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INDUCTION HEATING FURNACE CONSTRUCTION

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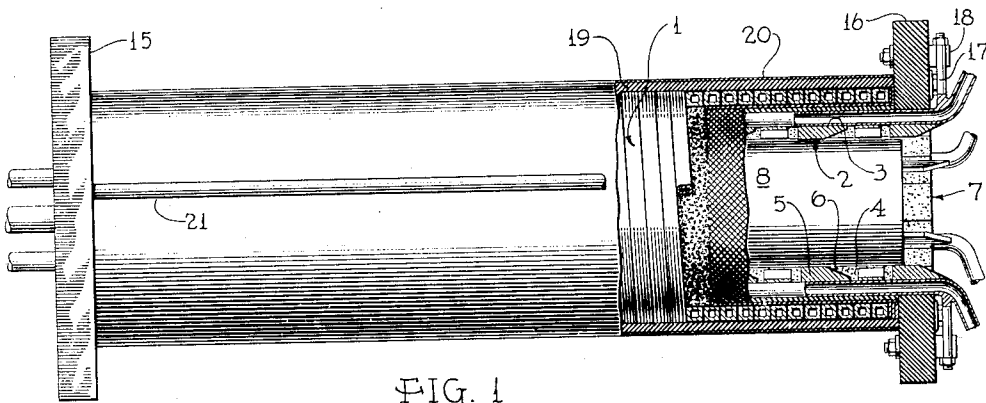


FIG. 1

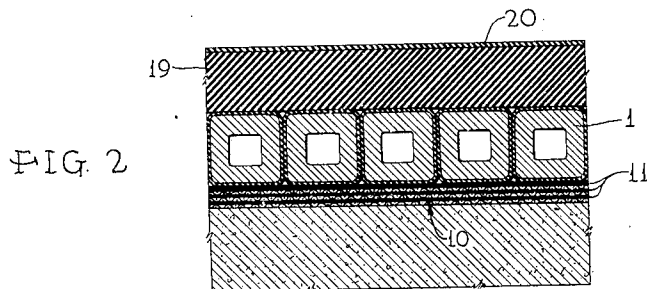


FIG. 2

FIG. 3

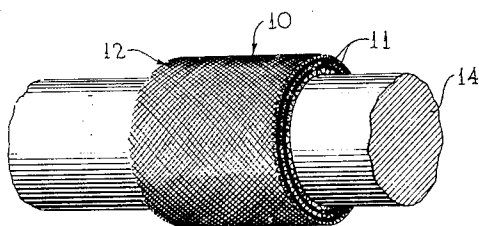
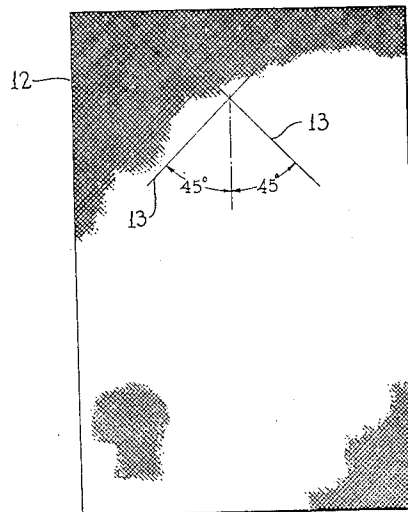


FIG. 4

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INDUCTION HEATING FURNACE
CONSTRUCTION

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11 Claims. (Cl. 219—13)

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This invention relates to furnace construction and particularly to the construction of furnaces of the induction heating type.

In a form of furnace construction utilizing induction coils as the heat source, of the general arrangement described in my copending application Serial No. 384,503, filed March 21, 1941, now Patent No. 2,408,350, dated September 24, 1946, a coil of tubular metal conductor is provided on the inside with a grille of load supporting rails or bars. These rails form with fire brick a continuous cylindrical heat resistant surface inasmuch as the rails are water cooled. Between this cylindrical member and the coil turns is placed a liner of protective and heat and electrical insulating material such as compositions containing mica and asbestos, this liner serving to protect the coil from high temperatures prevalent inside the heat resistant cylinder. It is desirable that this liner be permanently in contact with the inner surface of the coil so as to be susceptible to the cooling influence of the coolant passing through the conductor. Inasmuch as the temperature of the coil conductor is subject to a considerable variation as high as 50° F. during a heating cycle it is apparent that a liner of low expansibility will be subjected to severe strains causing cracking thereof and overheating due to physical separation from the coil unit.

A primary object of the invention therefore is to provide a liner which may be securely bonded to a metal coil or surface and which will follow the expansion and contraction of the coil as brought about by heat without disruption of the liner. An additional object of the invention is the provision of lining material for a coil or other base subject to extensive expansion and contraction which in its elementary form possesses a limited amount of expansibility with heat. A further object is to provide a liner construction which possesses not only inherent tensile strength in its elementary form but which is capable also of withstanding substantial electrical voltages through the normal temperature range of the liner. An object also is to provide a lining which may be utilized successfully in conjunction with a movable base to which it is attached, composed of glass tape and mica. Other objects will appear on consideration of the specific embodiment of the invention hereinafter disclosed and shown in the accompanying drawings, in which

Figure 1 is a view partly in section of a heating furnace of the inductor coil type disclosing my invention;

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Figure 2 is a detail of the lining and the contiguous coil turns;

Figure 3 is a view of the fabric employed for lining purpose; and

Figure 4 is a perspective of a mandrel with concentric liners of lining material thereon.

