opposite end from which the heat treat head is inserted. Such a quenching head may be composed of a tubular support member 90 having a shoulder 92 thereon adapted to engage the radial shoulder 26 of the hub so as to fix its proper position within the hub during quenching operation. The tubular support member is provided with a quenching nozzle 94 composed of a sleeve portion 96 threaded to the tubular support member 90 at 98 and an end cap 100 adapted to be axially adjustably positioned to provide an annular quenching orifice 102. The cap portion 100 has a central shank 104 extending into the sleeve portion 96 of the nozzle and the end of the shank is threaded for screw engagement into a perforated transverse diaphragm 106 extending across and being an integral part of the sleeve portion 96. Thus the cap member may be moved axially with respect to the sleeve portion of the nozzle by screw threading the same in the diaphragm 106 and thus the width of the annular conical quenching stream may be varied to suit the conditions.

As has previously been mentioned, upon cutting off of the high frequency induction heating, the heating head is immediately removed from its relative position with respect to the hub and the quench immediately placed in the relative position shown in the lower part of Figure 1 by the outline illustration of the hub indicated at 10'. In practice, it may be found desirable to support the heat treating head stationary during the series of operations, that is heating and quenching, and also the quenching head stationary during this series, and move the hub from its relative position with respect to the heat treat head to the proper relative position with respect to the quenching head. It will be well understood that any suitable support means may be provided to support the hub in accurate alignment during each stage of the heat treatment, and that if desired, the hub and treatment apparatus may be relatively rotated in order to assist in assuring annular uniformity.

While a single induction heating head has been illustrated and described in conjunction with the hardening of the bearing surface 24, a similar head may be employed for heat treating the bearing surface 22 through a series of steps similar to those hereinabove described. Such a heat treat head will obviously for the particular bearing illustrated be smaller in its constructional detail but may otherwise be similar to that shown, as will be well understood in the art.

The heads are quickly interchangeable upon the arbor formed by the conductors 68 and 70 by merely removing the central securing bolt 80, thereby rendering the central supporting member 40 removable, with the assemblage carried thereby. The connection to the external conductor, being made through the spring contact fingers 71, the complete removal of the head is accomplished through the removal of the bolt 80 and detachment of the water cooling connection.

For quenching the bearing surface 22 a quenching nozzle similar to that disclosed for quenching the surface 24 may be employed ex-

cept that the gauging shoulder 92 preferably should be readapted to engage the shoulder 21, it being readily understood that the hub would be in inverted position for such an operation.

It will be readily seen that a rough forging such as that shown in Figure 2 or casting may be readily machined to the shape illustrated in Figure 1 and hardened through operations taking a total time of a fraction of a minute and that thereafter the hardened surfaces may be quickly ground true to a common axis and a bearing structure provided having tapered bearing surfaces as accurately aligned as possible depending upon the accuracy of the grinding apparatus. Separate annular bearing rings of hardened material, which of necessity had to be ground to fit the internal bore of the hub member, are thus rendered unnecessary and the strength of the part considerably increased because of the integral structure.

Having the laminations 42 tapered as shown at 43 permits a good fit and their easy removal. As shown in the drawing, the plug 108 is the outlet for the coil cooling liquid supplied through the channels 86, 84 and 62 to the lower convolution of the inducing coil 58. The central supporting member 40 constitutes one of the coil connections, the contact between this member 40 and the central conducting member 68 of the arbor being through the clamping connection of the bolt 80 which clamps the inner bevelled end portion of the member 40 against the complementary bevelled surface shown in the drawing.

This application is a division of my prior application Serial No. 331,735, filed April 26, 1940, for Hub.

Although the invention has been illustrated and described in connection with a single structure, it is to be understood that the invention is not limited thereto but may be embodied in various modified forms. As many changes in the construction and arrangement may be made without departing from the spirit of the invention, as will be apparent to those skilled in the art, reference will be had to the appended claims for a definition of the invention.

What is claimed is:

1. In an induction heating apparatus, a supporting arbor, a coil supporting member projecting outwardly from said arbor, an induction heating coil mounted on said member, and means extending through said member and accessible from the outer end thereof for securing said supporting member to the end of said arbor.
2. In an induction heating apparatus, a supporting arbor having a recessed end, a coil supporting member having one end positioned in the recess of said arbor, an induction heating coil mounted on the other end of said member, and means for securing said member in said recess.
3. In an induction heating apparatus, a supporting arbor having a recessed end, a coil supporting member having one end positioned in the recess of said arbor, an induction heating coil mounted on the other end of said member, and means accessible from the end of said member for securing said member in said recess.
4. In an induction heating apparatus, a supporting arbor having a recessed end, a coil supporting member having a ridged outer face adjacent one end thereof and the other end seated in the recess in said arbor, an induction heating coil mounted on said supporting member, means cooperating with said ridge for securing said coil in place, and means extending through said sup-

porting member and engaging said arbor for securing said member thereto.

