Dec. 6, 1949 H. A. STRICKLAND, JR 2,490,107

HOOD AND COIL ARRANGEMENT FOR INDUCTION FURNACES

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Fig. 1.

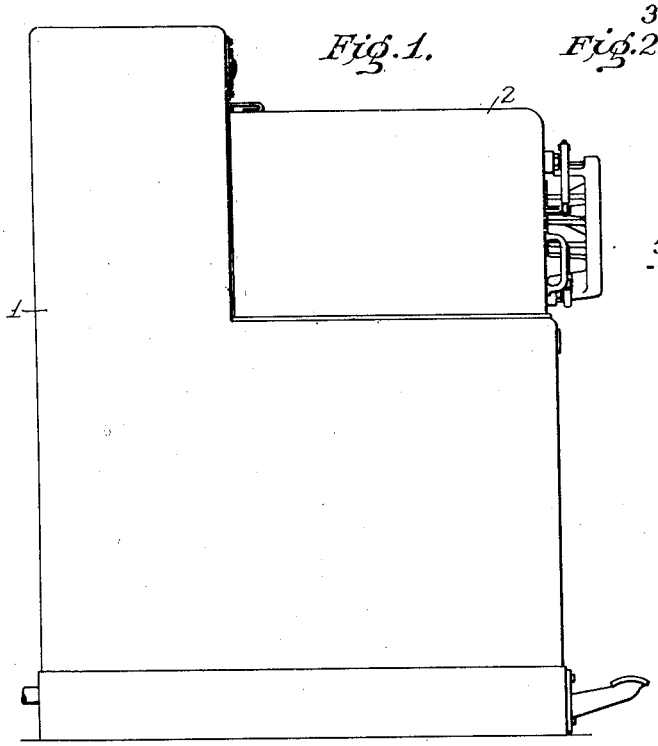
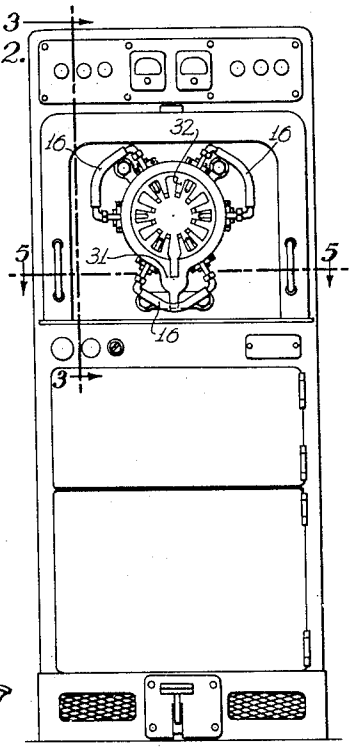


Fig. 2.



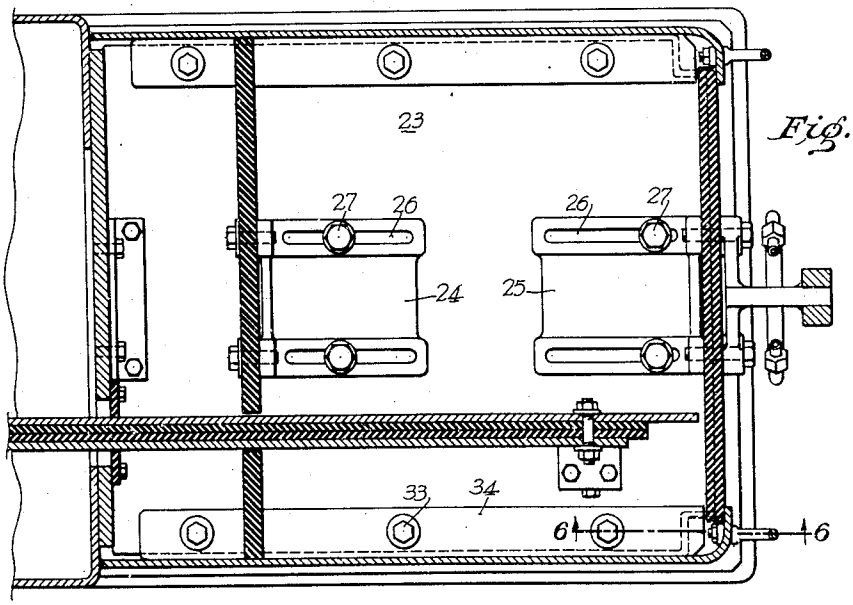


Fig. 5.