The furnace of Figure 1 is formed primarily of a coil 1 of tubular conductor, square in cross section and provided with spiral, overlapping, glass tape insulation. A single coil may be used or a plurality of coils placed end to end along a common axis with protruding taps (not shown) for appropriate connection to sources of electrical current and coolant. In the manufacture of this coil a mandrel may be used to give the coil the proper diameter. Coils of this type are usually of copper.

Within the coil 1 is a cylinder generally indicated by the numeral 2 formed of a plurality of rails 3 tubular in cross section and intervening segments 4 of fire brick so that the rails and fire bricks together form a closed cylinder. The rails being hollow are utilized for passage of a coolant so that these rails with the fire brick offer considerable resistance to the transfer of heat from the workpiece.

Attached to the inner surface of the rails 3 are a plurality of lugs 5 spaced axially along the rail and provided with inclined edge surfaces 6 on the lug ends toward the inlet opening 7 of the furnace chamber. As illustrated in Figure 1 a workpiece 8 is shown in position resting on the edges of the supporting lugs 5. The inclined edge surfaces 6 of the lugs facilitate movement of the workpiece into the heating chamber.

Intermediate the refractory cylinder 2 and the heating coil 1 is a lining generally indicated by the numeral 10. This lining or liner is formed of a plurality, preferably, of nested cylinders 11 of fabric 12. The material of this fabric consists of glass fibre or strands 13 which prior to formation as a cylinder have been impregnated with a high temperature varnish such as commercial Silicone varnish. It is important that this impregnation occur prior to the cylinder formation so as to insure that all sections of the fabric are properly treated. A varnish of the type which does not require a solvent, such as 100% solid Silicone, is desirable as preventing the formation of bubbles due to thinner during the heating steps. The effect desired is a complete coating and impregnation of the fabric in order to insure maintenance of form and to prevent breakage during the assembly of the fabric into the liner.

After impregnation the fabric is wound on a mandrel 14 in such manner that the individual strands form a bias with the axis of the mandrel. Experimentation has indicated that a bias of approximately 45° is preferable, as shown in Fig. 3, as this angle permits extension of the fabric either axially or radially with reference to the support. The fabric with the bias relationship mentioned is placed around the mandrel as a one layer cylinder preferably; and subsequently a second and third layer of fabric is wound around the first layer and completed as cylinders. Three nested cylinders have been found effective although the number may be varied in accordance with the requirements of the apparatus.

Having formed the fabric liner with the external diameter of the liner substantially equal to the inner diameter of the coil, having consideration for the individual insulation on the coil turns, the liner is removed from the mandrel and positioned within the coil to which it is secured or bonded by means of a heat resistant varnish. The refractory cylinder 2 is then placed within the liner and the whole unit assembled by placement at the ends of the coil of insulation plates 15 and 16 which may be of asbestos containing material such as Transite. These plates are apertured to permit extension of the rails to points external to the support plates where, by means of retention rods 17 and associated lugs 18 the rails and fire brick are maintained in position. External to the coil slabs 19 of Transite or other insulation material are placed to protect the coil from injury and to restrict unnecessary heat leakage and the slabs are retained by tape 20. The rods 21, external to the coil unit bind the furnace together.

As above mentioned the strands of the fabric are glass which for furnace uses is valuable because of its definite strength and also for its capability of withstanding ordinary temperatures encountered in heat treatment. A possible deficiency of glass however may result in some uses where the temperature may be excessive, arising from the fact that at high temperatures the glass tends to become somewhat electrically conductive. To overcome this tendency and to supplement the glass in other ways it has been found desirable to employ mica as a surfacing material for the liner. This material may be placed intermediate each concentric layer of the liner fabric or it may be placed only external to the outer liner layer adjacent the heating coil. To utilize mica in its natural form as solid sheets of mineral would defeat the purpose of the invention which requires extensivity of the liner. Applicant has found that the mica may be successfully employed as flakes which are overlapped or shingled onto the surface of the fabric. The varnish retains the mica in place. It is apparent that in this form the mica preserves its insulating characteristic and at the same time offers no resistance to the expansion and contraction of the fabric.

In the operation of the furnace on expansion of the heating coil during the heating cycle the liner fabric yields whether the expansion be radial or axial, the bond maintaining the fabric in close proximity to the coil. Consequently there is no tendency for the formation of an opening between the liner and the coil as usually would result if the fabric were wound without a bias. If such a development occurred the liner, when subjected to the heat escaping through the refractory cylinder without the benefit of the

cooling action of the coil, would soon disintegrate.

