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ELECTRIC COIL AND CORE THEREFOR

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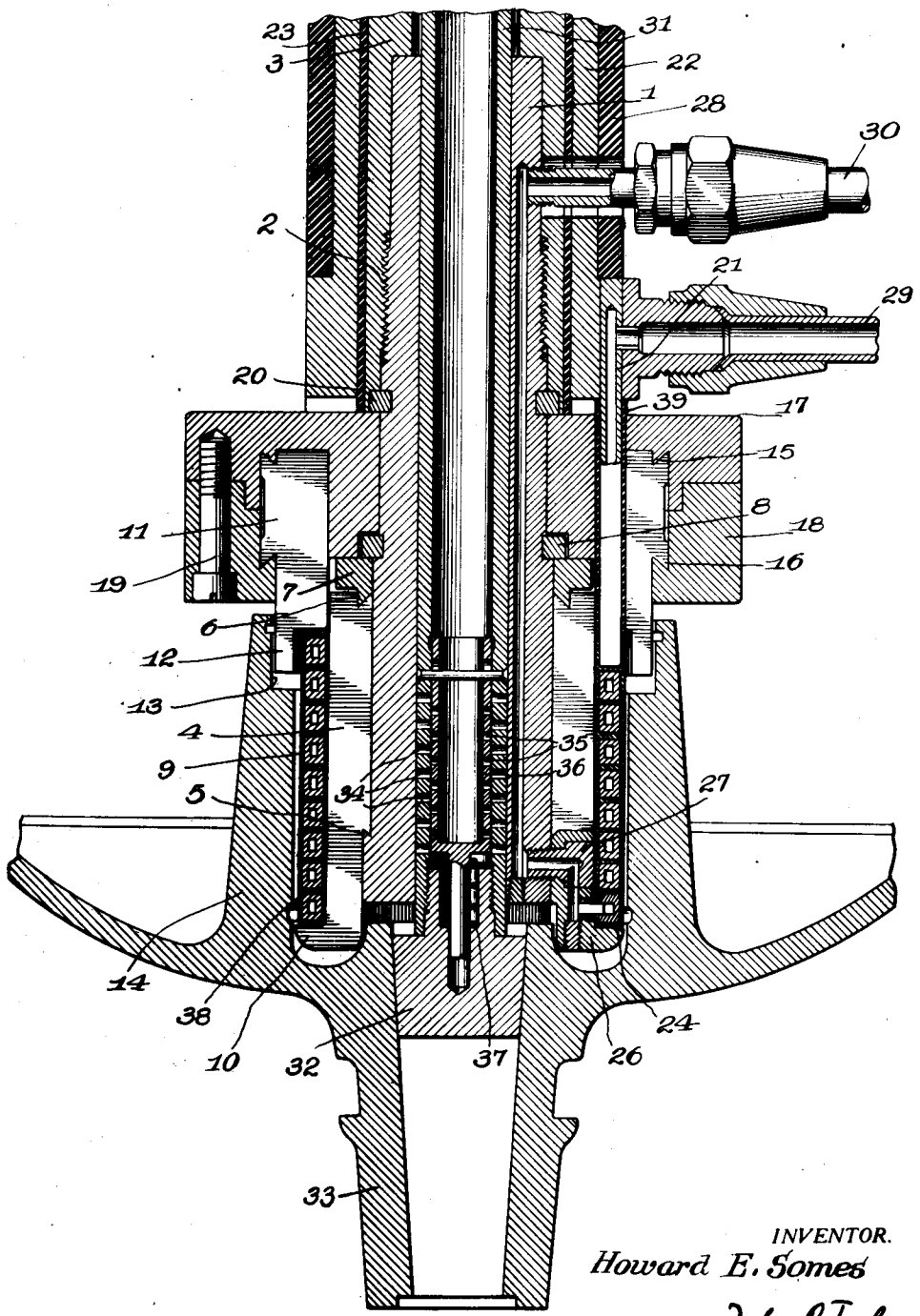

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ELECTRIC COIL AND CORE THEREFOR

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13 Claims. (Cl. 219—13)

The invention relates to an electric coil and to a core for such a coil. The invention is especially applicable for such coils used for heat treating articles by induction heating. The use of such coils is described in my copending applications: Serial No. 50,829, filed November 21, 1935; Serial No. 96,346, filed August 17, 1936; Serial No. 96,929, filed August 20, 1936; Serial No. 96,930, filed August 20, 1936; Serial No. 101,993, filed September 22, 1936; Serial No. 121,598, filed January 21, 1937; Serial No. 127,668, filed February 25, 1937 (now Patent No. 2,189,819, dated Feb. 13, 1940); and Serial No. 164,320, filed September 17, 1937.

It is the main object of the invention to permit the preforming of the conductor into a coil prior to its assembly with a core of low magnetic reluctance.

Another object is to allow the application of insulation to the exposed surfaces of the conductor and between adjacent windings thereof and thereby to form a complete mechanical coil unit which may be assembled with core members being also in the form of pre-assembled units.

