Oct. 18, 1949. H. A. STRICKLAND, JR., ET AL 2,484,864

INDUCTION HEATING HEAD

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Fig. 1.

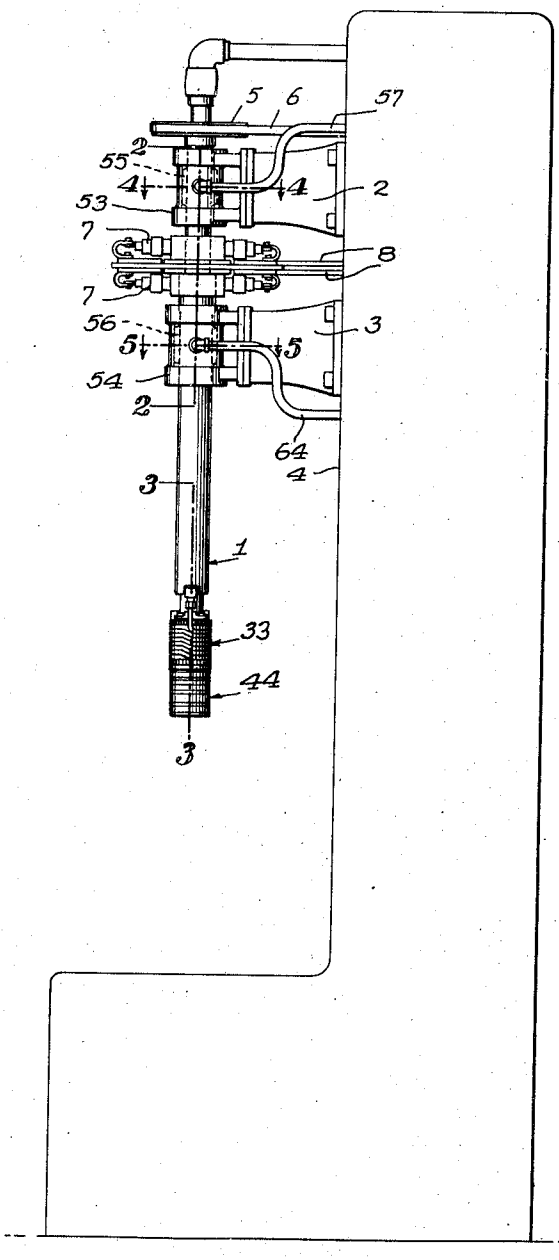
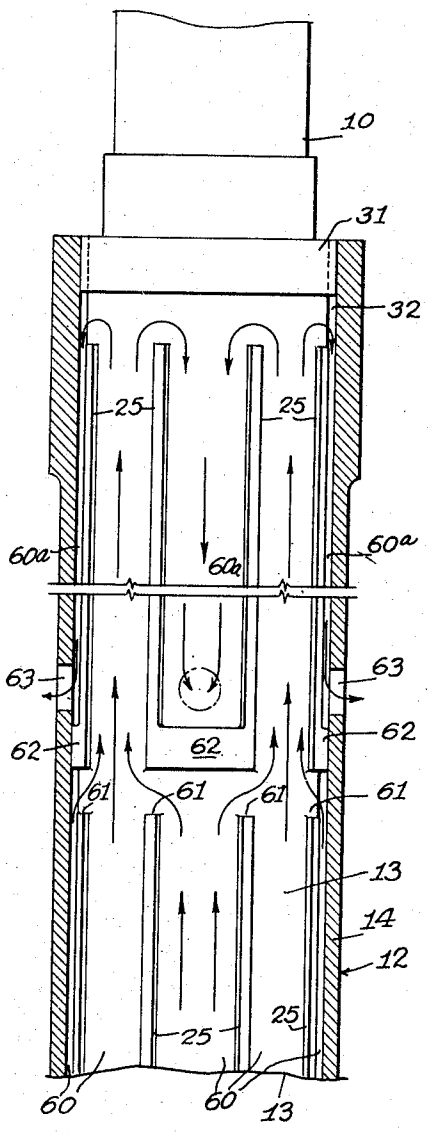


Fig. 6.



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Fig. 2.

