

July 21, 1925.

A. RUCKSTAHL

1,547,002

ELECTRIC FURNACE

Filed May 11, 1922

2 Sheets-Sheet 1

Fig. 1.

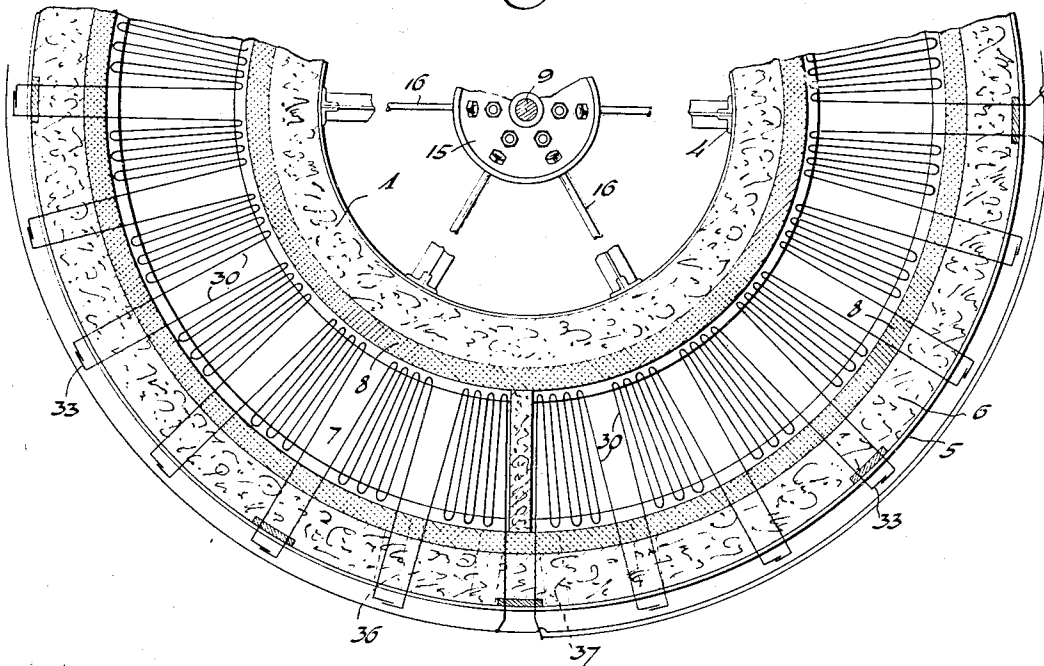
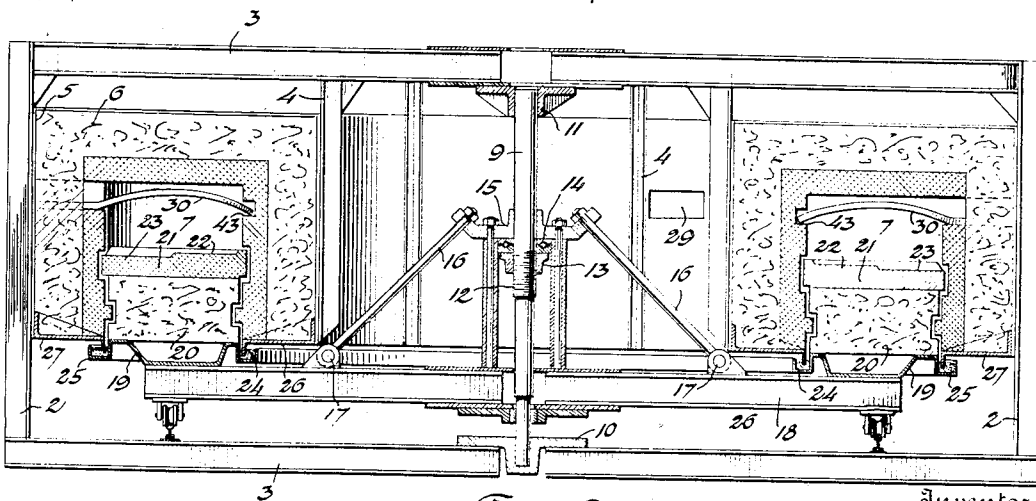


Fig. 2.

