

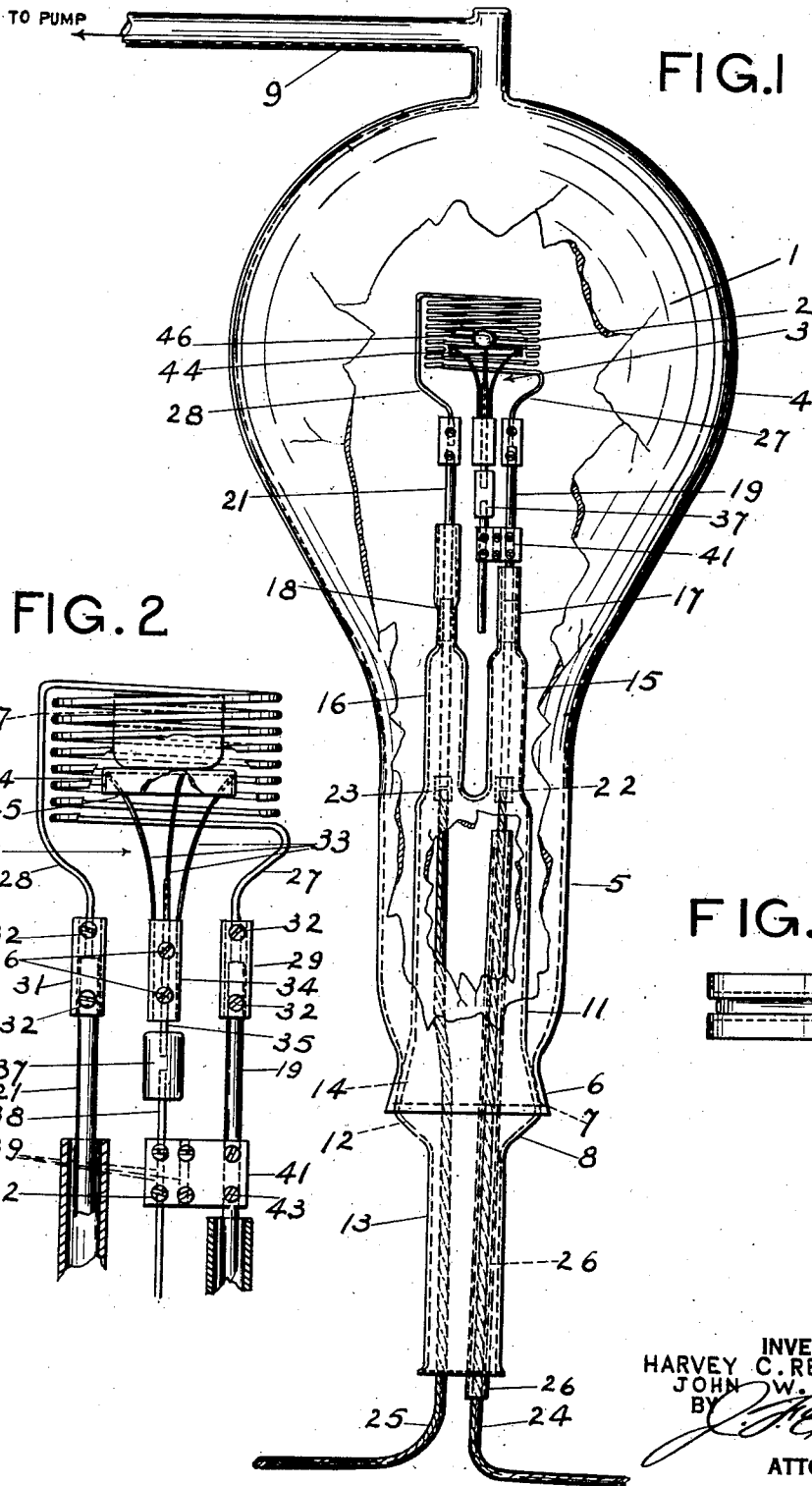
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HIGH FREQUENCY FURNACE

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HIGH-FREQUENCY FURNACE.