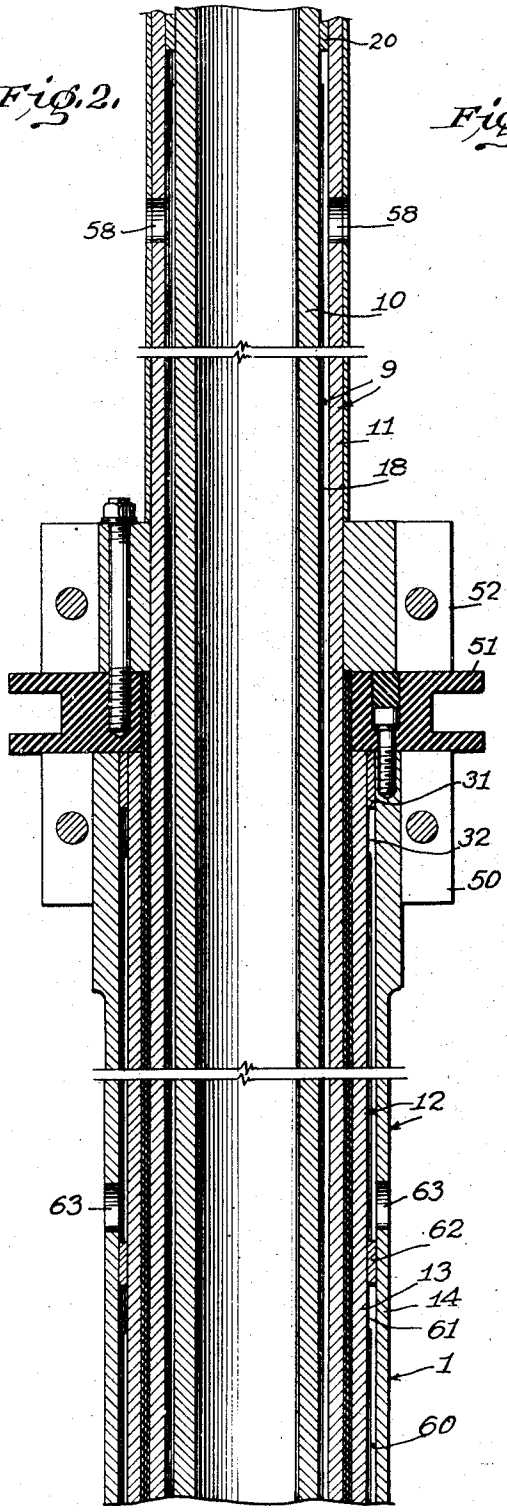
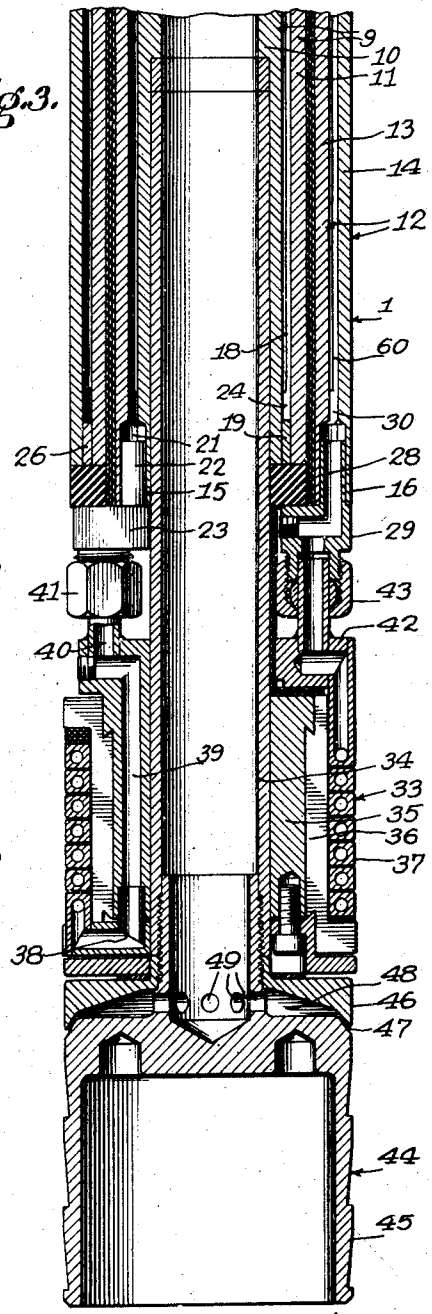


Fig. 3.



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Fig. 4.