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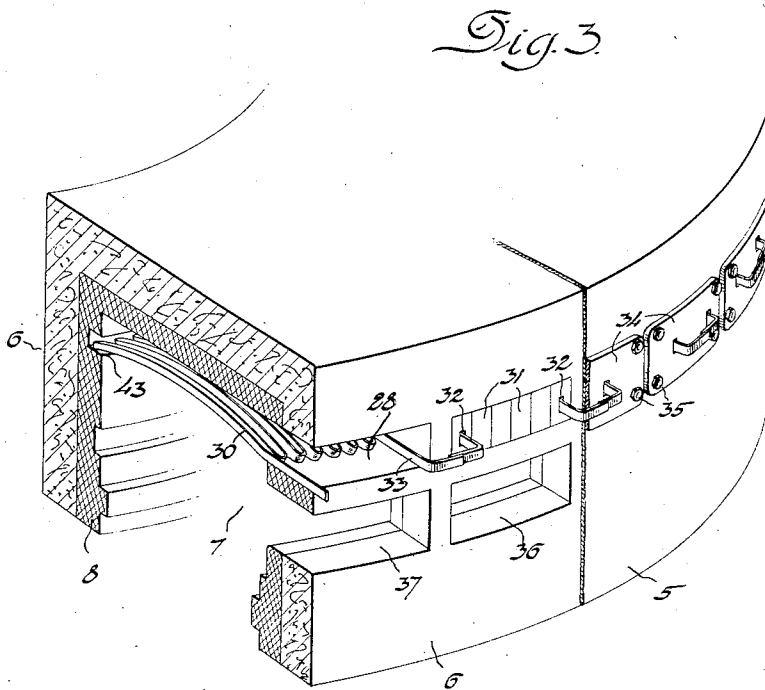
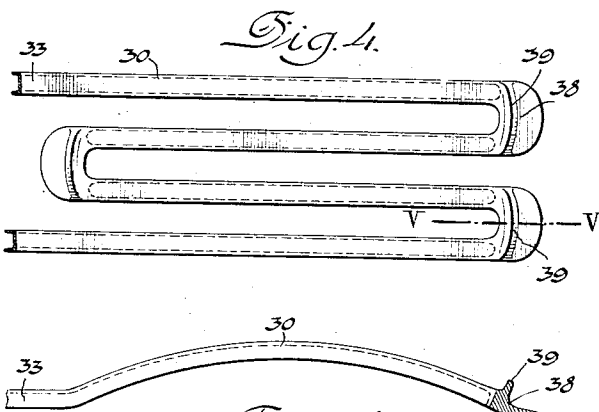
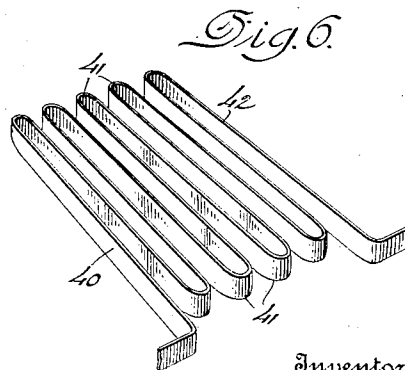
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2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE.

ALFRED RUCKSTAHL, OF DETROIT, MICHIGAN.

ELECTRIC FURNACE.

Application filed May 11, 1922. Serial No. 560,188.

To all whom it may concern:

Be it known that I, ALFRED RUCKSTAHL, a citizen of the United States of America, residing at Detroit, in the county of Wayne and State of Michigan, have invented certain new and useful Improvements in Electric Furnaces, of which the following is a specification, reference being had therein to the accompanying drawings.

10 This invention relates to electric furnaces suitable for the treatment of material at high temperatures.

The object of the invention is to provide a furnace of the circular type within which material may be made to travel past a series of heating elements adapted for easy removal and replacement.

A further object of the invention is the provision with a furnace of the type described of a series of interchangeable electrical heating elements of different heating characteristics whereby the temperature conditions within the furnace may be varied by the substitution of one element for another.