Application filed January 5, 1925. Serial No. 475.

This invention relates to furnaces and more particularly to high frequency induction furnaces.

The present invention is a continuation in part of application Serial No. 717,940, filed June 5, 1924, assigned to the same assignee as the present application. It also embodies certain specific improvements in the high frequency induction furnace described and illustrated in Patent No. 1,480,301 likewise assigned to the present assignee.

The furnace described in Patent No. 1,480,301 consists primarily of a large glass envelope enclosing a coil through which high frequency currents are adapted to be circulated. Within this coil is positioned a support upon which is placed the metal or compound to be heated. The vessel is connected to an exhaust system for the purpose of producing a high vacuum therein.

The device described more fully herein-after, finds special application in the heat treatment of metals which readily oxidize such, for example, as thorium, uranium, zirconium and the like, usually referred to as the rare or refractory metals. It is particularly useful in sintering or fusing such metals so as to obtain a uniformly coherent, pure and ductile product.

One of the features of the present invention relates to the provision of a unitary interior structure which is so designed as to provide for accurately positioning the support and metal thereon within the high frequency coil so as to obtain uniformity of heating as well as the maximum heating effect.

One of the principal and important features of our invention consists in the provision of a supporting disk or crucible which is composed of a material which will withstand the exceedingly high temperatures prevailing in the furnace during its operation and which, at the same time, will not contaminate the material undergoing treatment.

It should be appreciated that in heat-treating the rare metals, such as thorium, uranium, and the like, exceedingly high temperatures are desirable and furthermore, because of the avidity of such materials for oxygen, etc., it is important that the material should be supported in such a manner that the maximum heating effect may be

obtained and also so that there is no likelihood of their being contaminated. This is especially true of the very active rare metals thorium and uranium, for the reason that these metals reduce many refractories, such as lime, for example, thus making the use of a support such as thoria desirable.

One of the special advantages of our furnace is in the production of large masses of coherent, ductile material in special form, such as large X-ray targets in disk form which, when subjected to high heat treatment, will be preserved in their pure metallic condition.

Therefore, it is an object of the present invention to provide a form of support whereby uniform heat treatment may be given a large mass of material.

Another object of the invention is to provide a support which is of such a nature that it does not affect the material undergoing treatment at the high temperatures prevailing during the treatment.

Another object of the invention is to provide a furnace of the high frequency induction type in which the specimen undergoing treatment may be so positioned with respect to the heat inducing member as to obtain the maximum heating effect.

A still further object of the invention is to provide a more efficient and inexpensive furnace construction.

Other objects of the invention will be apparent from the following description.

Referring to the drawings,

Fig. 1 is a view in elevation of one form of the furnace, some parts being shown in section;

Fig. 2 is an enlarged elevational view partly broken away, of the heating element and support; and,

Fig. 3 is an elevational view of a support with a large mass of a metal thereon, the metal being given the form of an X-ray target of disk construction, a cover being provided to conserve the heat.

The furnace comprises essentially a hollow body or chamber 1 of any suitable shape and material, preferably glass, an induction member or coil 2, of tungsten or other suitable material, and a support 3 for the material undergoing treatment.

The envelope may comprise a bulbous portion 4 having a tubular neck 5 terminating

in an outwardly flared mouth 6 to form a seat 7 for a closure 8 to be described more fully hereinafter. The seat 7 of the mouth 6 is carefully ground upon its inner surface so that the closure 8 makes a hermetic joint therewith. To the upper end of the bulbous portion 4 there is secured a tube 9 which is connected with any suitable type of efficient exhaust apparatus capable of producing an exceedingly high vacuum within the chamber. The tube 9 is in open communication with the interior of the chamber 1.

