Feb. 2, 1943. E. I. HUFF 2,309,700

ANNEALING FURNACE

Filed Dec. 1, 1941 3 Sheets-Sheet 1

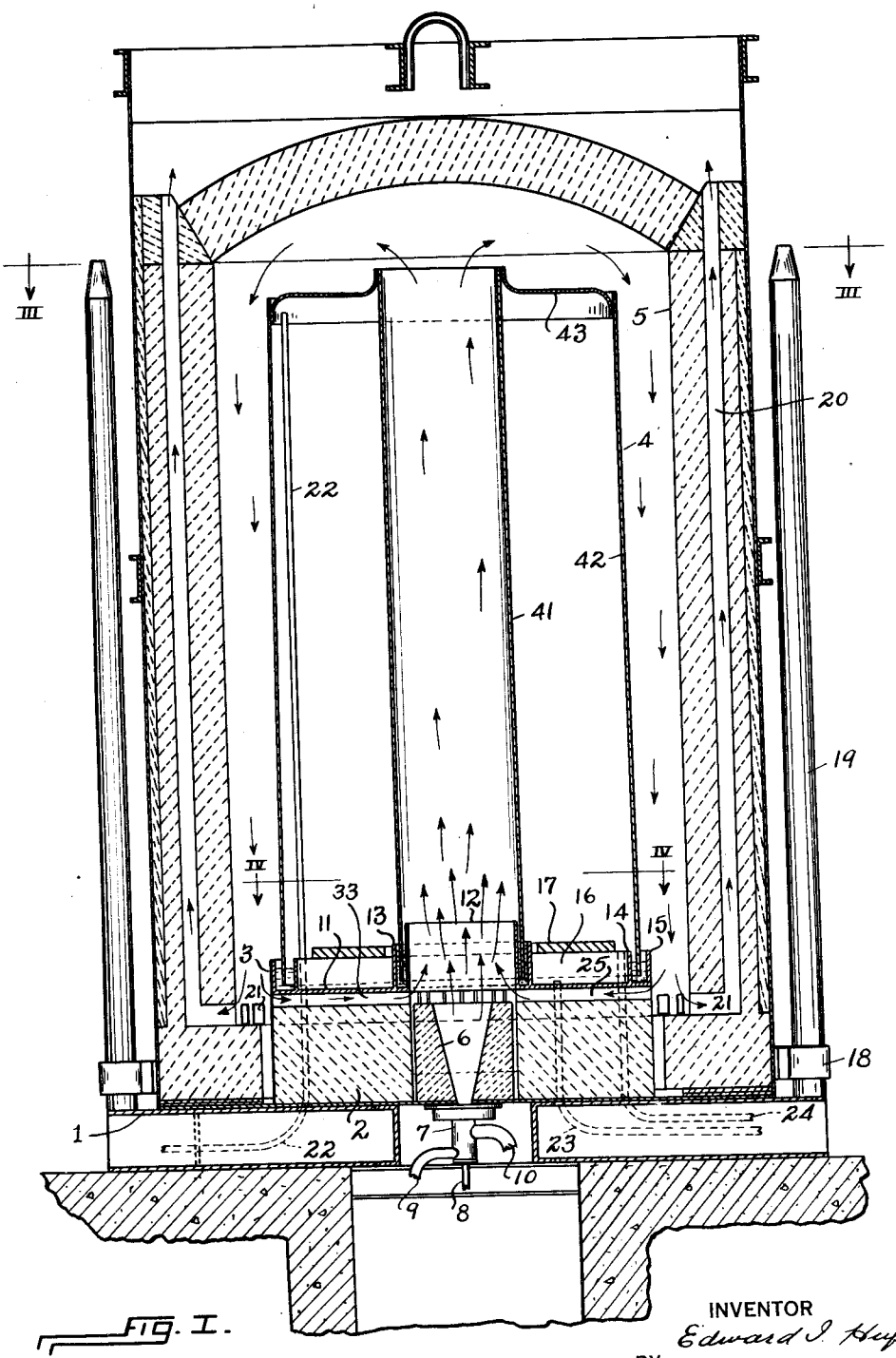


FIG. I.