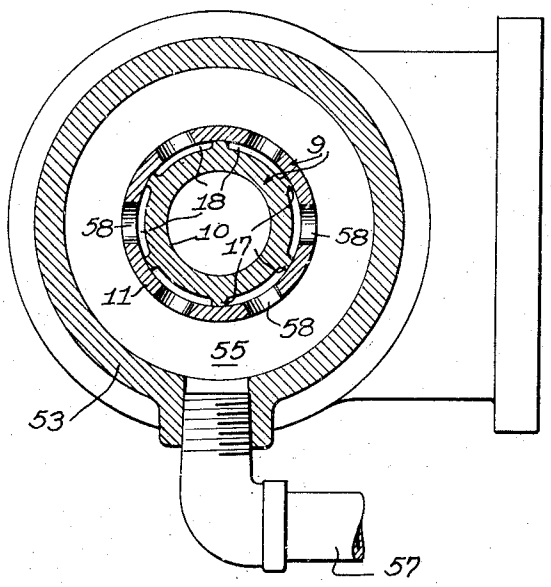
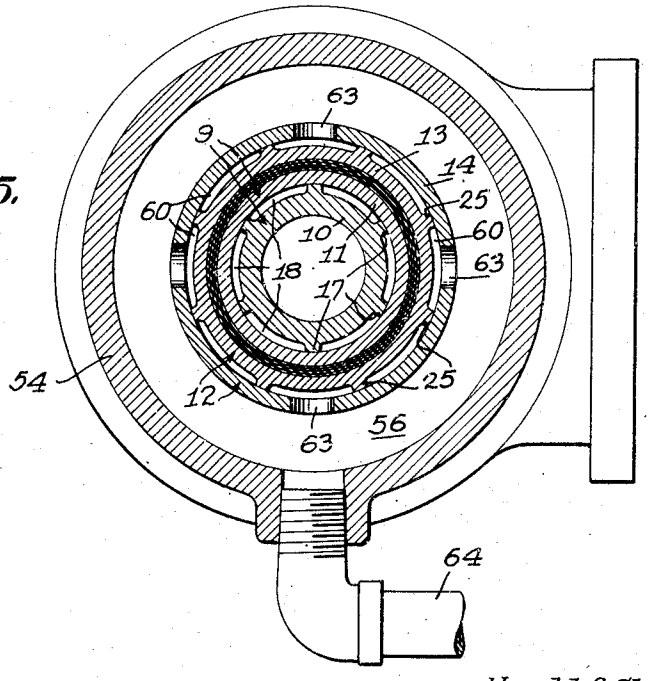


Fig. 5.



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INDUCTION HEATING HEAD

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7 Claims. (Cl. 219—13)

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This invention relates to induction heating equipment of the character having an inductor head supported by a current conducting arbor, and more particularly to improved means for effectively and efficiently cooling the inductor head and arbor.

The primary object of the present invention is to provide induction heating equipment having a current conducting arbor comprised of concentric conductors with a new and improved arrangement for uniformly extracting heat from each of the conductors.

Another object is to provide a current conductor in the form of concentric tubular elements so related to each other as to provide a plurality of circumferentially spaced, longitudinally extending cooling passages.

With the above and other objects in view, which will be apparent from the description to those skilled in the art to which the invention appertains, the present invention consists in certain features of construction and combinations of parts to be hereinafter described with reference to the accompanying drawings, and then claimed.

In the drawings, which illustrate a suitable embodiment for the purpose of description,

Figure 1 is a side elevation of an induction heating machine having the improved cooling means of the present invention incorporated therein;

Figure 2 is a fragmentary vertical section of the current conducting arbor taken substantially on the line 2—2 of Figure 1;

Figure 3 is a vertical section taken through the inductor head and arbor substantially on the line 3—3 of Figure 1;

Figures 4 and 5 are transverse sections taken substantially on lines 4—4 and 5—5, respectively; and

Figure 6 is a view showing the passage of cooling fluid through a portion of the arbor.

Referring to the accompanying drawings in which like numerals refer to like parts throughout the several views, the apparatus selected for illustration of the present invention includes a current conducting arbor 1 rotatably supported on upper and lower brackets 2 and 3, respectively, mounted on a base 4 and arranged to be rotated in any suitable means, such as for example, by the pulley 5 and belt 6, shown in Figure 1, arranged to be driven by an electric motor, not shown.

Suitable collector brushes 7 are employed for conducting high frequency current to the arbor 1 from bus bars 8 connected with a current source, not shown.

