

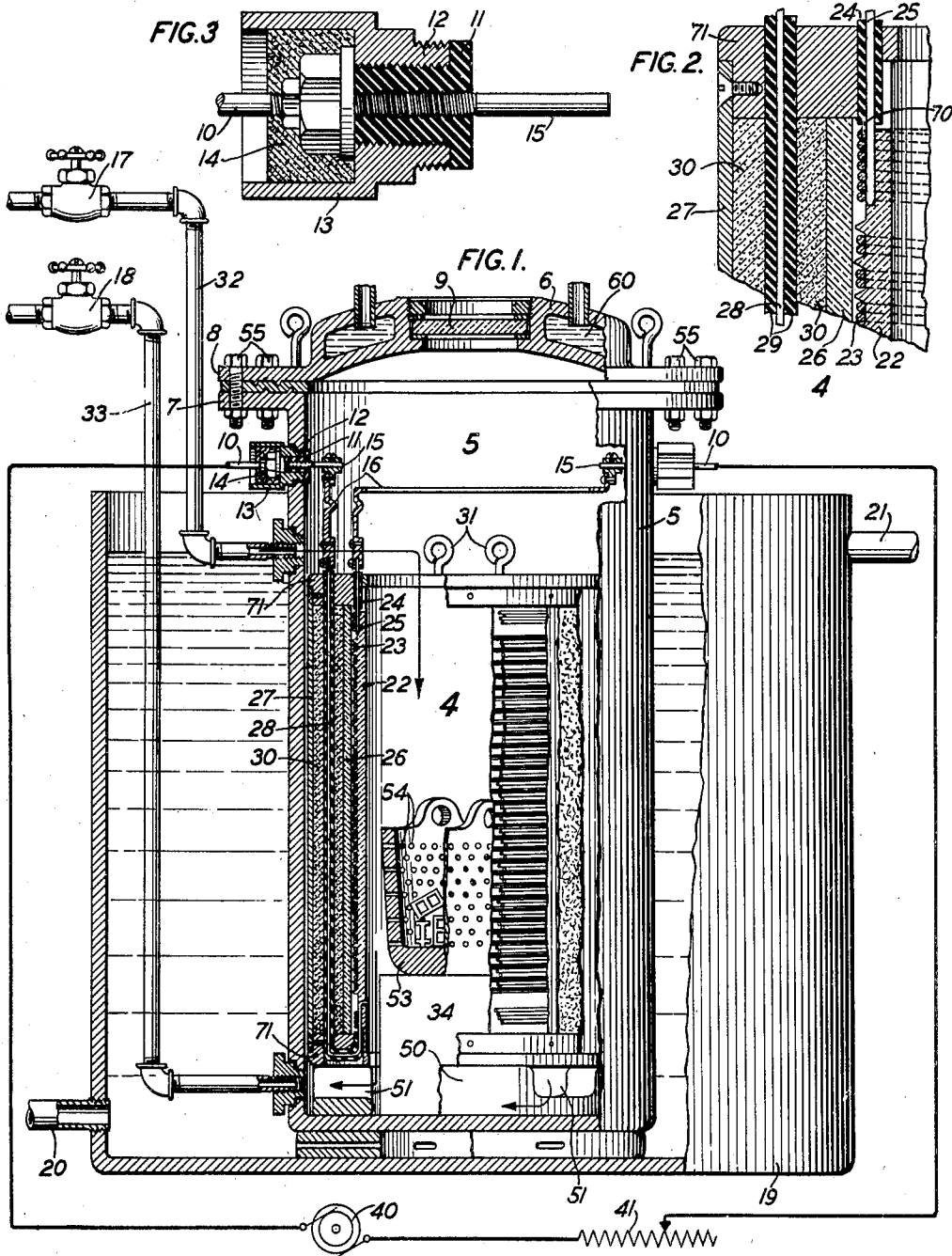
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HEAT TREATING FURNACE

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HEAT TREATING FURNACE

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The present invention relates to apparatus for heat treating magnetic materials.