A still further object of the invention is the provision of an electrically heated furnace having a rotating carriage forming the lower wall of the annular chamber and having a continuous series of electrical resistance elements extending across the upper portion of the chamber whereby work placed upon the rotary carriage will be exposed to heat from above.

35 Another object of the invention is the provision of an electric resistance unit which may be cheaply and economically constructed, which will maintain its rigidity substantially unimpaired at high temperature and which is adapted for ready insertion into and removal from its position within a furnace.

In the drawings,

Figure 1 is a horizontal section partially diagrammatic through a portion of a furnace constituting one embodiment of the invention;

Fig. 2 is a vertical central section;

Fig. 3 is a fragmentary perspective view of a portion of the furnace, parts being broken away;

Fig. 4 is a plan view of a preferred form of resistor element;

Fig. 5 is a side elevation thereof, a por-

tion being shown in section on the line V—V of Fig. 4, and

Fig. 6 is a perspective view of a modified form of resistor element.

In the embodiment of the invention shown in the drawings, the furnace is made in the form of a ring or annulus 1, mounted upon suitable supports 2 carrying horizontal beams 3 from which depend supports 4 secured to the inner wall of the annulus.

The outer wall of the furnace is preferably provided with the usual metallic jacket 5 within which is an insulating layer 6 of any suitable material such as sil-o-cel surrounding an annular chamber 7 provided with a lining 8 of a refractory material.

A central supporting shaft 9 rests at its lower end within a socket 10 and is held at its upper end within a member 11 carried by the beams 3. The central portion of the shaft 9 is screwthreaded at 12 to receive an adjusting nut 13 upon which is mounted a ball bearing 14 for a collar 15. Carried by the collar 15 are adjustable suspension rods 16, the outer lower ends of which are secured at 17 to beams 18. Upon the outer ends of the beams 18 which extend radially from the central shaft 9 is an annular carriage 19. The carriage 19 is provided with a layer of insulating material 20 upon which is supported a bed 21 of a suitable refractory material. As shown in Fig. 2, the bed is stepped, the inner portion 22 being somewhat higher than the outer portion 23 for a purpose later to be described. The carriage 19 has inner and outer channeled portions 24 and 25 containing sand which co-operates with downwardly extending flanges upon the metal members 26 and 27 to form a seal to prevent the loss of heat from the interior of the chamber 7.

The annular carriage 19 is preferably supported entirely from the shaft 9 and by the adjustment of the rods 16 and the collar 15 the carriage may be raised or lowered to provide proper clearance as it rotates within the chamber 7. Extending around the sides of the annular chamber 7 are openings adjacent to the roof of the chamber and preferably extending through the outer peripheral wall of the furnace as illustrated in Figs. 2 and 3, though it will be obvious that the openings might be formed within the interior wall of the annular chamber if

desired, as indicated at 29. These openings will form a substantially continuous series extending throughout the entire circumference of the furnace and each opening will be of a size permitting the insertion thereof of an electric resistance element 30. The openings 28 may be closed by means of bricks 31 adapted to fit closely within the openings and some of the bricks may be provided with apertures 32 through which the terminals 33 of the resistor elements 30 may extend to the outside of the furnace. As an additional insulating means, plates 34 of asbestos or similar material may be secured as by bolts 35 over the outer ends of the bricked-in openings 28. The furnace will be provided with inlet and outlet doors 36 and 37 which may have any suitable form of closure (not shown).

The resistor elements 30 will preferably be made of an alloy highly resistant to heat and oxidation. Such an alloy may consist of nickel and chromium, or of nickel, chromium and iron with or without the presence of other elements such as manganese and silicon. The specific alloy forms no part of the present invention and may be varied to suit conditions.

The preferred structure for the heating elements will be that illustrated in Figs. 4 and 5 in which the element consists of a plurality of channeled portions each arched as shown in Fig. 5, said channeled portions lying substantially parallel with each other as shown in Fig. 4 and connected at their adjacent ends alternately by solid sections 38 having a rib 39 formed thereon closely adjacent to the inner side of the connection. Resistor units of this form may conveniently be formed by casting, the arch shape and channeled cross section affording great rigidity to prevent sagging of the elements when heated to very high temperature. The ribs 39 are provided at the adjacent ends of the straight portions to provide an increased cross section to prevent excessive heating of the element at that point as would occur if the material were left of uniform thickness.