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The arbor 1 is comprised of an inner current conductor 9 which includes inner and outer tubular elements 10 and 11, respectively, and an outer current conductor 12 which includes inner and outer tubular elements 13 and 14, respectively, the outer conductor being shorter than the inner, but the lower ends thereof being substantially flush with each other except at diametrically opposed portions where the inner longitudinally projects at 15 beyond the outer and the outer longitudinally projects at 16 beyond the inner. As shown in the drawing, the two conductors are insulated from each other.

The inner element 10 of the inner current conductor 9 is formed with a plurality of through-running circumferentially spaced surface ribs 17 which terminate just short of the ends thereof and which tightly engage with the bore of the outer element 11 to provide a plurality of longitudinal passageways 18. At the lower ends, the circumferential space between elements 10 and 11 is closed by a sealing sleeve 19 (Figure 3) and at the upper end by a sealing sleeve 20 (Figure 2). The extending portion 15 of the inner conductor is drilled out at 21 to receive a tubular sleeve portion 22 of a connector fitting 23 which communicates with a distributing space 24 between the sealing ring 19 and the lower terminations of the ribs 17.

The inner element 13 of the outer conductor 12 is also provided with a series of circumferentially spaced longitudinally extending ribs 25. At the lower ends, the space between elements 13 and 14 is closed by a sealing ring 26 and the projecting portion 16 is drilled to receive the sleeve portion 28 of a connector fitting 29 which communicates with the distributing space 30 between the ring 26 and the lower terminations of the ribs 25. At the upper ends, the circumferential space between elements 13 and 14 is closed by a sealing ring 31 which, with the upper terminations of the ribs 25, forms a distributing passage 32.

Carried by the lower end of the arbor is the inducing head 33 which includes a tubular mandrel 34 fitting within the bore of the element 10 of the inner current conductor 9 and having an annular core supporting element 35 thereon. This element is surrounded by a laminated core 36 which in turn is surrounded by the hollow inductor coil 37. The lower terminal end of the coil 37 is connected through a hollow fitting 38 to a passageway 39 in the element 35 having a hollow fitting 40 which is secured by nut 41 to the fitting 23. The other terminal end of the coil 37

is provided with a hollow fitting 42 which is connected by nut 43 to the fitting 29.

Secured to the mandrel 34 is a quench head 44 comprised of a skirted member 45 and an annular member 46 which together provide a continuously open quench discharge orifice 47, the space 48 between these parts receiving quenching fluid through ports 49 from the communicating bores of the mandrel 34 and the inner element 10 of the current conductor 9.

The upper end of the outer conductor 12 is provided with a collector ring 50 in electrical contact therewith. Secured to the inner conductor 9 in electrical contact therewith adjacent the ring 50 but separated therefrom by an insulating ring 51 is a collector ring 52 for the inner conductor.

The arbor 1 is supported from the brackets 2 and 3 by upper and lower bearings 53 and 54, the upper bearing 53 surrounding the inner conductor 9 and having a fluid tight chamber 55 surrounding the inner conductor, and lower bearing 54 surrounding the outer conductor 12 and having a fluid tight chamber 56 surrounding the outer conductor.

During rotation of the arbor 1 and during the supply of current to the inducing head 33, cooling water is admitted through conduit 57 from a suitable supply source (not shown) to the chamber 55 of the upper bearing 53 from whence it passes through ports 58 into the passages 18, thence downwardly into collector space 21 and then through fittings 23 and 40 and passageway 39 to the coil 37. This cooling fluid after cooling the coil 37 flows through fittings 42 and 29 to the distributing space 30 in the outer conductor 12 and rises through the passages 60 between the ribs 25.

In order to provide effective cooling of the portion of the outer conductor which is above bearing 54 and underlies the collector ring 50, the ribs 25 are interrupted near the top to provide cross passages 61 and above these cross passages the passages 60 between four pairs of ribs are blocked off by dams 62, leaving four passages 60 open. Referring to Figure 6, the water flowing upwardly, as indicated by the arrows, through all of the passages 60, upon reaching the cross passages 61, is consolidated to flow upwardly through the four passages. This consolidated water, upon reaching distributing chamber 32 then reverses its flow and flows downwardly through the other four passages 60*a* and thence through the four ports 63 into the bearing chamber 56. The water then flows from this chamber through a discharge conduit 64.

By forming each of the current conductors of inner and outer tubular elements so disposed as to provide a plurality of circumferentially spaced, longitudinally extending cooling passages, there thus is provided an efficient means for uniformly extracting heat from the conductors. Cooling of the upper portion of the outer conductor is further augmented by the reverse flow arrangement described.

