

Dec. 9, 1947.

C. B. HOAK

2,432,239

ANNEALING FURNACE

Filed June 7, 1943

2 Sheets-Sheet 1

Fig.1.

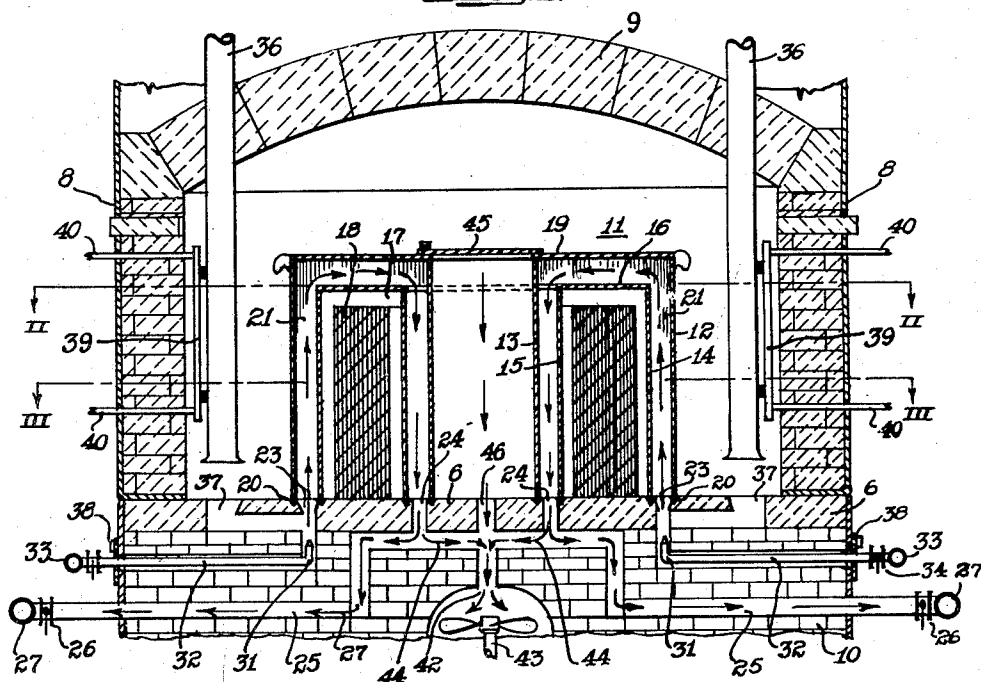
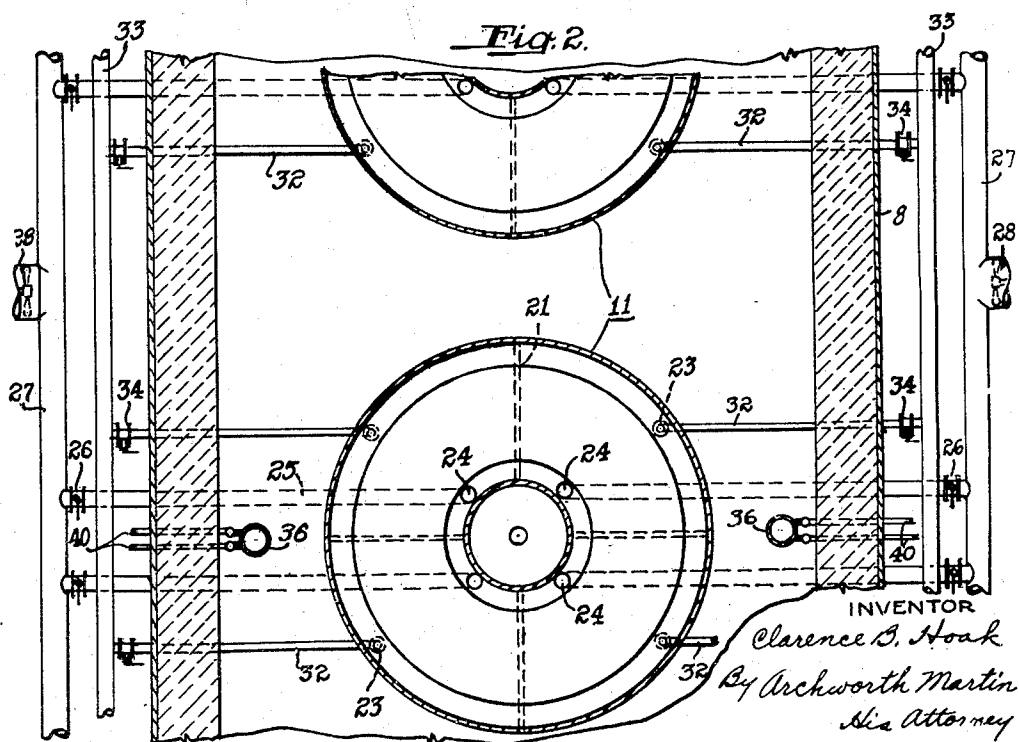


Fig. 2.