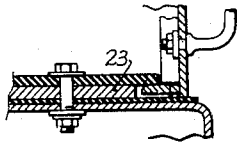


Fig. 6.

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Fig. 3.

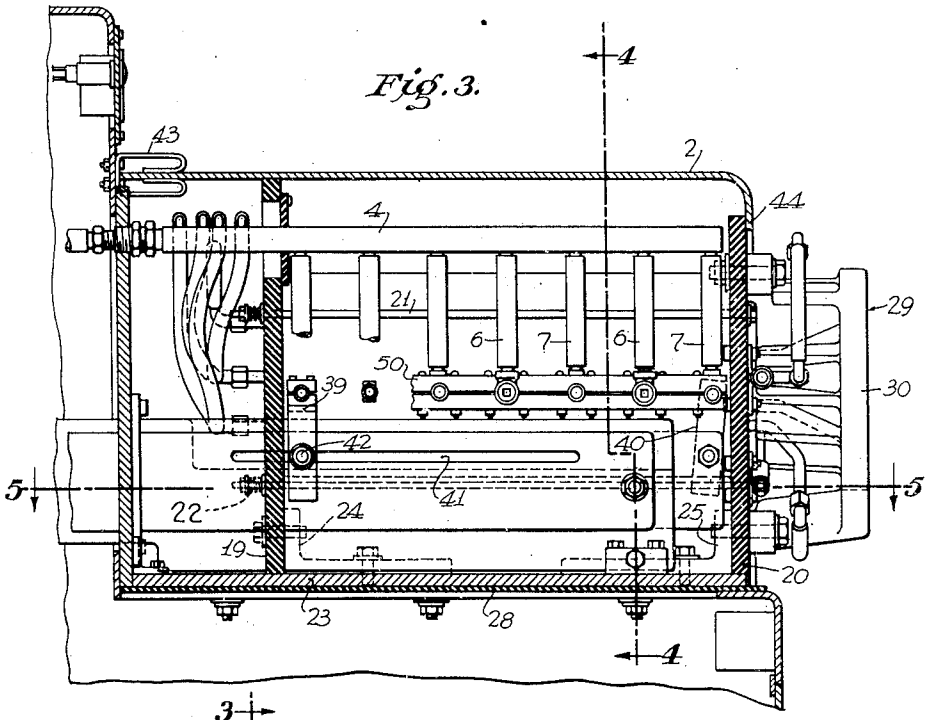
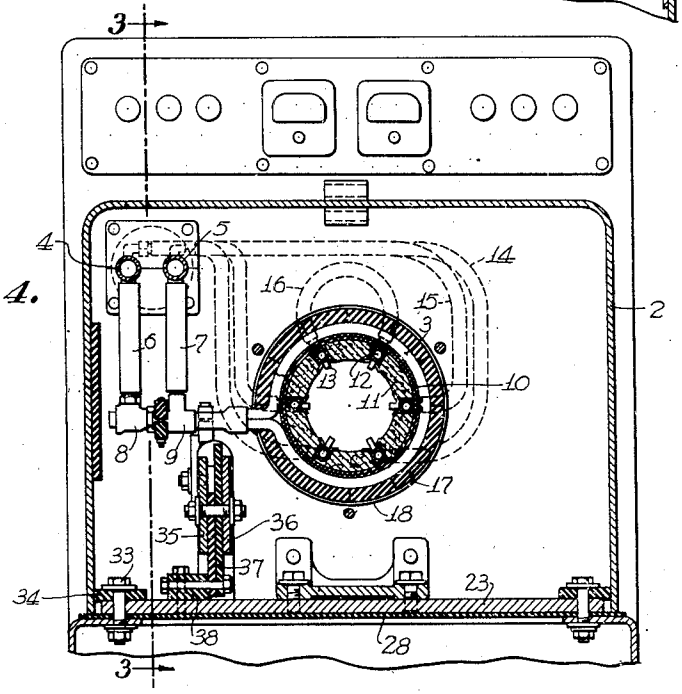


Fig. 4.