5. In an induction heating apparatus, an arbor including inner and outer conductors, an induction heating head including inner and outer electric conducting members engaging said inner and outer arbor conductors respectively for electrical contact therewith, an induction heating coil electrically connected between said members, and means connecting the inner of said members to said inner conductor to support said head on said arbor.

6. In an induction heating apparatus, an arbor including inner and outer conductors, an induction heating head including inner and outer electric conducting members slidably engaging said inner and outer arbor conductors respectively for electrical contact therewith, an induction heating coil electrically connected between said members, and means connecting the inner of said members to the inner of said arbor conductors to support said head on said arbor.

7. In an induction heating apparatus, an arbor including an outer conductor and an inner conductor having a recessed end, an induction heating head including an outer electric conducting member adapted to slidably engage said outer arbor conductor and an inner electric conducting member having an inner end slidably engaging in the recess in said arbor conductor, an induction heating coil electrically connected between said members, and means extending through the inner of said conducting members and accessible from the outer end thereof to secure said head to said inner arbor member.

8. In an induction heating apparatus, a supporting arbor having a passage for coolant therein, an induction heating head supported on said arbor including a hollow supporting member arranged to form a continuation of said passage, an induction coil mounted on said supporting member, and a connecting member extending through said supporting member and formed to provide a coolant-conveying channel from said passage to said coil.

9. In an induction heating apparatus, an arbor including an outer conductor and an inner conductor having a passage for coolant, an induction heating head including a hollow induction heating coil, an electric conducting member slidably engaging said outer arbor conductor and electrically connected to one end of said coil, a hollow supporting member for supporting said coil on said arbor, a fluid connection to one end of said coil through said outer member, and a fluid connection between the other end of said coil and said inner arbor passage through said hollow supporting member.

10. In an induction heating apparatus, an arbor including an outer conductor and an inner conductor having a passage for coolant, an induction heating head including a hollow induction heating coil, an electric conducting member slidably engaging said outer arbor conductor and electrically connected to one end of said coil, a hollow supporting member for supporting said coil on said arbor, a fluid connection to one end of said coil through said outer member, a fluid connection between the other end of said coil and said inner arbor passage through said hollow supporting member, and a securing bolt extending through said hollow supporting member for securing said head to said arbor and of such diameter as to provide a coolant passage between the bolt and said supporting member.

11. In an induction heating apparatus a conducting arbor, a heating head having an internal conductor and an inducing coil carried by and having one end in electrical engagement with said conductor, said arbor and conductor being in end abutting engagement, and a bolt extending axially within said conductor for removably securing said conductor and arbor together.

12. In an induction heating apparatus a conducting arbor, a heating head having an internal conductor and an inducing coil carried by and having one end in electrical engagement with said conductor, said arbor and conductor being in end abutting engagement, and a bolt extending axially within said conductor for removably securing said conductor and arbor together, said arbor and conductor being in telescoped electrical wiping contact with each other.

13. In an induction heating apparatus, an arbor having inner and outer conductors electrically insulated from each other, a heating head having an inducing coil, an inner conductor supporting said coil and being electrically connected with one end thereof and an outer concentric conductor electrically connected with the other end of said coil, and a removable means extending axially through the inner head conductor for securing it and the inner arbor conductor together with the outer head and arbor conductors in electrical contact with each other.

14. In an induction heating apparatus, an arbor having inner and outer conductors electrically insulated from each other, a heating head having an inducing coil, an inner conductor supporting said coil and being electrically connected with one end thereof and an outer concentric conductor electrically connected with the other end of said coil, an insulating sleeve between said inner and outer head conductors, and means for securing said head and arbor together with said inner conductors in telescoped electrical wiping contact and said outer conductors in telescoped electrical wiping contact.

15. In an induction heating apparatus, an arbor having inner and outer conductors electrically insulated from each other, a heating head having an inducing coil, an inner conductor supporting said coil and being electrically connected with one end thereof and an outer concentric conductor electrically connected with the other end of said coil, and a removable means extending axially through the inner head conductor for securing it and the inner arbor conductor together with the outer head and arbor conductors in electrical contact with each other, said head including an electrical insulating ring between said inner and outer head conductors.

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