Jan. 7, 1941. H. E. SOMES 2,227,866

PROTECTED AND INSULATED HEAT TREATMENT COIL

Filed June 29, 1938

Fig. 1.

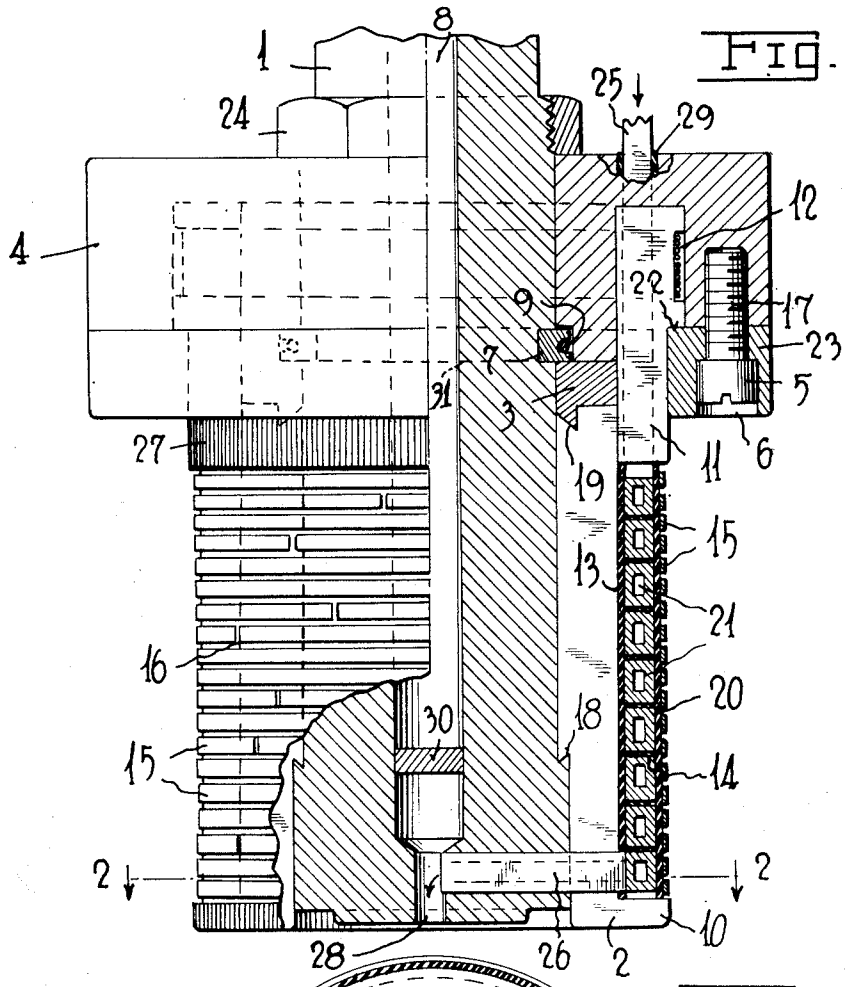
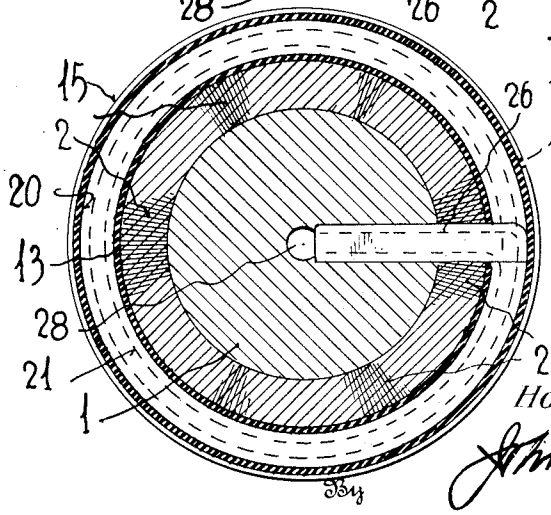


Fig. 2.