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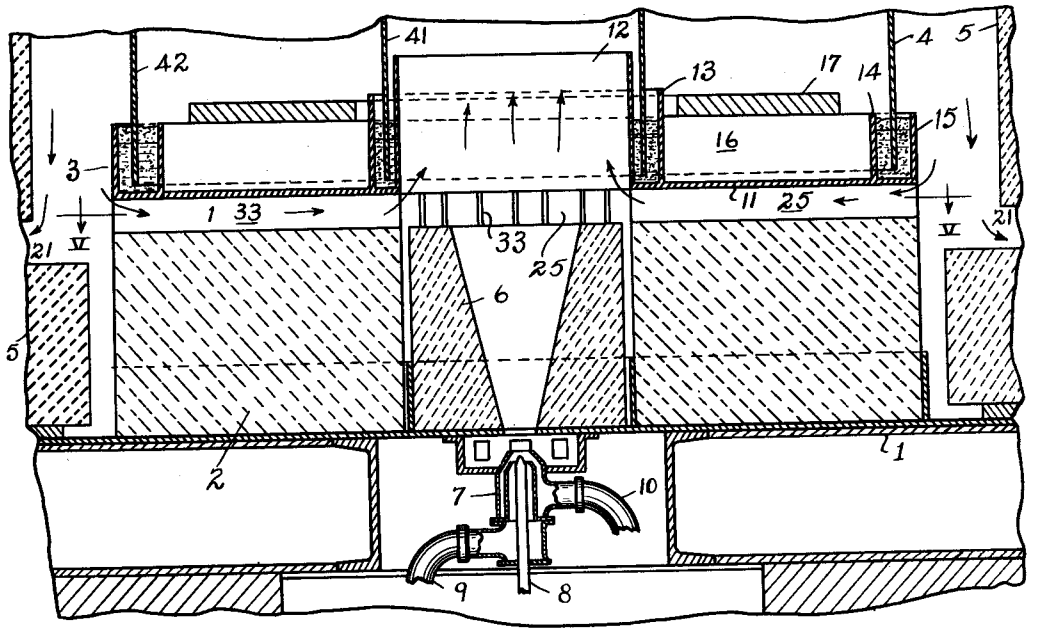


FIG. II.

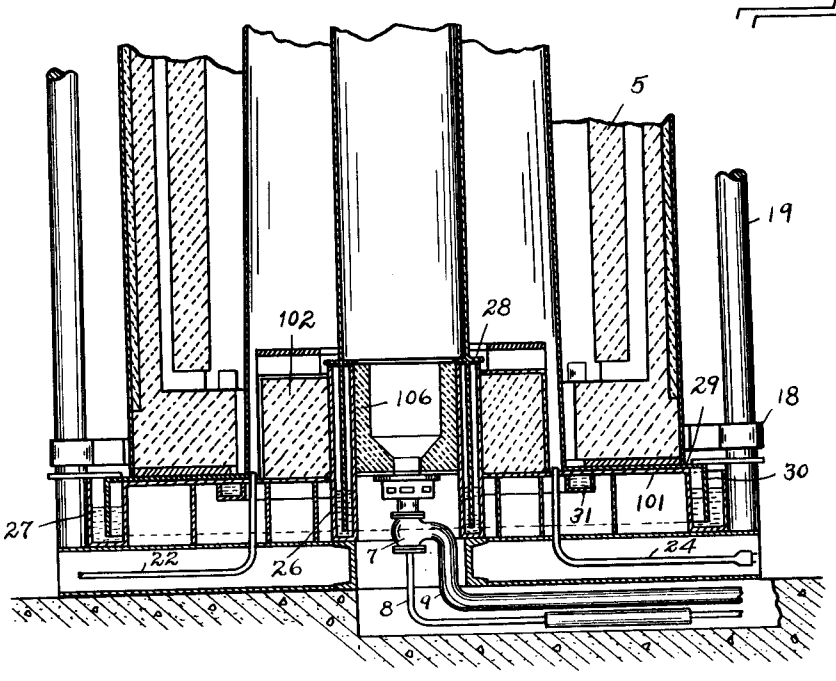


FIG. VI.