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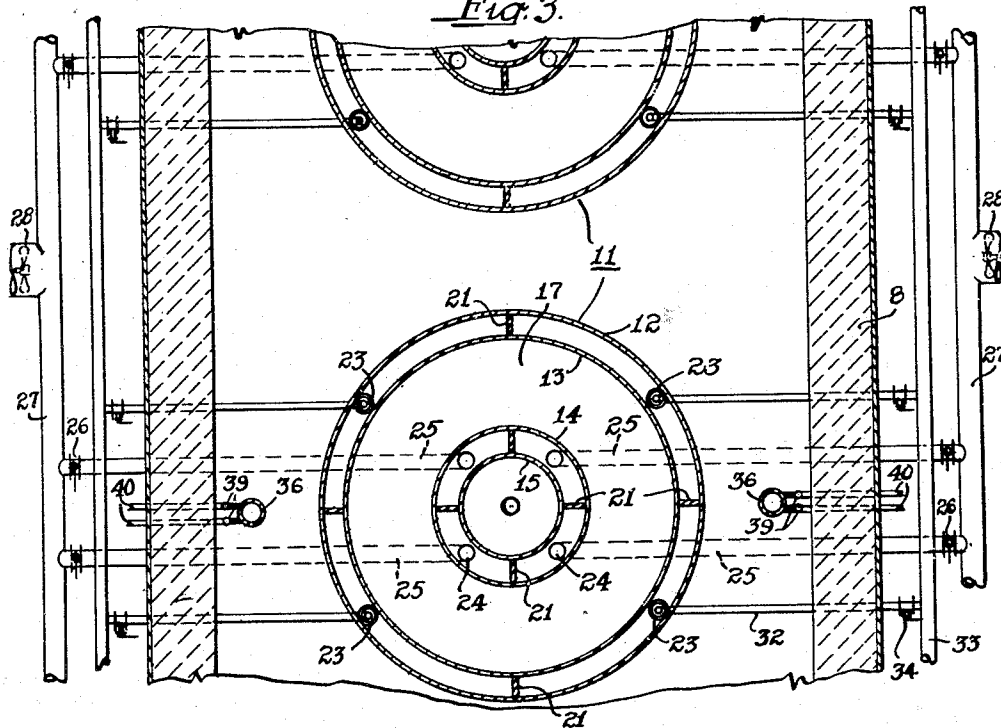
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Fig. 3.



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ANNEALING FURNACE

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14 Claims. (Cl. 263—43)

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My invention relates to annealing furnaces, and more particularly to those of the muffle type, and while I here show and describe a furnace especially suited for the annealing of strip steel coils, various features of the invention are applicable to the annealing of other articles, such as stacks of flat sheets.

This application is, in part, a continuation of my application Serial No. 315,234, filed January 23, 1940 (Patent 2,325,677).

One object of my invention is to provide an improved form of muffle and a novel arrangement for heating and cooling the same and for the circulation of heating and cooling gases around and through the muffle.

Another object of my invention is to provide an improved arrangement for accurately controlling the temperature applied to various portions of the material in the muffle.

Another object of my invention is to provide a means for conveniently using either ordinary burner flames for the annealing operation, or using deoxidizing or inert gases that are heated in the furnace, and directing flow of the heated air or gases around the muffle, in controlled paths.

Another object of my invention is to provide a furnace adapted to contain a plurality of muffles, with means for controllably heating each muffle independently of the other muffles.

Another object is to provide an improved means for heating coils or the like more rapidly and at a more uniform rate in the various portions thereof, than has been heretofore possible.

Another object is to provide annealing apparatus of such form that heating and cooling air or protective gases can be applied to the material or to a muffle containing the material, in such manner as to control the metallurgical properties and color of the material more effectively than can be done with various prior forms of annealing apparatus.

Still another object of my invention is to provide a furnace and muffle arrangement wherein when the enclosing furnace walls are removed from the muffle a protective atmosphere can be retained around the material in the muffle and circulated to cool the material.

In the accompanying drawings, Figure 1 is a vertical sectional view through a furnace embodying my invention; Fig. 2 is a plan view thereof, taken on the line II—II of Fig. 1, and Fig. 3 is a view similar to Fig. 2, but taken on the line III—III of Fig. 1.

In the drawings, I show a furnace chamber that is removably supported on a base or founda-

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tion 7. The chamber has the usual side walls 8 and roof 9, and may be of sufficient length to receive several muffles or annealing boxes that are individually removable when the furnace has been removed from its base 7. A muffle base or hearth 6 is provided for supporting each muffle and is in turn supported upon a foundation 10, certain ports and passageways being provided in the bases 6 and beneath them, as hereinafter described.