In small furnaces, where the span is not excessive, a simpler form of resistance element may be used, this modification being illustrated in Fig. 6. This form of element may consist of a ribbon 40 having a series of bends 41 connecting a series of parallel or slightly divergent portions 42, the bends being substantially in line with each other at each end. In either case, the resistor element may readily be passed through the openings 28 into position within the upper portion of the furnace just beneath the roof, the inner ends of the element resting in recesses 43 formed in the side walls of the refractory lining 8.

The carriage 19 may be rotated contin-

uously or intermittently by means not illustrated and assuming that the rotation is counterclockwise in Fig. 1, articles to be treated may be introduced through the doorway 36 onto the bed 21. The step 22 remote from the doorway 36 is higher than the step 23 so that articles resting upon the inner step 22 may be placed in position or removed therefrom without interfering with articles upon the step 23. As the carriage 19 rotates, the articles introduced through the doorway 36 will be brought within the range of radiation of the elements 30 and if an increase in temperature during the progress of the material is desired, suitable elements will be located at proper intervals about the annular chamber to produce the desired progressive alteration in temperature. It will be evident that this variation in temperature may readily be produced by the proper selection from among the interchangeable units of those possessing the desired heating characteristics and the introduction of such elements through the side openings 28 at proper places around the circumference of the circle. Thus for example, material introduced at the doorway 36 may first be raised rapidly to a certain temperature, maintained at that temperature, for a predetermined portion of its path and then lowered in temperature during the remainder of its progress by the proper selection of heating elements for introduction into the series within the range of which the material is brought as it travels through the annular chamber.

On the other hand at the will of the operator, certain elements may be withdrawn and others substituted so that within a short time the furnace may be adapted for an entirely different range of heating in which material introduced at the doorway 36 will be slowly raised in temperature, reaching its maximum only as it reaches the doorway 37. This flexibility of operation is obviously impossible in the ordinary type of electric furnace at present in use in which the heating element consists of a continuous ribbon suspended from insulator members upon the side walls of the furnace. A further advantage of the present construction is the readiness with which any break occurring within the heating system may be located by the application of a testing instrument to the exposed terminals. Whenever a break occurs, the broken element may be removed with a minimum loss of time and another element substituted therefor without waiting for the furnace to cool and without the necessity of removing the material being treated from the furnace.

Certain features of the present invention are also disclosed in my co-pending application, Serial No. 560,186 filed concurrently herewith.

It will be obvious that many changes and modifications may be made in the details of construction without departing from the principle of this invention or sacrificing any of its advantages. The invention is therefore claimed in any of its forms or modifications within the legitimate and valid scope of the appended claims.

I claim:

1. An electric furnace comprising a wall having a lining of refractory material enclosing an annular chamber, a bed forming the bottom of said chamber, a central supporting shaft, suspension members carried by said shaft, and means carried by said suspension members, said beams forming a support for said bed, the furnace being of general annular arrangement, the suspension members being located to be supported by the shaft above the plane of the beams and within the central zone of the furnace.
2. A structure as in claim 1, in which the suspension members are adjustable to raise and lower said supporting means.
3. A structure as in claim 1, in which the suspension members, the beams and the bed carried thereby are mounted for rotation about said central supporting shaft.
4. An electric furnace comprising an enclosure provided with an annular chamber therein open at the bottom, an annular bed mounted within the bottom of said chamber, and a support for said bed adapted to permit the rotation of said bed within said chamber, said support being provided with adjusting means whereby to control the independent vertical adjustment of various portions of said bed, the furnace being of general annular arrangement, the suspension members being located to be supported by the shaft above the plane of the beams and within the central zone of the furnace.
5. An electric furnace comprising an enclosing furnace wall having a lining of refractory material therein surrounding the top and sides of an annular chamber formed within the furnace, said furnace wall having a plurality of openings throughout its periphery of a size adapted to permit the passage of electric heating units, and a plurality of removable electric heating units arranged substantially radially of said chamber and forming a portion of a non-arcng circuit.
6. An electric furnace having an annular chamber therein, said chamber having a bed forming the floor thereof and adapted for movement within said chamber whereby material placed upon said bed will be carried in a substantially circular path through said chamber, and a plurality of interchangeable electric heating units arranged substantially radially of said chamber and forming a portion of a non-arcng circuit, said units being adapted for insertion at

intervals throughout substantially the entire periphery of the furnace.