It is to be understood that various changes may be made in the detailed construction and arrangement of the parts described without departing from the spirit and substance of the invention, the scope of which is defined by the appended claims.

What is claimed is:

1. In an induction heating apparatus having an inducing head provided with a hollow inductor coil, the improvement which comprises an arbor adapted for connection at one end to said head and comprising a pair of concentric electric current conductors insulated from each other, each conductor including inner and outer concentric elements, one having a plurality of circumferentially spaced, longitudinally extending rib-like elements tightly engaged with a circumferential surface of the other to provide a plurality of longitudinally extending cooling fluid passageways between said elements, said elements being continuously circumferentially engaged with each other at their ends.

2. An electric current conductor comprising inner and outer impervious concentric members circumferentially spaced apart at their ends, means at each end of the conductor sealing the space between adjacent ends of said members, one of said members having a plurality of rib-like portions extending longitudinally thereon in tight engagement with the adjacent circumferential surface of the other and providing cooling fluid passageways, means at the one end for conducting cooling fluid to said passageways, and means at the other end for conducting cooling fluid from said passageways.

3. An electric current conductor comprising inner and outer impervious concentric members circumferentially spaced apart at their ends, means at each end of the conductor sealing the space between adjacent ends of said members, one of said members having a plurality of rib-like portions extending longitudinally thereon in tight engagement with the adjacent circumferential surface of the other and providing cooling fluid passageways, said rib-like portions at one end being longitudinally spaced from the sealing means for that end to provide a passage common to said passageways, a cooling fluid connection for said common passage, and cooling fluid connection at the other end for said passageways.

4. An electric current conductor comprising inner and outer concentric members circumferentially spaced apart at their ends, means at each end of the conductor sealing the space between adjacent ends of said members, one of said members having a plurality of rib-like portions extending longitudinally thereon in tight engagement with the adjacent circumferential surface of the other and providing cooling fluid passageways, said rib-like portions at one end being longitudinally spaced from the sealing means for that end to provide a circumferential passage common to said passageways, the outermost member having a plurality of ports through the wall thereof at said other end, one for each passageway, for conducting cooling fluid thereto, and a cooling fluid connection communicating with said common space for conducting cooling fluid therefrom.

5. An electric current conductor comprising inner and outer concentric members circumferentially spaced apart at their ends, means at each end of the conductor sealing the space between adjacent ends of said members, one of said members having a plurality of rib-like portions extending longitudinally thereon in tight engagement with the adjacent circumferential surface of the other and providing cooling fluid passageways, said rib-like portions at one end being longitudinally spaced from the sealing means for that end to provide a circumferential passage common to said passageways, alternate passageways at a region in advance of said common passage being blocked off and other alternate passageways in

advance of the blocked-off region being in communication with the next adjacent passageways for directing cooling fluid from said adjacent passageways for flow to said common passage and return flow in said alternate passageways toward the blocked-off regions, the outermost of said members having ports through the wall thereof, one for each alternate passage, and located between the common passageway and the blocked-off region, and means at the other end of the conductor for conducting cooling fluid to said passageways.

6. An electric current conductor comprising inner and outer current conductors, circumferentially spaced means between the adjacent circumferential walls of said conductors forming circumferentially spaced cooling fluid passageways, said conductor having at one end a circumferential passage between said members and common to said passageways, and intermediate the ends of the conductor a second circumferential passage between said members and common to said passageways, a closure for each alternate passage located between said common passages, the outermost member having a discharge port through the wall thereof for each of said alternate passageways, said discharge ports being located between the closures and the first-mentioned common passage, means at the opposite end of the conductor for conducting cooling fluid to said passageways, and closure means at each end of the conductor forming end stops for the cooling fluid.

7. In an induction heating apparatus, an arbor

comprising inner and outer electric current conductors, said inner conductor at one end extending longitudinally beyond said outer conductor, each of said conductors having a plurality of longitudinally extending internal cooling fluid passageways therein for conducting cooling fluid, spaced bearings rotatably supporting said arbor, one bearing surrounding said outer conductor and the other surrounding said inner conductor, and each having a cooling fluid chamber around the surrounded conductor, each conductor having fluid ports in the wall thereof between its cooling fluid passageways and the chamber of its bearing, means for supplying cooling fluid to one of said bearing chambers and means for discharging cooling fluid from the other of said chambers.

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