Each muffle 11 has concentrically arranged vertical walls 12, 13, 14 and 15. The walls 14—15, together with their top plate 16, form a circular compartment 17 for a coil 18 or other material 15 which is to be annealed, this compartment being open at its bottom except when resting upon the hearth 10.

The base 6 is provided with circular grooves 20 for receiving the lower edges of the muffle walls 12, 13, 14 and 15. These grooves may be filled with sand in the usual way, but in the present instance I show them as containing lead which will become melted by the annealing heat and will make a more effective air seal than sand.

The walls 12—13, with their top plate 16 and partitions 21, form passageways for the travel of gases as indicated by the arrows. The concentric walls, the cover plates and the partitions may all be welded together to form a unitary muffle structure that can conveniently be placed over and removed from the material 18, and may be of ordinary sheet steel or a non-oxidizable alloy, or of any suitable refractory material or combination of steel and refractory material.

There are four partitions 21 shown, each having vertical leg portions welded or otherwise secured to the adjacent walls 12—14 and 13—15 respectively, and having upper portions disposed between the plates 16—19 and the side walls 12—13. A greater or a less number of partitions and passageways may be provided, as required. These partitions not only form the looped passageways that are indicated by the arrows in Fig. 1, but also serve to strengthen and brace the side walls of the muffle against excessive and permanent distortion.

The base 6 is provided with an inlet port 23 for each passageway, through which heating gases or cooling gases may be introduced into the various passageways around the muffle compartment 17. The base 6 is also provided with four exhaust ports 24—one for each of the passageways. Each port 24 communicates through a duct 25 and past a valve 26 with an exhaust manifold 27 from which the gases are drawn by

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a fan 28 or through a stack (not shown). The valves or dampers 26 are operated to afford control of the gases in the individual passages through the muffle, so as to prevent underheating or overheating of any part of the coil 18 relative to other parts thereof.

Also, each port 23 is supplied from a burner 31 to which fuel is fed through a pipe 32, from a line 33. The pipes 32 are controlled by valves 34, to regulate the amount of heat supplied to each of the four portions of the muffle. The rate of flow of heating gases through the ports 23 as well as the length of each burner flame, or the point at which it becomes hottest while passing through the muffle will further be controlled by adjustment of the dampers 26.

As an alternative means for heating the muffle, I provide pipes 36 through which a deoxidizing gas or other gaseous heating medium is supplied. Gases flow from these pipes through ports 37 in the muffle base 6, that lead to the ports 23, when damper plates 38 are swung into place to close the outer ends of the air inlets that surround the pipes 32 and when the burner-pipe valves 34 are closed. The gases usually will be cold when entering the pipes 36, and while passing therethrough will be heated by electrical resistors or suitable radiant heaters or burners. In the present instance, I provide resistors 39 having electrical conductors 40 and arranged to radiate heat against the pipes 36, so that the gas or air will be at a desired high temperature as it passes through the ports 23. These heated gases are drawn through the passageways by the fans 28 or a stack draft, as in the case of the burner gases, at a desired rate which is controlled by the dampers 26 that may at times be entirely closed in controlling the temperature in the passageways that extend around the annealing compartments 17.

I also provide means for drawing gases through all of the looped passage ways in the muffle, past a common exhaust port 42, instead of directing the gases through the individual passageways 25. To this end I may employ a fan 43 or suitable stack draft pulling the gases through lateral passageways 44, from the ports 24, when the dampers 26 are closed. This arrangement may be employed when there is no particular problem of accuracy in control of heating as between various parts of the coil 18 or other work piece, and can also be utilized effectively in cooling the coil after it has been heated to annealing temperature.

The cooling gases can be drawn through the pipes 26 or through the air passageways that surrounds the gas pipes 32. Also, the inner portion of the coil 18 may be cooled more rapidly by swinging aside a damper 45 that closes an opening through the top plate 19 and causing the fan 43 to draw cooling air or gases through a port 46 in the muffle base 6. This latter operation may conveniently be employed when the furnace cover or hood 8-9 is removed from the base 6.

It will be seen that the muffle base 6 and the foundation 10, which are not disturbed during removal of the furnace cover 8-9 and the muffle 11, contain the ports and passageways that communicate with the looped passageways in the muffle and that therefore there need be no connection or disconnection of parts when placing or removing the cover, except for the connections to the oxidizing gas pipes 35 and the conductors 40.