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UNITED STATES PATENT OFFICE

2,490,107

HOOD AND COIL ARRANGEMENT FOR INDUCTION FURNACES

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Application February 4, 1946, Serial No. 645,451

3 Claims. (Cl. 13—26)

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This invention relates to a hood and coil arrangement having general applicability to electric furnaces, with specific adaptability to bar heaters.

In my copending application Serial No. 384,503, filed March 21, 1941, entitled "Electric furnace machine," now Patent No. 2,408,350 dated September 24, 1946, is described a form of induction furnace intended for the heating of metal bars in which an induction coil is mounted on a supporting means and provided with a multi-fingered mouth-piece for directing the work into the coil interior, and an over-all casing which serves as a support for the mouthpiece and a cover for the induction coil of the furnace and the associated bus bars supplying heating current to the coil. In the arrangement of this copending application several difficulties develop in use, among which may be mentioned a tendency for oil vapor to penetrate within the casing in the space between the coil and casing and coat the bus bars and bring about eventually a dust film which tends to short-circuit or ground the current and thus reduce the efficiency of the heating.

One of the primary objects of the present invention is to provide a hood and coil assembly with the parts so related as to prevent in-flow of oil vapors from the furnace chamber of the coil into the space between the casing and the coil.

Another object of the invention is to utilize a construction wherein the mouthpiece of the furnace coil is positioned external to the casing so that ready assembly may be accomplished.

Still another object of the invention is to provide a coil structure in which the support rods which are ordinarily embedded within the coil unit extend directly outwardly through the coil inlet opening without passage through the supporting end plate.

An object also is to provide novel means for supporting the mouthpiece so as to relieve strain on the casing structure.

A further object is to provide insulation on the base side of the casing so that circulatory currents are eliminated, there being an appropriate ground connection to the metallic base support.

The above and other objects of the invention are accomplished by the structural arrangement set out hereinbelow and illustrated in the accompanying drawings, in which:

Figure 1 is an elevation of a furnace unit embodying my invention;

Figure 2 is a front elevation of the furnace of Figure 1;

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Figure 3 is a sectional elevation along lines 3—3 of Figures 2 and 4;

Figure 4 is a cross-sectional view of the furnace taken along lines 4—4 of Figure 3;

Figure 5 is a plan view in section taken along the lines 5—5 of Figure 3; and

Figure 6 is a detail showing the joint between the casing and the base plates of the furnace.

As shown in my copending application above referred to, the entire furnace construction comprises two units 1 and 2, as indicated in Figure 1. The unit 1 includes the capacitors and miscellaneous bus bar connections, the control elements and instrument panel, and serves as support for a heating unit which comprises an induction heating coil 3, bus bar connections 39, 40, mouthpiece guide 29, and casing 2 enclosing these elements.

Referring more particularly to Figures 2 and 4, the induction coil 3 is formed of a tubular electrical conductor in a plurality of sections, such as described in my Patent No. 2,325,810, each section terminating in an offset section included in a coupling making connection to the inlet or outlet coolant reservoirs. As shown in these figures, manifolds 4 and 5 extend horizontally adjacent the coil unit, the manifold 4 being for inlet coolant and the manifold 5 for exhaust coolant. Depending from these manifolds are a series of insulator couplings 6 and 7, such as rubber tubing, which join respectively with the couplings 8 and 9 to complete the inlet and outlet circuit of coolant through the sections of induction coil. The manifolds 4 and 5 project rearwardly alongside the coil into the main support casing 1 to an appropriate coolant source.