While I have specified the use of glass as the elementary strand in the liner fabric it is of course apparent that other materials may be utilized. It is also obvious that electrical insulating substances other than mica might be employed. Hence no limitation is implied by reference to the specific materials or to the specific arrangement, other than may be required by the claims as hereto appended.

What is claimed is:

1. An induction heating furnace comprising a tubular chamber having a wall subject to expansion and contraction due to heat, and a liner supported in juxtaposition to said chamber wall, said liner having a coefficient of expansion for heat diverse from that of said chamber wall and comprising a fabric with strands woven on a bias in relation to the tubular chamber axis whereby the resistance to axial forces on said liner due to axial heat movement of the wall is reduced.

2. An induction heating furnace comprising a tubular chamber having a wall subject to expansion and contraction due to heat, a liner supported in juxtaposition to said chamber wall, said liner having a coefficient of expansion for heat diverse from that of said chamber wall and comprising a fabric with strands woven on a bias in relation to the tubular chamber axis, and a coating of electrical insulating plates coated on said fabric.

3. An induction heating furnace comprising a tubular chamber subject to expansion and contraction due to heat, and a liner supported in contacting proximity to said chamber wall, said liner having a coefficient of expansion for heat diverse from that of said chamber wall and comprising a fabric with strands woven on a bias of 45° in relation to the tubular chamber axis.

4. An induction heating furnace comprising a tubular chamber subject to axial expansion and contraction due to heat, a liner supported in concentric relation to said wall and in juxtaposition therewith, said liner having a coefficient of expansion for heat lesser than that of said wall and comprising a fabric with strands woven on a bias in relation to the tubular chamber axis, and a coating of electrical insulating plates secured to the external surface of said fabric, said plates being applied in shingle formation whereby slip occurs between the plates on axial heat movement of the chamber wall.

5. An induction heating furnace comprising a heating coil formed of an electrical conductor subject to heat expansion and contraction in a direction parallel to the coil axis, and a layer of fabric secured fixedly in intimate contact with said coil, said layer and coil having a different coefficient of heat expansion and said layer being formed of a fabric having strands woven at a bias with relation to the coil axis whereby disruption of contact between layer and coil is prevented.

6. An induction heating furnace comprising a tubular chamber having a wall subject to expansion and contraction due to heat, a liner attached to the chamber wall and subject to temperature variation thereof, and a layer of electric insulation material attached to said liner between the liner and chamber, said layer comprising a plurality of overlapping flakes.

7. An induction heating furnace comprising a tubular chamber having a wall subject to expansion and contraction due to heat, a liner attached to the chamber wall and subject to temperature

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variation thereof, and a layer of electric insulation material interposed between the liner and chamber, said layer comprising a plurality of mica flakes placed in overlying contact with each other.

8. An induction heating furnace comprising a tubular chamber having a wall subject to expansion and contraction due to heat, and a protective liner attached to the chamber wall and subject to temperature variations thereof, said liner comprising a plurality of nested layers of fabric having strands lying at a bias with relation to the chamber wall axis and electrically insulating flakes interposed between said liner layers and between said liner and said chamber whereby expansion and contraction of the liner with said chamber wall may be accommodated without rupture of the fabric strands.

9. An induction heating furnace comprising a tubular chamber having a wall subject to expansion and contraction due to heat, a refractory load retaining chamber within said tubular chamber and a liner interposed between said chambers, said liner being movable with said tubular chamber and being formed of a fabric, the strands of which have a bias in relation to the common axis of the chambers permitting yield of the fabric without rupture through movement of the tubular chamber wall.

10. An induction heating furnace comprising a tubular chamber having a wall subject to expansion and contraction due to heat, and a liner supported in juxtaposition to said chamber wall, said liner having a coefficient of expansion for heat diverse from that of said chamber wall and

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comprising a fabric with strands woven on a bias in relation to the tubular chamber axis whereby the resistance to axial forces on said liner due to axial heat movement of the wall is reduced, said fabric being impregnated with substantially a 100 per cent Silicone.

11. An induction heating furnace comprising a tubular chamber having a wall subject to expansion and contraction due to heat, a liner attached to the chamber wall and subject to temperature variation thereof and a layer of electric insulation material attached to said liner between the liner and chamber, said layer comprising a plurality of overlapping flakes impregnated into a substantially integral layer by a substantially 100 per cent Silicone.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,289,896	Pfanstiehl	Dec. 31, 1918
2,122,604	Bridges	July 5, 1938
2,133,183	Baird et al.	Oct. 11, 1938
2,181,274	Jackson et al.	Nov. 28, 1939
2,184,534	Smith et al.	Dec. 26, 1939
2,221,302	Mizzy et al.	Nov. 12, 1940
2,227,931	Greenleaf	Jan. 7, 1941
2,251,697	Van Daam et al.	Aug. 5, 1941
2,357,241	Wagner	Aug. 29, 1944
2,373,719	Strickland	Apr. 17, 1945
2,397,568	Seaman	Apr. 2, 1946