I claim as my invention:

1. An annealing furnace comprising a muffle having an annealing compartment for receiving

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the material to be treated, wall elements partially enclosing the compartment in spaced relation to the sides thereof, partition elements connecting the sides of the compartment to the wall elements, and arranged to form looped passageways around the compartment, and means for creating a controlled flow of heating gases in each passageway independently of the flow in other passageways.

2. An annealing furnace comprising a muffle having an annealing compartment for receiving the material to be treated, wall elements partially enclosing the compartment in spaced relation to the sides thereof, partition elements connecting the sides of the compartment to the wall elements, and arranged to form looped passageways around the compartment, means for setting up a flow of heating gases through the passageways, and means for exhausting the gases from each passageway, at a controllable rate relative to the exhaust from other passageways.

3. An annealing furnace comprising a muffle having an annealing compartment for receiving the material to be treated, wall elements partially enclosing the compartment in spaced relation to the sides thereof, partition elements connecting the sides of the compartment to the wall elements, and arranged to form looped passageways around the compartment, and means for creating a controlled flow of heating gases in each passageway independently of the flow in other passageways, the said passageways extending vertically along the outer sides of the compartment and across the top thereof.

4. An annealing furnace comprising a hearth, a muffle removably supported thereon and having a compartment formed by annular inner and outer walls that are spaced apart and provided with a cover and which are disposed around a central space, the compartment also having enclosing walls extending around the same, in spaced arrangement to said outer wall and the inner wall, and means for directing heating gases from below the hearth and through the spaces between the compartment and the enclosing walls, in defined paths.

5. An annealing furnace comprising a muffle having a compartment formed by annular inner and outer walls that are spaced apart and provided with a cover and which are disposed around a central space, the compartment also having enclosing walls extending around the same, in spaced arrangement to said outer wall and the inner wall, and means for directing heating gases through the spaces between the compartment and the enclosing walls, in defined paths, and at individually-controlled rates.

6. An annealing furnace comprising a muffle having a compartment formed by annular inner and outer walls that are spaced apart and provided with a cover and which are disposed around a central space, the compartment also having enclosing walls extending around the same, in spaced arrangement to said outer wall and the inner wall, and means for directing heating gases through the spaces between the compartment and the enclosing walls, in defined paths, the gases being directed upwardly along the outermost wall surface of the compartment, thence across the top and down the opposite side thereof in separate paths.

7. An annealing furnace comprising removable furnace walls, a muffle therein having a compartment for material to be annealed, a wall spaced from one side of the muffle and formed unitarily therewith, and means for directing heating gases

through the space between the compartment and the said wall, in defined paths, at individually controlled rates.

8. An annealing furnace comprising a furnace chamber having a hearth, a muffle within the chamber and having an annealing compartment surrounded by walls spaced from the compartment walls, and means for introducing heating gases through the hearth and into the space between the compartment and said walls, and directing them through defined paths, to exhaust openings in said hearth.

9. Annealing apparatus comprising a hearth provided with ports open at its upper surface, a furnace removably supported on the hearth, a muffle within the furnace and having passages registering with the first-named ports, and means for circulating gases through said ports and the muffle, in definite paths.

10. Annealing apparatus comprising a hearth provided with ports open at its upper surface, a muffle having passageways formed therein and an annealing compartment adjacent to the passageways, each passageway communicating at its ends with two of said ports, and means for effecting a circulation of gases through the ports and passageways.

11. Annealing apparatus comprising a muffle having an annealing compartment with a plurality of separate passageways formed in its side walls, means for directing a combustible gaseous mixture into one end of each passageway, a suction device at the other end of the passageways, for drawing the mixture into the passageways, and means for controlling the degree of suctional force exerted in each passageway, independently of control of the other passageways.

12. An annealing furnace comprising a chamber having a hearth, a plurality of muffles in said chamber, each of which has an annealing compartment for receiving the material to be treated, wall elements partially enclosing each compart-

ment in spaced relation to the sides thereof, partitions associated with the wall elements of each muffle and arranged to form a plurality of looped passageways around the annealing compartment, means for supplying heating gases into the ends of the passageways, and means for creating a desired rate of flow of gases in each passageway independently of the rate of flow in the other passageways.

13. An annealing furnace comprising a muffle having an annealing compartment for receiving the material to be treated, wall elements partially enclosing the compartment in spaced relation to the sides thereof, partition elements arranged to form looped passageways around the compartment, means for supplying heating gases to the passageways, at one end thereof, and means for withdrawing the gases at the other end of each passageway and at individually controllable rates.

14. An annealing furnace comprising a chamber having a hearth, a plurality of muffles in said chamber, each of which has an annealing compartment for receiving the material to be treated, and means controllable from outside the furnace for creating a desired flow of heating gases from within the furnace chamber, around each compartment independently of the rate of flow of the gases around the other compartments.

CLARENCE B. HOAK.

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