United States Patent

Binard

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[54] **INDUCTOR FOR THE THERMAL TREATMENT OF A MATERIAL WHICH IS NOT VERY OR NON-ELECTRICALLY CONDUCTING CONTAINING FERROMAGNETIC OR ELECTRICALLY CONDUCTIVE PARTICLES**

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[30] **Foreign Application Priority Data**

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[52] **U.S. Cl.**.....**219/10.49,** 18/38, 156/110 R, 219/10.79

[51] **Int. Cl.** **H05b 5/00,** B29h 5/02, H05b 9/02

[58] **Field of Search**..219/10.53, 10.49, 10.79, 10.65, 219/10.51, 535, 10.39; 18/38; 156/110 R, 272

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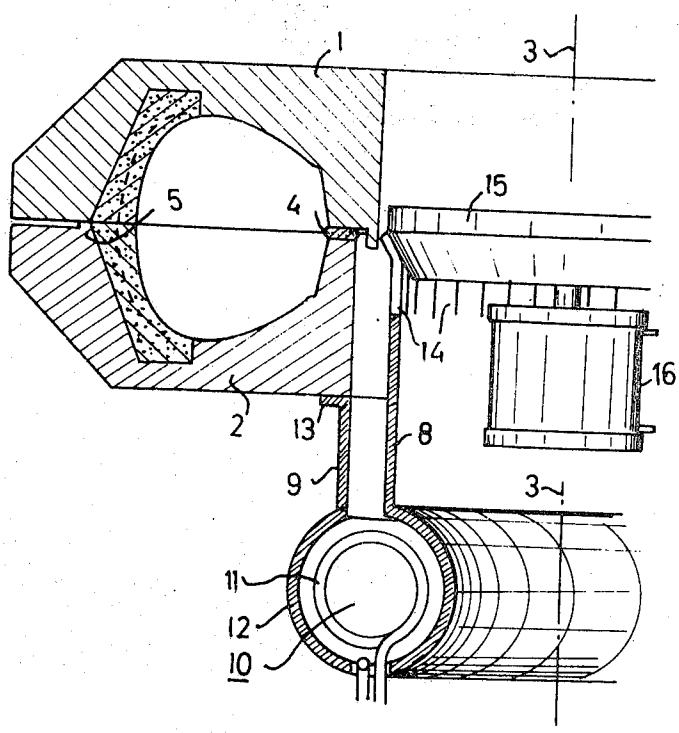
[57] **ABSTRACT**

An inductor for use in the thermal treatment of a material which is not very or non-electrically conducting containing ferromagnetic or electrically conductive particles. The inductor forms, in combination with the insulation between its conductors, a mold in which the material containing ferromagnetic or electrically conductive particles is submitted to the thermal treatment.

8 Claims, 3 Drawing Figures



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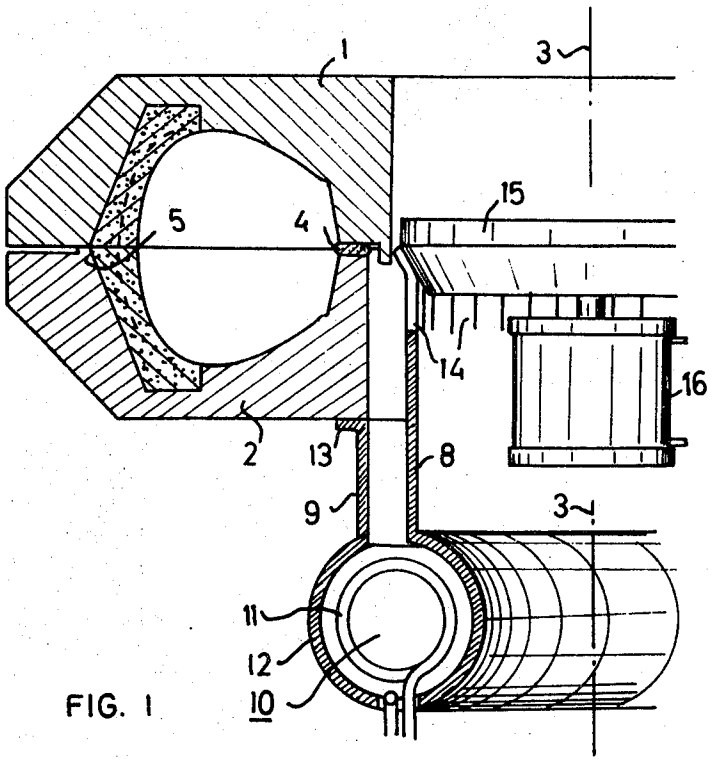