7. An electric furnace having an annular chamber and a plurality of interchangeable removable electric resistance units arranged substantially radially of said chamber in a series extending substantially throughout the entire circumference of said furnace, said units forming a portion of a non-arcng circuit.

8. An electric furnace having an annular chamber therein and a bed forming the floor of said chamber and mounted for rotary movement, said bed being provided with inner and outer steps, the surface of the bed toward the inner portion of the chamber being higher than the surface of the outer portion, the chamber having a passageway, the lower portion of which is opposite the lower outer step of the rotary bed, whereby material introduced into said chamber through said passageway may be placed upon said upper inner step without interfering with material upon said lower outer step.

9. In a furnace for heat-treatment of metallic objects, a chamber having a refractory lining within which the objects are movable in an advancing direction, and means for producing the treatment temperatures within such chamber, said means including an electric circuit of the non-arcng type, said circuit including a succession of individual heating units within the chamber and collectively connected to complete the circuit and individually removable to permit substitution of units.

10. In a furnace for heat-treatment of metallic objects, an annular chamber having a refractory lining and within which the objects are movable in the direction of length of the chamber, means for producing the treatment temperatures within such chamber, said means including an electric circuit of the non-arcng type, said circuit including a succession of individual heating units operably connected to complete the circuit and individually removable in radial directions of the furnace assembly to permit substitution of units.

11. A furnace as in claim 10 characterized in that the units are arranged in series relation within the circuit.

12. A furnace as in claim 10 characterized in that the heating units are arranged at the top of the chamber above the objects being treated.

13. A furnace as in claim 10 characterized in that the heating units are arranged adjacent but spaced from the top of the chamber.

14. A furnace as in claim 10 characterized in that each unit is of the grid-type with an overall dimension in the direction of width of the chamber at least equal to the width of such chamber.

15. A furnace as in claim 10 characterized in that a vertical wall of the chamber is provided with an opening through which an individual unit may be inserted and removed.

16. A furnace as in claim 10 characterized in that a vertical wall of the chamber is provided with an opening for and individual to each unit to permit individual insertion and removal of a unit at will.

17. In an electric furnace, wherein the furnace walls having a lining of refractory material, and wherein the furnace is adapted to permit the movement therethrough of articles or material to be treated by the furnace, said furnace having one of its walls formed with a passageway of a size to permit insertion and removal bodily of a resistor unit, said furnace having a support for the resistor unit when the latter is in position for active service, and a resistor unit having a form and dimensions to be supported within the furnace and be movable through such passageway, the movement of the resistor unit to and from service position being in directions substantially transverse to the direction of travel of the material or articles through the treatment chamber of the furnace.

18. In an electric furnace, a chamber having a refractory lining and within which the objects or material to be treated are advanced through a generally predetermined travel path, and means for producing the

treatment temperatures within the chamber, said means including an electric circuit of the non-arc type, said circuit including a succession of individual heating units combinedly connected to complete the circuit and individually removable to permit substitution of units.

19. A furnace as in claim 18 characterized in that the direction of movement of a unit to and from service position is substantially transverse to the direction of advance of the articles or material to be treated within the chamber.

20. A furnace as in claim 18 characterized in that a wall of the furnace is formed with individual passageways through which the units are movable to and from service position.

21. A furnace as in claim 18 characterized in that a wall of the furnace is formed with individual passageways through which the units are movable to and from service position, the movement of a unit to and from such position being in directions substantially transverse to the direction of length of the travel path of the articles or material within the furnace.

In testimony whereof I affix my signature in presence of two witnesses.

ALFRED RUCKSTAHL.

Witnesses:

CHAS. W. STAUFFIGER,
ARTHUR MINNICK.