The objects of the invention are attained by forming the core from two parts or units whereby the one unit may at first be assembled with the coil whereupon the second core unit is brought into place.

Further features, details and advantages of the invention will become clear from the embodiment shown in the attached drawing and from the following description thereof.

The drawing shows a vertical and axial section through an induction heating coil and through a wheel hub to be treated.

In the drawing 1 designates a tubular member screw threaded at 2 into a second tubular member 3 which in turn is connected to the machine as shown in detail in the above mentioned applications.

Laminations 4 consisting of a metal of low magnetic reluctance are arranged radially around the outer cylindrical surface at the lower end of the tube 1 and are connected to said tube by dove-tail connections 5 and 6. The upper dove-tail connection comprises a dove-tail carrying ring 7 which is removably connected as by the spring ring 8 to the tube 1. The laminations 4 present by their outer edges a cylindrical surface which is surrounded by a tubular conductor 9 consisting, for instance, of copper. At their lower ends laminations 4 are provided with projections 10 extending across the lower end face of the conductor 9.

The upper ends of the laminations 4 are free from projections corresponding to the projections 10 at the lower end. Instead thereof a second set of radially extending laminations 11 of a material of low magnetic reluctance is provided which partly overlaps the outer surface at the upper ends of the laminations 4 and which extend radially across the upper end face of the conductor coil 9. These laminations 11 may furthermore have a projection 12 extending into an annular space between the upper end of the coil 9 and the inner surface 13 of a recessed portion of the hub 14 or the like to be treated. The laminations 11 are clamped together by dove-tail connections 15, 16, partly formed at two annular shaped members 17 and 18 which are drawn together by screw bolts 19. The unit formed by the laminations 4, the members 17 and 18, and the screw bolts 19 is slid over a cylindrical portion of the tube 1 and removably connected therewith as by a second spring ring 20.

The one end 21 of the coil 9 is connected to a tubular member 22 surrounding the tubular members 1, 3, but separated therefrom by the tubular insulation 23. The other end of the coil 9 is connected by the intermediate pieces 24, 26 and 27 to the tube 1. The tubes 3 and 22 are connected as shown in the above mentioned earlier applications to a suitable source of electric current preferably a high frequency current. The tubular insulation 28 surrounds the greater part of the outer surface of the tubular member 22.

The hollow interior of the coiled conductor 9 communicates, by means clearly shown in the drawing, with conduits 29 and 30 respectively which, in turn, are connected to a source of a cooling medium such as water. These conduits 29 and 30 may also serve to make an electrical connection with capacitors (not shown).

A tube 31 is slidably mounted within the tube 1. The lower end of the tube 31 is centered by a member 32 in the smaller barrel 33 of the hub 14 to be treated. Upon removal of the inductor coil and the parts associated therewith including the tube 1 out of the hub 14, the lower end of the tube 31 remains within the hub so as to spray a quenching fluid through the apertures 34 thereof. The apertures 34 register with the corresponding apertures 35 of the valve member 36 which valve member is downwardly moved against the action of spring 37 upon the application of pressure by the quenching fluid.

Between the outside of the laminations 4 and the inner surface of the coil 9 and between the adjacent windings of the coil 9 an insulation 38 is inserted and this insulation may also cover

the end faces and the outer surface coil. The connecting extension 21 of the coil is insulated from the laminations 4 and 11 and from the clamping ring 17 for the laminations 11 by a tube or coating 39 of insulating material.

The device shown in the drawing may be assembled in the following manner. The tube 1, the laminations 4, the clamping rings 7 and 8, and the connecting pieces 24, 26 and 27 for the lower end of the coil 9, are assembled into one unit. The laminations 11, the clamping rings 17 and 18 and the screw bolts 19 are assembled into a second separate unit. The copper conductor 9 is formed into the final shape of the coil whereupon the coil part is coated with frit, the said frit being forced between the conductor to provide for the insulation of adjacent surfaces of said conductor 9 and additional frit may be sprayed on the ends and the outside surface of the coil; when fired, the vitreous enamel so obtained will form an insulating medium to insulate the coils and to combine also the coil into a complete unit mechanically.

After these three units have been made, the vitreous enamel coil is slid into its proper position with respect to the core formed by the laminations 4, whereupon the lower end of the conductor 9 is connected to the piece 24. Now the unit comprising the laminations 11 is slid into its place on the tube 1 and secured there by the ring 20. Before or during the connection of this last unit, the insulation 39 is of course attached to the upper end 21 of the conductor 9. Now the tube 1 is screwed into the tube 3; then the tube 22 with its outer shell 28 is slid into its place and finally the connections for the conductors 29 and 30 are attached and the tube 31 with its appertaining parts 32, 36 and 37 inserted.

Obviously, many modifications of the shown embodiment can easily be designed by those skilled in the art and it is the intention to protect each and every modification by the appended claims.

The invention is, for instance, not restricted to the arrangement of the main core member in the interior of the coil, but the expression "core" is intended also to cover a member of low magnetic reluctance when arranged at the outside of the coil. The invention is furthermore, for instance, not restricted to any specific form of the coil, which coil instead of being cylindrical may be tapering and an axial section may have any possible configuration in cross section. The invention is also not restricted to induction coils for heat treating by electro-magnetic induction although the invention is especially designated as applicable to such heat treating devices.