An object of the invention is to provide a furnace for heat treating magnetic materials at elevated temperatures and at pressures above and below atmospheric pressure.

In applicant's former applications, Serial Nos. 325,883, filed December 13, 1928 and 471,988, filed July 31, 1930 there are disclosed methods for securing desirable magnetic properties in magnetic materials by heat treating them in hydrogenous atmospheres and in vacua. It has been found that the attainment of the desired improvements in the magnetic properties of the materials treated in accordance with the methods described in said applications and other similar methods may be practiced more effectively on a large scale by a furnace especially designed for the purpose. A phase of this heat treating problem involves, for example, the heating of magnetic materials at temperatures around or above the melting point of iron; another phase is that of performing such heating in gases of controlled composition at controlled pressures; another phase is the provision of apparatus capable of withstanding the pressures due to possible explosions in the case of accidental production of explosive mixtures; another phase is that of ready control and regulation of temperatures and pressures with (if desired) suitable variation of them during the progress of the treatment. By employing the furnace herein described the temperatures, pressures and times of treatment may be selected and regulated in a convenient manner. A furnace of this kind is useful especially to treat materials of varying shape and/or composition economically on a relatively large scale. It is suitable for heat treating magnetic materials at gas pressures approximating a vacuum up to 20 atmospheres at temperatures up to about 1700° C.

To the extent that the present application discloses means for enabling the practice on a commercial scale of the inventions described in the said prior applications, this application is to be read in the light of the former applications which are, by reference,

made a part of the present disclosure. However, the improved furnace may be used to treat any desired magnetic material or similar materials in various gases at various temperatures and pressures.

A particular embodiment of this invention will now be described with reference to the accompanying drawing, in which:—

Fig. 1 shows a view partly in elevation and partly in section of a heat treating furnace of the electric resistance type embodying the principles of the invention;

Fig. 2 is a detailed view of a portion of the heating element of the furnace; and

Fig. 3 is a detailed view of an insulating and pressure resisting bushing enabling the passage of electrical conductors through the furnace walls.

In accordance with the drawing, a composite cylindrical heating element 4 to be described in more detail hereinafter is contained in a furnace chamber constituted by a steel cylinder 5 of suitable wall thickness and internal diameter. The element 4 is supported by an annular base 50 having apertures 51 affording passages for gaseous atmospheres, as shown by the arrows. A steel head 6 provided with a water cooling chamber 60 is bolted to the flange 7 so that circular knife-edged ridges protruding from the lower surface of the head and upper surface of the flange 7 sink into a lead gasket 8 between them, thus insuring air and gas-tight joints. A small thick plate glass window 9 in the head is provided for visual observation and temperature measurements by means of an optical pyrometer. Electrodes 15 are provided for establishing electrical connection with the heating element; they consist of threaded copper rods 10 screwed into an insulating and pressure resisting sealing bushing which is shown in more detail in Fig. 3. In this bushing, a threaded insulating plug 11 made of any suitable insulating material capable of withstanding heat and pressure is screwed into a cup-shaped threaded steel plug 12 whose cup portion 13 is filled with a suitable insulating material 14. In order to insure hermetically tight joints at the various threaded joints between 10, 11

and 12, respectively, these joints are filled with a suitable sealing agent, such as litharge-glycerine cement. Valves 17 and 18 are provided for controlling the gas flow through the inlet and outlet pipes located at opposite ends of the heating element 4. The entire furnace structure is placed in a vat 19 and cooled by a continuous stream of water entering through pipe 20 and flowing out through pipe 21. The water level of the vat may, if necessary, be higher and cover the terminals of the wires 10 which would then be insulated with water-proof insulation.