The closure 8 comprises a tubular portion 11 of glass having an enlargement 12 terminating in an outwardly extending tubular extension 13. A cooling fluid may be projected into the tubular extension 3 to maintain the closure 8 cool. The enlargement 12 has a conical portion 14 corresponding in shape to the seat 7, but of slightly smaller diameter so as to snugly fit within the mouth 6 of the envelope. This conical portion of the closure is ground in a manner similar to the seat 7 so as to obtain a hermetic seal, although it may be found desirable, as has been done in practice, to place an evenly deposited layer of stopcock grease upon the seat 7 and conical portion 14, whereby an air tight joint is obtained. Where grease is objectionable, talc may be used.

The closure 8 as well as the envelope 1 is made of glass, preferably a hard glass such as a silica or quartz glass.

Extending inwardly from the tubular portion 11 are two spaced-apart small tubular extensions 15 and 16, the ends of which are formed into two presses 17 and 18. In the presses are sealed tungsten rods 19 and 21, which serve as conductors of the high frequency current as well as supports for the high frequency coil or induction member 2.

The lower portions of the tungsten rods 19 and 21 extend through the tubular extensions 15 and 16 and are brazed or otherwise electrically united at 22 and 23 to lead-in wires 24 and 25, formed of stranded twisted copper, which latter may be connected to any suitable source of high frequency current supply. A sleeve of glass 26 surrounds a portion of the conductor 24 to insulate the same from the other conductor 25.

Referring to Fig. 2, it will be observed that the high frequency coil or induction member 2 consists of a helix made up of closely spaced turns of wire, preferably tungsten. The lower end of the helix terminates in a downwardly extending leg 27 and the upper end in a downwardly extending leg 28. These legs are removably secured in clamps 29 and 31. The clamps consist of sleeves of suitable conducting metal, the ends of the supporting rods 19 and 21 and the ends of the legs 27 and 28 being secured

therein by means of screws 32 or the like.

The support 3 for the material to be heat-treated comprises a plurality of upwardly extending and outwardly flaring arms 33, having their lower ends secured in a sleeve 34, their upper ends being free. A supporting rod 35 is centrally disposed within the sleeve 34 and removably fastened therein by screws 36. The lower end of the rod 35 is embedded in a block of insulating material 37, such as glass. Another supporting rod 38 has one end also embedded in the block 37, such end being spaced from the end of the rod 35, so that the two rods are separated by insulation furnished by the block 37. The lower end of the rod 38 is removably secured in one of a plurality of openings 39 in a clamp 41. Fastening means 42 such as screws may be employed to secure the rod 38 in any position of adjustment. The clamp 41 may be adjustably secured to the tungsten supporting rod 19 by screws 43, the rod 19 passing through an opening in the clamp. It will thus be apparent that the support 3 may be vertically adjusted with respect to the induction member 2, and also adjusted horizontally by disposing the supporting rod 38 in one of the openings 39 of the clamp 41. By reason of the insulating block 37, the current passing through the tungsten rod 29 is prevented from passing through the support 3 and the material resting thereon. The structure thus provided facilitates the positioning of the specimen undergoing treatment within the induction member 2 so as to obtain the maximum heating effect. It is obvious, however, that other means of adjustment, apparent to those skilled in the art, may be provided.

The support proper for the material to be treated and which we have found to be the most efficient for our purpose, may be one preferably consisting of thoria, zirconia, or the like, free from impurities which may melt or volatilize during the treatment and which will not contaminate or combine with the metal undergoing treatment or be effected thereby. The method described and claimed in copending application Serial No. 542,134, filed March 8, 1922, assigned to the same assignee as the present application, may be employed to produce these supports.

The support consists in a preferred form of a shallow cup-shaped body 44 of thoria which is inverted and placed upon the ends of the arms 33, so that the latter engage the inner sides of the downwardly extending wall 45 of the support. The support is thus firmly held in position.