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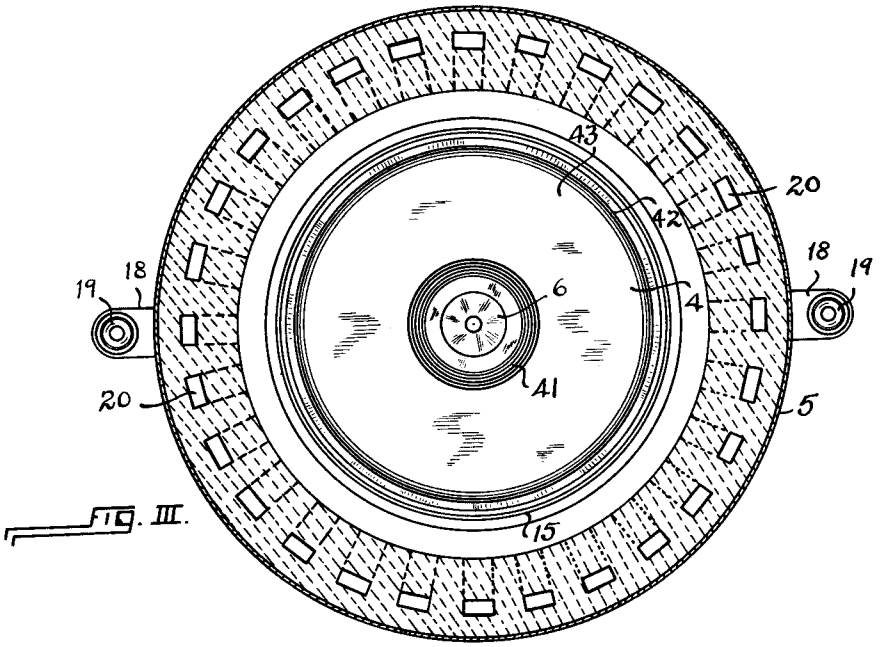


FIG. III.

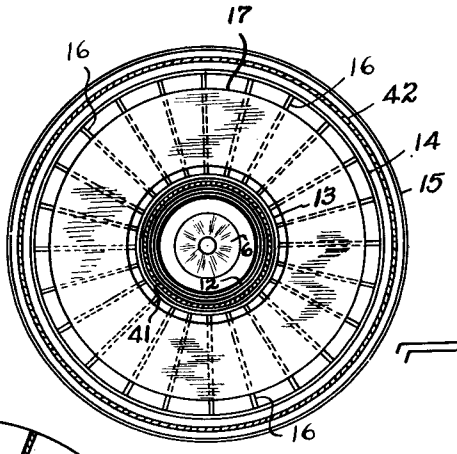


FIG. IV.

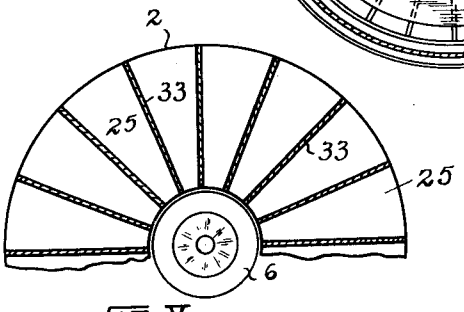


FIG. V.