FIG. 1

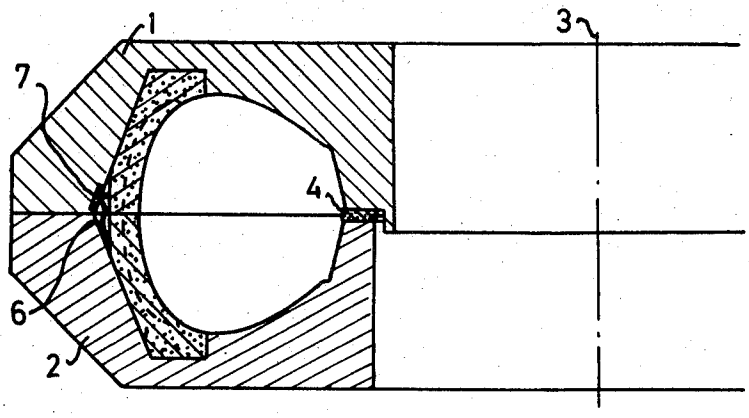

FIG. 2

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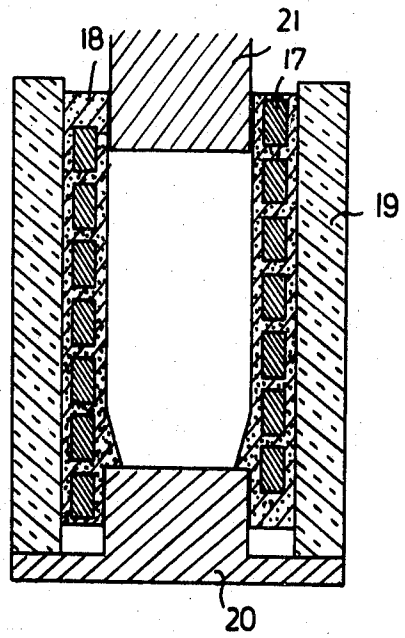

FIG. 3

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INDUCTOR FOR THE THERMAL TREATMENT OF A MATERIAL WHICH IS NOT VERY OR NON-ELECTRICALLY CONDUCTING CONTAINING FERROMAGNETIC OR ELECTRICALLY CONDUCTIVE PARTICLES

The invention relates to an inductor for use in the thermal treatment of a material which is not very or non-electrically conductive containing ferromagnetic or electrically conductive particles.

It is known in the art to incorporate powders of magnetite, of ferromagnetic metals, or of electrically conductive materials in substances which are not very or non-electrically conductive and to submit these mixtures to an electromagnetic alternating field so as to heat them in order to render them fluids, to vulcanize them, to polymerize them or to dry them etc.

The object of the invention is to provide an inductor for use with such a known process, wherein the thermal treatment of the material containing ferromagnetic or electrically conductive particles is carried out in a receptacle such as a mold, the chamber of a screw type pump, a dye etc.

The inductor, in accordance with the invention, is characterized in that it forms, in combination with the insulation between its conductors, the mold in which the material containing ferromagnetic or electrically conductive particles is submitted to the thermal treatment.

The invention will now be disclosed with reference to two embodiments thereof and to the accompanying drawings in which:

FIGS. 1 and 2 illustrate similar arrangements of a first inductor in accordance with the invention; and

FIG. 3 illustrates a second embodiment of an inductor in accordance with the invention.

In FIG. 1, there is shown two half molds 1 and 2 which are electrically conductive and made of, for example, cast aluminum. The half molds have roughly the shape of a hollow torus separated in two through its plane of symmetry perpendicular to the axis 3 thereof. However, the two half molds are not necessarily perfectly symmetrical. An insulating ring 4 is positioned between the two inside mating edges of the half molds 1 and 2 and provides an electrical insulation between the current feeding conductors. The ring 4 includes an opening therein through which may petrude a pipette (not shown) for permitting to build up a pressure the two half molds once assembled. The insulating ring 4 may be made of an elastomer which is resistant to high temperatures. The outside mating edges of the two half molds 1 and 2 include means to ensure a good electrical contact between such edges such as, for example, a small projection 5 on the half mold 2 along the inside circumference thereof. When the two half molds 1 and 2 are made of aluminum, the contact surface of projection 5 and the opposite contact surface of the half mold 1 are coated with a thin layer of a material the conducting properties of which are not impaired by sulphur such as, for example, gold.