A multiple clamp 50 of insulation material holds the couplings 8 and 9 in fixed relative position. The induction coil unit includes, in addition to the coil 3, a tube of insulation 10, a tube of firebrick 11, and a plurality of concentrically arranged and axially extending metal tubes or rails 12 which serve, in conjunction with the wear-resistant projections 13 inwardly attached thereto, as bearing means for supporting the workpiece. These rails are embedded within the firebrick cylinder and extend the full length of the coil, the ends thereof projecting outwardly beyond the coil at each end. These rails are adapted to receive coolant from the manifolds 4 and 5, as indicated in dotted outline in Figure 4. To this end tubular connectors 14 and 15 are provided, connecting to the manifolds 4 and 5 and flexible connectors such as rubber tubing 16 at both ends of the coil and external thereto to

establish a series circuit from the inlet point to the outer point.

Surrounding the coil is a layer 17 of heat insulating and heat-resistant material, such as asbestos board, formed usually of asbestos and Portland cement. An outside enclosing fabric layer 18 binds the segments of the layer 17 in position on the coil.

The induction coil unit as above described is maintained in position in the casing 2 through connection at the ends to upstanding asbestos board plates 19 and 20. The plate 20 is at the front end of the furnace and is formed with an opening coinciding with the front coil opening. The rear plate 19 closes the casing 2 transversely. These plates are reinforced by connecting rods 21 extending from plate to plate and yieldably held in position by the coil springs 22. These rods are positioned at points angularly displaced around the coil. The plates 19 and 20 are adjustably supported on the base plate or base support 23 by means of brackets 24 and 25. As shown particularly in Figure 5, each bracket has side slots 26 on the base section through which the supporting bolts 27 extend at any desired point of the slot. In this manner the end plates 19 and 20 may be adjusted with reference to the size of the coil and in relation to the base plate 23. Underlying the base plate 23 is an insulation plate 28 which insulates the lower edges of casing 2 from the casing 1 of the unit. This plate also insulates the casing 2 from casing 1 to prevent transmission of current from the induction coil to the casing 1 arising either from short-circuiting or inductive effects. Attachment of these plates is by means of bolts 33. These bolts also hold the insulation strip 34 with the outer edge thereof extending beyond the edge of plate 23 to space the casing walls from the plate edge and thus establish electrical discontinuity. Base plate 23 is thoroughly grounded to casing 1 by grounding bolts (not shown).

Adapted for connection to the front support plate 20 and the front bracket 25 and positioned generally in line axially with the heating coil of the furnace is a mouthpiece unit 29. This mouthpiece includes a solid ring 30 having a radial projection 31 adapted to engage the lower bracket 25 on the base plate 23 and be supported thereby. Additional bolts connect the upper side of the ring with the front plate 20 to augment the supporting means. In addition to the ring 30 the unit includes a plurality of free-ended fingers 32 which converge toward the inlet opening of the furnace coil to form a guide envelope through which a workpiece is led to proper seating within the heating coil.

The space around the envelope formed by the fingers of the mouthpiece is ample for the extension of the rails of the coil and connection to the return conduits 16 without interference with the mouthpiece.

Also included in the structure are bus bars 35 and 36 which with separating insulation plates 37 form a bus bar unit on the lower side of the coil. This unit is supported by means of the bracket structure 38, as shown in Figure 4, along the base plate 23 directly beneath the coupling sections 9 of the heating coil. Strap connectors 39 and 40 are employed to make connection to the bus bars 35 and 36, respectively, the connection between bus bar 36 and strap 40 being fixed whereas the connection between bus bar 35 and strap 39 is adjustable through provision of a slot 41 in the bus bar connecting with a slidable bolt 42 inserted in the strap 39. The head of the strap is detachable to form a clamp connection with the connectors 8 and 9 so that any desired section of the coil may be tapped to secure the proper electrical values desired.