The cylindrical heating element 4 consists of a threaded alundum tube 22 (see Fig. 2) which is wound with heat resisting wires 23; two molybdenum wires in parallel have been found to be suitable. This winding extends over about three-fourths of the length of the heating element. At the upper and lower end of the heating element each wire of winding 23 is fastened to rods 25, which may be made of molybdenum, by passing the wire through openings in the rod and tying the wires together. (Only the connection at the upper end is shown in detail in Fig. 2.) The rods 25 are insulated from the metallic lugs 71 by being surrounded by a silica tubing 24; they are bound to the unthreaded portion of the alundum tube by wires 70. The alundum tube thus constituted is surrounded by an alundum shield 26. The tube and shield are connected to and centrally supported by a thin external steel cylinder 27 which is fastened to two lugs 71, one at the top and one at the bottom of the heating element. The space between the steel cylinder 27, the alundum shield 26 and the lugs 71 may be packed with powdered alundum 30. If the furnace is used only as a vacuum furnace, the powdered alundum 30 may be omitted in order to avoid evolution of undesired gas by the alundum. The electrical conductor 28 is insulated with silica tubing 29. The entire heating unit 4 may be readily removed from and inserted into the furnace chamber 5, for purposes of inspection and repair, etc., by removing the cover 6, detaching the copper braids 16 from the electrodes at 15, and lifting the heating unit by its hooks 31 (by a chain hoist in the case of a large furnace). The base 34 may consist of suitable metal. It may be integral with the bottom end of cylinder 5 or separate therefrom. When separate it may consist of any heat resistant material.

The mode of operation of an annealing treatment is as follows: The cover 6 being removed from the furnace and the heating unit 4 being in the position shown, the materials to be treated, which are preferably contained in an annealing pot 53, are lowered into the heating unit 4 and deposited upon the base 34; preferably also, the annealing pot 53 has perforations 54, for the purpose

of facilitating the circulation of the gaseous atmospheres around the materials. Then the cover is replaced and the bolts 55 tightened. The terminals 10 are connected to a suitable electric circuit such as, for instance, any suitable power circuit, represented schematically by the source of current 40. The heat produced within the unit 4 by the dissipation of electric energy in its winding 23 may be controlled by adjustable resistance element 41. The gases or gas mixtures in which it is desired to treat the magnetic materials are admitted into and cleared from the furnace by pipes 32 and 33 and their flow controlled by valves 17 and 18.

For vacuum or low pressure treatments, the inlet valve 17 must effect a hermetic seal. The exhaust valve 18 is replaced with a connection to a vacuum pump (not shown) to create a rarefied atmosphere or a vacuum of any suitable degree within the air-tight furnace chamber.

The glass window 14 on top of the furnace permits visual inspection of the material under treatment, as well as measurement of the heat treating temperature by means of an optical pyrometer. The resistance element 41 or other suitable means may be employed to regulate the heat up to and beyond the melting point of the material under treatment in accordance with the indications of the pyrometer.

Gas pressures greater and less than those mentioned herein may be applied in heat treating magnetic materials. The wall thickness and/or the material of the exterior furnace chamber may be modified in a manner appropriate to the pressures employed.

What is claimed is:

A furnace for heat treating magnetic materials adapted to be operated when containing hydrogenous atmospheres at pressures ranging from a vacuum up to several atmospheres and at temperatures around the melting point of iron, said furnace comprising a pressure resisting metallic shell having a removable hermetically sealing cover, a transparent pressure resisting window in said cover for visual and pyrometric observation of the furnace interior, a hollow heating element for receiving the charge removably arranged in said shell and carrying electric resistor wires, insulating and hermetically sealing electrical inlets in said metallic shell for admitting electrode wires into the furnace chamber, said inlets being gas-tight and provided with means to insulate said wires from said shell, said means being of material resistant to temperatures stated at the pressures stated.

In witness whereof, I hereunto subscribe my name, this 8th day of April, 1931.

PAUL P. CIOFFI.