It is also possible to provide a series of contact springs 6 located at equal distances along the inside circumference of the outside edge of one of the two half molds such as, for example, the half mold 2 as illustrated in FIG. 2. These contact springs 6 may be made of bronze and may bear on a copper band 7 inserted into the other half mold 1.

The two half molds 1 and 2 are connected at their inside edges to two high frequency current feeding conductors 8 and 9. These conductors may consist of two sleeves providing a uniform electrical contact along the inside edge of each half mold or may consist of a number of contact fingers equally spaced along the inside edges of the half molds.

The high frequency current is generated, preferably, by a transformer 10 located adjacent to the torus. In accordance with a first embodiment, which is particularly advantageous for the manufacture of vehicle tires, the transformer 10 is a toroidal transformer comprising an inside primary winding made of a number of turns of conductors and an outside secondary winding 12 consisting of a torus cut along two parallel circles and welded at the location of such cut to the two sleeves 8 and 9. The sleeve 9 may be permanently connected to half mold 2 by means of screws, for example, protruding through a flange 13 of the sleeve, while the edge of the other sleeve 8, which is to contact the half mold 1, may be slit so as to form a number of contact fingers 14 which are applied against the half mold 1 by means of a conical piston 15 operated by a pneumatic device 16.

Inside the hollow torus, there are provided shaped pieces made of an electrically non-conducting material which is also heat resistant. Such pieces may be made, for example, of a material known under the trade mark Araldite containing quartz and resistant to at least 150°C. It is also possible to make such pieces of a thermosetting material containing a ferromagnetic or electrically conductive powder. In addition, these pieces may be reinforced by glass fibers or by textiles of the same material.

In FIG. 3, there is shown an alternative embodiment of the invention.

In such embodiment, a spiral inductor having a solid conductor 17 is surrounded by a layer of an insulating material 18 such as, for example, polytetrafluorethylene known under the trade mark Teflon. The insulating material 18 fully surrounds the conductor 17 and has an inside surface which is suitable for a mold. The assembly of the inductor and of the insulating material is supported by a reinforcing outside tube 19 made of, for example, porcelain. Such tube 19 may be replaced by the jaws of a clamping tool since the use thereof is to prevent inductor 17 from opening up when a pressure is established inside the mold. When the pressure is nil or very low, outside clamping means such as tube 19 are not necessary. In order to permit molding inside inductor 17, a lower piston 20 and an upper piston 21 are provided. These pistons may be made, preferably, of a material which is electrically and thermally insulating. However, it is also possible to provide pistons which are electrically conducting or having sufficient magnetization losses to produce about the same amount of heating than that produced in the material to be treated.

It is also possible to provide a conductor 17 which is hollow so as to permit circulation of water or vapor inside the conductor, in order to always maintain the conductor at a predetermined temperature which may be chosen to be about equal to that of the material undergoing a thermal treatment inside the inductor.

I claim:

1. An inductor for use in the thermal treatment of a material which is relatively poorly electrically conduct-

ing and containing electrically conductive particles comprising two electrically conductive half molds having the shape of a hollow torus separated through its plane of symmetry perpendicular to the axis of the torus, an insulating ring positioned between the two inside mating edges of said half molds, means for insuring a positive electrical contact between outside mating edges of said half molds, and current feeding conductors connected to the inside edges of said half molds and adapted for connection to a source of high frequency current.

2. An inductor as defined in claim 1, further comprising shaped pieces located inside the half molds and made of a thermosetting material which is non electrically conducting.

3. An inductor as defined in claim 2, wherein said thermosetting material is Araldite which is resistant to at least 150°C.

4. An inductor as defined in claim 1, wherein the means ensuring a positive electrical contact between the outside edges of said half molds comprise contact springs located at equal distances along the inside circumference of the outside edges of said half molds.

5. An inductor as defined in claim 1, wherein the means ensuring a positive electrical contact between the outside edges of said half molds comprise a small projection along the inside circumference of the outside edges of sad half molds.

6. An inductor as defined in claim 5, wherein a thin coating of a metal the conducting properties of which are not impaired by sulphur are disposed along the mating outside edges of said half molds.

7. An inductor as defined in claim 1, wherein said high frequency current source comprises a transformer having a primary winding and a secondary winding located adjacent to the torus formed by said half molds, and wherein the current conductors connected to the inside edges of said half molds are the ends of the secondary winding of said transformer.

8. An inductor as defined in claim 13, wherein said transformer is a toroidal transformer which is connected to said half molds by means of two concentric sleeves.

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