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UNITED STATES PATENT OFFICE

2,309,700

ANNEALING FURNACE

Edward I. Huff, Nutley, N. J., assignor to Huff Equipment Company, a corporation of Pennsylvania

Application December 1, 1941, Serial No. 421,150

5 Claims. (Cl. 266—5)

This invention relates to annealing furnaces of muffle type, fired by flame, in which the muffle chamber is of annular form in horizontal section, and adapted by shape to the annealing of such articles as coiled steel strip and coiled wire. Furnaces so characterized are shown and described in Letters Patent granted on my application, No. 2,146,432, February 7, 1939, and No. 2,250,868, July 29, 1941; and also in a pending application, filed by me November 25, 1941; Serial No. 420,393.

In the furnaces of the patents named, the flame enters the furnace chamber at the base and through the walls of the hood, and flows upwardly over the outer wall of the annular muffle and, passing over the top, descends through the central columnar space defined by the inner wall of the muffle. According to my present invention, as also in the application named, the flame enters the furnace chamber at the bottom of the columnar space defined by the inner wall of the muffle, and flows thence upwardly, over the top of the muffle and downwardly over the outer wall of the muffle to exit at the base of the hood.

This new arrangement is not a mere reversal in organization, for in consequence of reversal new utility is realized; and, furthermore, in consequence of such reversal, it has been possible to make particular structural changes, with the effect that the annealing operation is improved and rendered more efficient.

In the accompanying drawings Fig. I is a view in vertical and axial section of an annealing furnace in which my invention is embodied; Fig. II is a fragmentary view to larger scale of a portion of the furnace as seen in Fig. I; Figs. III and IV are views in horizontal section, on the planes indicated, respectively, at III—III and IV—IV, Fig. I; Fig. V is a fragmentary view (on reduced scale) in horizontal section, on the plane indicated at V—V, Fig. II; and Fig. VI is a fragmentary view showing in vertical and axial section the lower portion of a furnace in which are embodied specific structural features, other than those of Figs. I–V.

Referring, first, to the furnace as shown in Figs. I–V, it is, as has been said, an annealing furnace of muffle type, in which the muffle is of annular shape. Upon a suitable floor plate 1 is placed a hearth block 2; the hearth block carries the base plate 3 of the muffle; and upon this base plate the muffle 4 is removably borne. The hood 5 is removably borne by the floor plate 1, and when in place the hood at its base immediately surrounds the hearth block 2.

The hearth block 2 of refractory material is centrally perforate; the orifice is circular and is of substantially equal diameter with the columnar space defined by the inner wall of the muffle. In the central perforation of the hearth block 2 is set the burner block 6 of a burner 7. The burner block too is formed of refractory material. The burner may be adapted to burn any suitable fuel—gas, oil, or finely divided coal. As here shown, it is an oil burner, fed through a pipe 8 by oil under pressure, and through pipes 9 and 10 by air under pressure. Through the burner block 6 the burner projects flame upwardly from below into the columnar space defined by the inner wall of the muffle which columnar space is part of the furnace chamber beneath hood 5.

The base plate 3 is formed of metal—ordinarily, of cast-iron. It is essentially annular (since it forms part of the annular muffle) and consists of a horizontally extending web 11, radially arranged flanges 33 that extend from the nether face of web 11, co-axially arranged cylindrical flanges 12, 13, 14, and 15 that extend from the upper face of web 11, and radially arranged flanges 16 that extend from the upper face of web 11 and between the cylindrical flanges 13 and 14. The radial flanges 33 immediately engage the upper face of the hearth block and, with the block below and the web 11 above, define passageways 25 beneath the muffle, whose utility will presently be indicated. The pairs of cylindrical flanges 12, 13 and 14, 15 form with the web 11 troughs into which in the assembly the inner and outer rims at the lower end of the movable muffle 4 extend and within which the muffle is sealed by the familiar sand seal. The radial flanges 16 afford support for an annular plate 17 which is the stool-plate upon which the furnace charge rests.