The entire structure as described including the coil, the coolant couplings, and the bus bars is enclosed by the casing 2. This casing is of metal and is approximately in U shape with the U branches engaging the insulation plate 28 and retaining strips 34. The rear end of the casing is grounded through the spring connector 43 on the casing 1. The front end of the casing is flanged as at 44 to form an opening which is ample to enclose and be spaced from the outer elements of the mouthpiece 29 but at the same time overlap the outer edge of the front face of the front support plate 20. In this manner a fairly close vapor-proof contact may be made for the purpose hereinafter described, it being observed that since the front plate is in intimate engagement with the front end of the coil and also with the lapped edge of the casing, passage of vapors from the interior of the coil to the space between the coil and the casing is for all practical purposes prevented.

In use, workpieces as placed in the furnace for heating are usually coated with oil, and, due to the heat of the furnace vapors from this oil develop which, if permitted to enter the area between the casing and the coil, would coat the bus bar insulators and other electrical connections and supports and consequently these parts become subject to deposition of particles of dust including conducting substances such as metallic fragments and water vapor, so that after a time period there is a leakage path formed between the bus bars which serves to diminish the efficiency of the furnace. This oil penetration also is found undesirable from the viewpoint of manipulation and repair. Consequently, it now appears that by forming a close joint between the front coil support plate 20 and the casing flange 44, and bearing in mind that the rear support plate 19 extends completely across the casing so as to form a complete wall at the rear, there is no avenue remaining for penetration of the oil vapor into the space between the coil and casing and hence the deposition of oil on the conductors and intermediate supports thereof is eliminated.

Various additional features of the construction as described may now be pointed out. It is noted that the mouthpiece 29, being supported entirely on the front side of the support plate 20 and completely without the casing 2, is subject to ready detachment at will to permit of repair or replacement or to allow easy access to the coil interior. The mouthpiece 29 is grounded through its connection with bracket 25 affording added safety to operator. An added feature is that the single assembly of mouthpiece and coil which is possible with this construction allows quicker changing from one size coil to another since there is not a separate mouthpiece attached to the hood as previously. Mention has already been made also of the lending of this construction to the use of straight rails for the support of the workpiece, thus simplifying the construction both of the coil unit and the connections to the rail external to the coil ends. The mounting of the casing 2 on the insulation plate 28 insures elimination of circulatory currents in the casing. The electrical grounding

of the casing at 43 also insures appropriate conditions for operation of the unit.

Modifications of structure may of course be made providing such modifications come within the limits of the claims as hereto appended.

What is claimed is:

1. In furnace apparatus, an induction heating coil adapted to have high frequency current circulated therethrough and to have a high frequency flux field therearound, support plates secured to and overlying the coil ends, one of said plates having a feed opening therethrough, a metal base support for said support plates, a metal casing overlying said coil and support plates of approximately inverted U-shape cross-section, a metallic base underlying the base support, and an insulating means electrically insulating the sides of said metal casing from said metallic base and said metal base support whereby circulatory currents caused by stray flux induced between the casing and base are substantially reduced.

2. In furnace apparatus, an induction heating coil adapted to have high frequency current circulated therethrough and to have a high frequency flux field therearound, support plates secured to and overlying the coil ends, one of said plates having a feed opening therethrough, a metal base support for said support plates, a metal casing overlying said coil and support plates of approximately inverted U-shape cross-section, a metallic base underlying the base support, an insulating means electrically insulating the sides of said metal casing from said metallic base and said metal base support whereby circulatory currents caused by stray flux induced between the casing and base are substantially reduced, and detachable clamp means for electrically connecting said casing to said base.

3. In furnace apparatus, an induction heating coil having a feed opening, heat insulation material forming a hollow furnace chamber within said coil, a plurality of hollow workpiece support tubes embedded in said insulation material and adapted to have a cooling medium circulated therethrough and extending outwardly without curvature beyond said feed opening, flexible tubing connecting the interior of said tubes in series, a workpiece mouthpiece in extension of said feed opening, and means for supporting said coil, insulation material, tubes, and mouthpiece in cooperative relationship.

HAROLD A. STRICKLAND, JR.

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