What I claim is:

1. A body of low magnetic reluctance having a part of its surface adapted to telescope unobstructedly from its one end only with a correspondingly shaped electric coil, said body being composed of laminations arranged substantially in the direction of and radially to the axis of the surface part telescoping with said coil; and lamination holding means remote from said surface part and shielded from the coil by the magnetic circuit formed by said body for holding said laminations together, said holding means being centrally located with respect to the coil.

2. A body according to claim 1, in which each of said laminations has an extension at the one end only extending radially beyond said coil telescoping surface, said extensions being adapted to extend across the one end of said coil.

3. In combination, a body according to claim 1 with a second body likewise composed of laminations arranged substantially in radial planes to the axis of the coil telescoping surface of said first body and provided with means for holding said laminations together shielded from the coil by the magnetic circuit formed by said body; said second body being arranged to extend across the one end of said coil and to form a substantially uninterrupted continuation of said first-named body.

4. In combination with the structure of claim 1, a second body of low magnetic reluctance being composed of laminations arranged in the direction of and extending radially beyond said coil engaging surface of said first-named body; and lamination holding means shielded from the coil by the magnetic circuit formed by said bodies for holding the laminations of said second body together independently of the other said body.

5. A laminated body of low magnetic reluctance having a part of its surface encircling its one axis, substantially free from portions projecting radially beyond any of its portions succeeding in one of the two general directions of said axis, so as to be adapted to permit of an electric coil having a complementary shaped surface part being telescoped with said body in said general direction and holding means for said body shielded from said surface by the magnetic circuit formed by said body; a second body of low magnetic reluctance having a surface portion complementally shaped to a surface portion of said first-named body, said second body being composed of laminations arranged substantially in the direction of and radially with respect to said axis and being adapted to extend across one end of said coil; and a second lamination holding means shielded from the surface by the magnetic circuit formed by said bodies for holding the laminations of said second body together, one of said holding means being central with respect to said coil receiving surface.

6. In a device according to claim 5, the laminations of said second body having extensions adapted to overlie a part of the axially extending surface of the coil opposite the coil surface telescoping with said first named body.

7. In a device according to claim 5, the laminations of said second body having extensions adapted to extend into a space between one axially extending surface portion of said coil and a surface portion of a work piece to be treated by said coil.

8. In a device according to claim 5, the laminations of said second body extending in the axial direction of said coil a substantial distance beyond its coil engaging surface portion, said means for holding said laminations together gripping portions of these extended parts of said laminations.

9. In combination, a member provided with a cylindrical outer surface portion; laminations of low magnetic reluctance extending in the axial direction of and radially from said surface and forming by their outer edges a second cylindrical surface, said laminations being free at one of their ends from parts projecting radially beyond said second surface; means for rigidly connecting said member and said laminations; an electric conductor surrounding said cylindrical surface; a further member comprising laminations of low magnetic reluctance, these laminations being arranged in the same general axial and radial direction as said first named laminations, said fur-

ther laminations extending radially outwardly beyond the cylindrical outer surface of said first named laminations in the region axially adjacent said electric conductor; and means for rigidly uniting these further laminations shielded from the conductor by the magnetic circuit formed by said laminations, one of said means for rigidly connecting and means for rigidly uniting the laminations being at least partly centrally located with respect to the coil.

10. In a combination according to claim 9, said two members being provided with means for being rigidly but removably connected.

11. In combination an electric coil and a core of low magnetic reluctance fitting thereinto, said core being composed of laminations extending in the axial direction of said coil, said core and said coil having each one of their axially extending surfaces complementally shaped so as to be slid unobstructedly the one over the other, an additional core member likewise composed of axially extending laminations forming a continuation of said first named core and extending radially over one of the end faces of said coil and means shielded from the coil by the magnetic circuit for securing said laminations together, a portion of said means being central with respect to the coil.

12. A body of low magnetic reluctance having a part of its surface arranged to telescope unobstructedly from its one end with a correspondingly shaped electric conductor coil; a second body of low magnetic reluctance being composed of laminations arranged in the direction of and extending radially beyond said coil engaging surface of said first named body; and lamination holding means shielded from the coil by the magnetic circuit formed by said bodies for holding the laminations of said second body together independently of the other said body, said lamination holding means comprising a projection on each lamination extending in a direction away from the magnetic circuit formed by said bodies and clamping means securing said projections in position.

13. A body of low magnetic reluctance having a part of its surface adapted to telescope unobstructedly from its one end only with a correspondingly shaped electric coil, said body being composed of laminations arranged substantially in the direction of and radially to the axis of the surface part telescoping with said coil; and lamination holding means remote from said surface part and shielded from the coil by the magnetic circuit formed by said body for holding said laminations together, said lamination holding means comprising a projection on each lamination extending in a direction away from the magnetic circuit formed by said body and clamping means securing said projections in position.

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