The muffle is formed of heat-conducting material, ordinarily of steel; it is, as has been said, of annular form and includes inner and outer substantially cylindrical side walls 41, 42 that may be organized into a one-piece furnace part (for facility in application and removal) by integration with a top wall 43. The lower rims of the muffle walls are free and lie in substantially a common plane. These rims in the assembly extend within the troughs of the base plate defined by the flanges 12, 13 and 14, 15, and upon these rims the muffle stands. The flange 12 upon the base plate is prolonged upwardly beyond the

companion flange 13, and the flange 13 in turn rises higher than the flanges 14 and 15, that the application of the muffle to the base plate may be facilitated.

The hood is formed essentially of refractory material; it is of a general form and arrangement already well known to the art. It is provided externally wth rings 18 that engage stationary posts 19 rising from the floor plate, and by such engagement the hood is guided when being applied and removed. Within the hood walls flues 20 are formed. Ports 21 open to these flues from within and near the base of the hood. At their upper ends these flues are freely open. They may vent to the open air, as here they are shown to do; or, manifestly, they may be brought into communication with a stack or other draft-inducing apparatus.

Through the floor plate and base block tubes 22, 23 may extend, for the circulation within the closed muffle of any desired gas (non-oxidizing, reducing, etc.); and tube 24 also may be similarly arranged, for the introduction of a thermo-couple or other instrument for determining conditions within the muffle.

Operation is conducted in familiar manner. When hood and muffle have been removed the charge of material to be annealed is stacked upon the stool plate 17. The muffle 4 and the hood 5 are then successively brought to position. At the beginning, or as operation progresses, such gas as may be desired for protection or for reaction is caused to circulate through pipes 22, 23 and through the muffle chamber. The burner 7 is lighted, or being already lit, is adjusted to afford a flame of desired size and character. The flame streams in the course indicated by arrows in Fig. I, upward through the columnar space formed by the inner wall of the muffle, over the top, and down over the outer wall of the muffle, to the exit ports 21. In this course combustion will have been completed and large quantities of heat generated by combustion will have been absorbed by the muffle walls. The products of combustion will escape through the flues 20 in the hood.

The passageways 25 formed by and between the flanges 33 that extend from the nether surface of the base plate 11 afford a by-pass, through which a portion of the stream of spent gases will return to mingle with the stream of burning gases that springs from the burner.

The heating operation properly controlled (as, may be, with the aid of a thermo-couple) is performed in accordance with a known temperature gradient; cooling may be accelerated by shutting off the fuel and causing air at suitable temperature to enter through the burner block and circulate through the furnace chamber; and when a proper degree of temperature has been reached the furnace may be opened and the annealed charge removed from it.

The advantages of the structure as described, in which the stream of flame is upward through the columnar space within the ring-shaped muffle and downward over the exterior surface, over the usual arrangement, in which the flow of flame is upward over the exterior and downward through the central columnar space, are these: (1) The structure of the hood is not complicated, and its manipulation in service is not embarrassed by the presence of burners in that portion of the structure. (2) There is more perfect distribution of heat circumferentially of the muffle than is possible in case oil burners be arranged circumferentially and at intervals at the base of the hood, to deliver their flames to the space between hood and muffle. (3) It becomes possible to provide an aggregate passage for flame that has no substantial diminution, but that rather increases in cross-sectional area from the point of the injection of the combustible gaseous mixture through the burner block 6 to the emergence of the spent gases through the ports 21, and in consequence the gaseous flow is relatively smooth, and efficiency in heat-absorption through the muffle walls is increased. (4) In consequence of flow of spent gas from the base of the hood adjacent the ports 21 inward through passageways 25 to the stream of burning gases that springs from burner block 6, an equilibrium of pressure is established throughout the course of stream flow, with the consequence and effect that localized concentration of heat is avoided, heat absorption by the muffle walls is more evenly distributed and brought to maximum total value, and the life of the structure is prolonged.