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PROTECTED AND INSULATED HEAT TREATMENT COIL

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Application June 29, 1938, Serial No. 216,614

2 Claims. (Cl. 219—13)

The present invention relates to heat treatment coils for heating articles by means of high frequency electromagnetic induction currents.

More specifically, it relates to a readily interchangeable coil for carrying high intensity, high frequency currents, preferably mounted upon a laminated core of magnetic material, for insertion into articles which are to be heated by induction. Such coil is of the general type disclosed in my copending case Serial No. 101,993, filed September 22, 1936.

An object of the present invention is to provide a coil of this nature with efficient insulation and also to provide it with an armor or other external protection made of highly refractory material, which will prevent mechanical injury to the coil.

A further object is to provide an armor for such coils which while made of metal will be substantially free from eddy currents, this result being attained by breaking up the armor into small component parts which are not in electrical contact with one another and which do not form closed circuits.

Still more specifically, the invention relates to a heat treating coil consisting of a mandrel having radially arranged laminations mounted thereon with a heat treating coil made of hollow conductive tubing surrounding said laminations, the coil being insulated from the remaining parts, an armor consisting of a number of narrow resilient split rings of highly refractory metal, such as Chromel "A," being provided over the coil to protect the same from mechanical injury.

One embodiment of the device is illustrated in the accompanying drawing wherein:

Figure 1 is an elevation, partly in longitudinal axial section, of a coil together with the mounting means for the same, and

Figure 2 is a cross section on the line 2—2 of the structure shown in Figure 1.

For convenience of manipulation the coil and its laminations are mounted on a hollow mandrel 1 having the bore 8. This mandrel has a portion of increased diameter near one end thereof and this portion is preferably undercut as shown at 18 to provide an annular retaining "hook" or groove.

A series of laminations 2 is arranged annularly about this end of the mandrel 1, each lamination being preferably tapered in a radial direction, that is, in such manner that the opposite faces of each lamination would converge toward the center of the mandrel, if extended. To hold the laminations on the mandrel a retaining ring 3 is provided which fits over the mandrel and which has a projecting portion 19 forming an annular "hook" directed oppositely to the hook 18.

The laminations are, of course, correspondingly shaped so that the hooks 18 and 19 will hold them in position firmly and securely when they are engaged with such laminations. A key 7 of any suitable nature may be engaged against the outside of the ring 3 to hold it in position and the key 7 will itself be engaged in a suitable slot in the mandrel 1, so that once the ring 3 is in its proper position to hold the laminations and the key 7 is engaged in its groove in the mandrel the laminations will be prevented from becoming loosened. The key 7 may be split or divided ring seated in an annular groove 31, for example, and the parts of this ring may be held in place by means of a resilient ring 9 engaged therearound.

The laminations 2 have at one end an angularly offset portion 10, preferably projecting at right angles as shown in Figure 1, which serves as an abutment for the outer end of the winding 21. This winding consists of a suitable number of turns of tubing made of conductive material, preferably copper tubing which will serve to conduct electricity and also provide a conduit for a cooling liquid.

This coil is preferably wound on a form and slipped on the core, with a ring of mica or similar refractory insulating material 13, interposed between it and the outer edges of the laminations. The individual turns of the winding may also be insulated from one another by split rings 14 of similar insulating material, which may be threaded into the said spaces, or insulation of any other type may be introduced in any feasible manner between the turns. In certain cases a mere spacing of the turns from one another by air spaces will suffice, particularly if the coil is rigid enough to maintain its turns properly spaced from one another.

A cooperating set of radial laminations 11 is arranged to abut against the remaining end of the coil, these laminations being retained in the head or collar 4 and secured to one another by a suitable binding 12 of wire or cord, which serves merely to perform a mechanical retaining function.

The laminations 11 have a shoulder as shown at 22 and a ring 23 bears against this shoulder and is secured to the head 4 by means of bolts 5 mounted in suitable openings 6 in the ring 23 and entering screw threaded bores 17 in the head or collar 4.

This collar 4 may be in turn secured to the mandrel 1 by any suitable means, for example

by means of a nut 24 threaded on the said mandrel.