As illustrated in Fig. 1, the specimen 46, to be treated, may be placed directly upon the support 44. This material when placed upon the support may consist of a pellet or cake of the powder of the metal pressed into a compact mass. Upon heat-treating thor-

oughly the metal may be sintered or/and fused, and we have found in instances where the metal has been melted that it draws away from the support and does not run into it, and forms into a globular-shaped pellet, such as indicated in Fig. 1. This shows the purity of the metal and its freedom from contamination.

In Fig. 2 we have illustrated in dotted outline 47, a crucible formed of thoria, or the like. The material undergoing treatment may be placed within the crucible and melted. The crucible may be so shaped as to impart to the material any desired configuration, thus, in a sense constituting a mold in which the material is cast to form.

In treating large masses 48 or specimens of rare metals to form, for example, large disk targets for X-ray tubes and the like, the arrangement illustrated in Fig. 3 may be employed. In this construction an additional support or cover 49 may be provided. The cover may be placed directly upon the specimen or target. By means of this arrangement the specimen is positioned in such a manner as to diminish the heat losses as the support and cover serve as heat retainers to prevent radiation and thus permit the attainment of higher temperatures as well as more uniform heating of the specimen. It is possible with this form of support to uniformly heat a very large mass of thorium and the like to form a homogeneous body of metal which is ductile throughout.

The operation of the furnace may be readily inferred from the preceding description.

It is obvious that the material support may be made in a variety of shapes, such as disks, crucibles and the like.

Modifications of the foregoing invention may suggest themselves to those skilled in the art, but such as fall within the scope of the appended claims are contemplated as forming part of our invention.

What is claimed is:

1. A furnace comprising an hermetically sealed vessel, means connecting said vessel to an exhaust pump, a removable mount for said vessel, said mount comprising a hollow tubular member open at one end and terminating in a press at the other end, a plurality of leading-in wires sealed in said press, main supports connected to said leading-in wires, a high frequency induction coil carried by said supports, and a material support connected to one of said main supports, said material support being composed in part of a material which does not react with the material undergoing treatment.

2. A furnace comprising an hermetically sealed vessel, means connecting said vessel to an exhaust pump, a removable mount for said vessel, said mount comprising a hollow

tubular member open at one end and terminating in a press at the other end, a plurality of leading-in wires sealed in said press, main supports connected to said leading-in wires, a high frequency induction coil carried by said supports, and a material support connected to one of said main supports, said material support being composed in part of a material which does not react with the material undergoing treatment, said material support being adjustably secured to said main support.

3. A furnace comprising an hermetically sealed vessel, means connecting said vessel to an exhaust pump, a removable mount for said vessel, said mount comprising a hollow tubular member open at one end and terminating in a press at the other end, a plurality of leading-in wires sealed in said press, main supports connected to said leading-in wires, a high frequency induction coil carried by said supports, and a material support connected to one of said main supports, said material support being composed in part of a material which does not react with the material undergoing treatment, said high frequency coil being removably secured to said main supports.

4. A furnace comprising an hermetically sealed vessel, means connecting said vessel to an exhaust pump, a removable mount for said vessel, said mount comprising a hollow tubular member open at one end and terminating in a press at the other end, a plurality of leading-in wires sealed in said press, main supports connected to said leading-in wires, a high frequency induction coil carried by said supports, and a material support connected to one of said main supports, said material support being composed in part of a material which does not react with the material undergoing treatment, said material support being adjustably secured to said main support so as to be capable of movement in the direction of the longitudinal axis of the mount and in a plane transverse thereto.

5. A furnace comprising an hermetically sealed vessel, means connecting said vessel to an exhaust pump, a removable mount for said vessel, said mount comprising a hollow tubular member open at one end and terminating in a press at the other end, a plurality of leading-in wires sealed in said press, main supports connected to said leading-in wires, a high frequency induction coil carried by said supports, and a material support connected to one of said main supports, said material support being composed of thoria.

In testimony whereof, we have hereunto subscribed our names this 3rd day of January 1925,

HARVEY CLAYTON RENTSCHLER.
JOHN WESLEY MARDEN.