Another and an alternative elaboration of structure, rendered possible by the reorganization of the furnace and the arrangement of the burner at the centre with stream flow upward through the centre of the muffle and downward over the outside, is illustrated in Fig. VI. In this case the passageways 25 are not provided. Instead, the floor plate 101 is provided with central and peripheral troughs 26 and 27 adapted to contain proper quantities of sealing liquid. Both troughs extend downward below the level of the floor plate; the walls of the inner trough 26 rise above the level of the floor plate and between the burner block 106 and the hearth block 102; these two blocks in this case being spaced apart sufficiently to allow such an intrusion of the trough. The walls of trough 27 are arranged wholly below the level of the floor plate. The muffle is so adapted that, when in place, it is borne by the floor plate and yet its outer and its inner lower rims extend free within the two troughs 26 and 27. To accomplish this the inner wall of the muffle near its lower end is provided with a flange 28, by which it rests on the rim of trough 26 with its own rim extending free within the trough 26, while the outer wall of the muffle near the lower rim is spread outward in a flange-like plate 29 which in the assembly rests immediately upon the floor plate 101, and at the outer edge of this outward spreading flange-like plate 29 the muffle wall is continued in a downward prolongation 30 that extends free within trough 27. The hood when applied rests immediately upon the flange 29 of the muffle, which flange in turn rests immediately upon the floor plate 101. The two troughs 26 and 27, arranged as they are beyond and beneath the substantially continuous horizontal wall of refractory material afforded by the burner block 106, the base block 102, and the hood 5, are remote from the region of intense heat. With such arrangement the seals for both the inner and the outer rims of the muffle may be liquid seals, and in consequence the isolation of the material under treatment within the muffle may be rendered more perfect. More complete protection of the liquid seals from access of heat may be afforded by cooling the floor plate by means of streams of liquid circulating in conduits 31 arranged beneath and conveniently formed upon its lower face.

I claim as my invention:

1. In an annealing furnace of muffle type and having a muffle of annular shape, such furnace including a base, a muffle, and a hood, the muffle

and the hood being severally applicable to and removable from the base and when applied forming between themselves a furnace chamber, the invention herein described which consists in means for introducing flame to the furnace chamber at the base of the columnar space defined by the inner wall of the annular muffle, and flues for the products of combustion opening from the furnace chamber through the hood and at the base thereof.

2. The structure defined in claim 1, having the additional provision of a pressure-equalizing passageway leading from the outer basal portion of the furnace chamber to the inner basal portion thereof.

3. The structure defined in claim 1, having the additional provision that the base is provided with inner and outer concentric sealing troughs in which the inner and outer lower rims of the muffle are borne, and pressure-equalizing passageways arranged beneath said sealing troughs and leading radially inward from the outer basal portion of the furnace chamber to the inner basal portion thereof.

4. The structure of claim 1, the base including a floor plate with inner and outer concentrically arranged troughs for sealing liquid extending below the level of the floor plate and opening upwardly through the floor plate, the muffle at its lower end being adapted, when applied, to rest upon the floor plate, the muffle being provided with rims that, when the muffle is applied, enter the said troughs, and, so entering, are adapted to be submerged in liquid contained therein.

5. In an annealing furnace of muffle type and having a muffle of annular shape closed above and at its lower end terminating in inner and outer concentric rims, the combination with a floor, a hearth block of refractory material and of annular shape borne by the floor, a burner block of refractory material centrally arranged within the hearth block, a trough adapted to contain sealing liquid formed in the floor, opening between hearth block and burner block, and extending below the floor level, a second trough adapted to contain sealing liquid formed in the floor at an interval beyond the outer edge of the hearth block and extending below the floor level, the muffle provided adjacent its lower inner and outer rims with supporting flanges, which flanges when the muffle is applied bear upon the floor and support the muffle with its rims in sealing positions within the troughs, a hood of refractory material adapted to rest by its rim upon the floor-engaging flange of the outer rim of the muffle, and a burner adapted to deliver a flame through the burner block, the burner block, the hearth block, and the hood forming at the floor a substantially continuous wall of refractory, protecting the bodies of liquid in the said troughs from access in injurious quantity of heat from the flame.

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