The copper or other tubing may be insulated from its surrounding conducting parts by any suitable means, for example, by porcelain-enameling, by oxidizing the conductor to provide a film of oxide, or by other known ways of providing insulation, and a layer of mica 20 is preferably placed around the coil 21 as shown. Other materials may also be used for this purpose, but mica will ordinarily be the preferred form of insulation employed.

In order to provide a suitable armor for the winding, use is made of resilient rings made of a high resistance non-magnetic or substantially non-magnetic material, such as Chromel "A," which is formed into thin narrow split rings as shown at 15, each such ring having a gap therein, as indicated at 16, for the double purpose of increasing the range of resiliency of the ring and of preventing it from forming a closed turn in which eddy currents could flow. The gaps in the rings will preferably, of course, be located at distributed points about the periphery of the coil, so that they will not all come in the same line or nearly in the same line with one another. Preferably also, these rings will have an insulating coating, such as an oxide film, so as to avoid short circuiting one another if they should accidentally be shifted into contact with one another, or they may lie positively held in spaced relation axially by interposed insulating material. For example, they may be axially spaced by means of a glass thread impregnated with one of the porcelain enamel compounds or with glyptal and baked.

A suitable connection will be made to each end of the coil 21 to feed the electrical energy and the cooling liquid through the same. One lead 25 for this purpose will preferably run through the collar 4, while the other lead 26 is grounded and connects to the bore 8. Connection to such leads may be made in any desired manner, for example, by welding or by threaded or other fittings. Insulation 29 surrounding the lead 25 will serve to insulate it from the collar 4 and other parts through which it passes. This lead constitutes the upper end of the coil 21.

The cooling liquid enters through the inlet tube 25 and after traversing the coil 21 will be discharged through the grounded outlet tube 26 which is connected to the last turn. This tube 26 leads the water to the central bore 28 which is located at one end of the mandrel 1. Since the mandrel is intended to be used mostly in a vertical position with the collar 4 upward, it is obvious that the water will discharge by gravitation from the passage 28. If the coil is to be used in a horizontal position it will be preferable to provide a plug 30 to shut off the bore 8, as shown, so as to prevent the water from traveling in the wrong direction through the bore 8.

In operation the coil is introduced into the bore of the article which is to be heat treated, so that the high frequency flux produced by the coil 21 in the laminations 2 and 11 will flow in the inner surface portions of the article being heat treated, said flux entering and leaving the laminations at the portions 10 and 27. This high frequency magnetic flux will thereupon produce the necessary heat in the article as disclosed in copending case Serial No. 101,993, filed September 22, 1936.

The armor 15 which, for example, in one specific instance was made of Chromel rings having a thickness of fifteen one thousandths of one inch and a width of six one hundredths of one inch, occupies a relatively small space, has a high electrical resistance and is non-magnetic so that very little loss due to eddy currents and/or hysteresis is produced in said rings, particularly inasmuch as each ring is split. However, these rings are very strong and highly refractory and serve to protect the winding beneath them from short circuits which might otherwise occur due to abrasion or accidental presence of metal turnings or borings in the article being treated, as well as against any dropping of fused metal upon the winding.

The coil and its mounting means are so designed that it is possible to manufacture them in quantity without difficulty and the construction is much simplified by the fact that the coils are form-wound.

I claim:

1. A heating coil assembly comprising a support, a core made of laminations of magnetic material mounted thereon, a form-wound coil surrounding the core, means for insulating the coil from the core, a number of split rings made of metallic non-magnetic material surrounding the coil in staggered relation, and insulation between the coil and the rings.

2. A heating coil assembly comprising a support, a core made of laminations of magnetic material mounted thereon, a form-wound coil consisting of tubing and providing a passage for a cooling fluid, surrounding the core, refractory insulation comprising glass thread and a refractory binder separating the coil from the core, further refractory insulation surrounding the coil and a number of spaced discontinuous staggered rings made of refractory metallic non-magnetic high resistance resilient material enclosing said last-named insulation and resiliently holding it to the coil.

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