

Sept. 7, 1937.

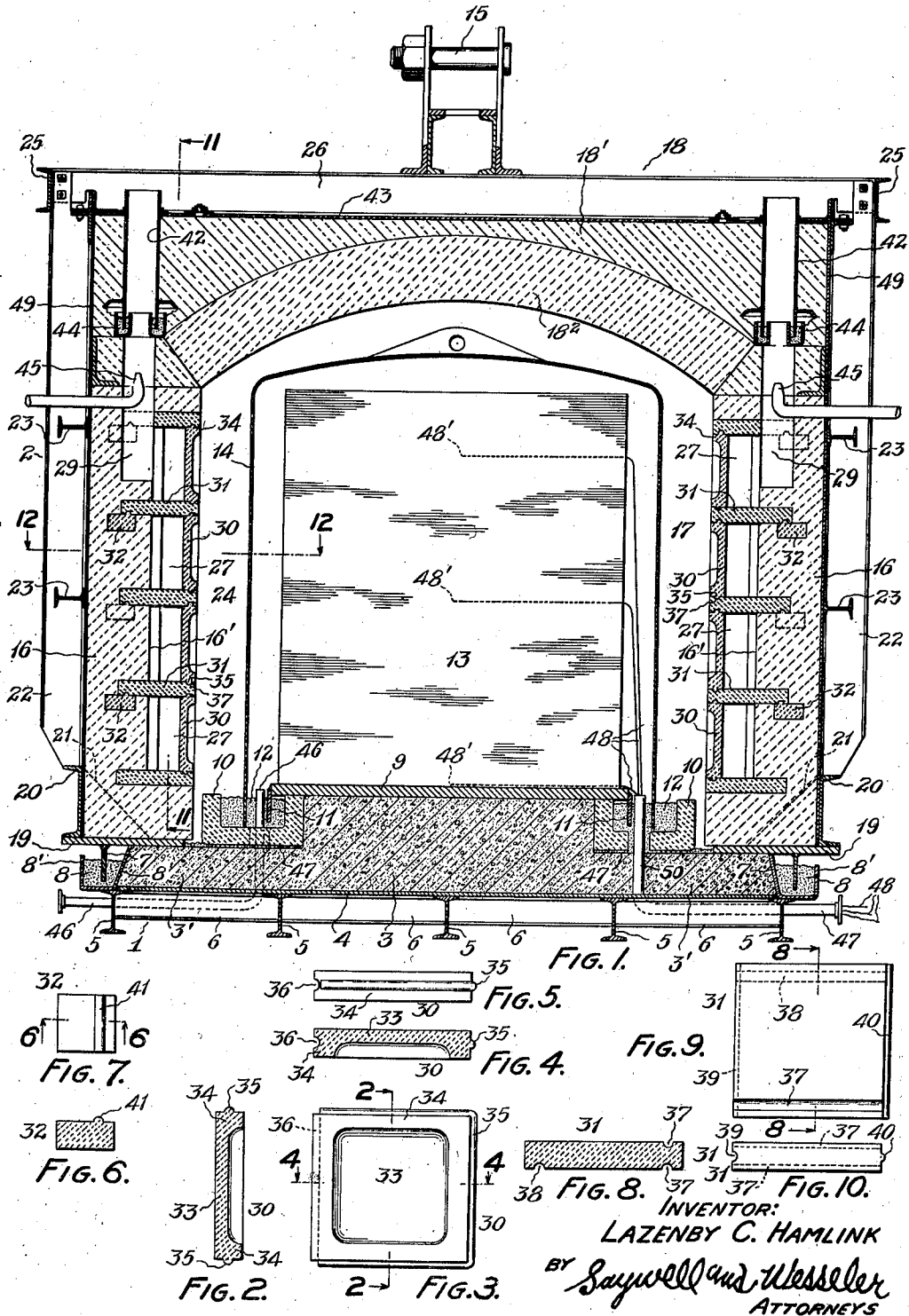
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2,091,979

ANNEALING FURNACE

Filed June 6, 1935

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

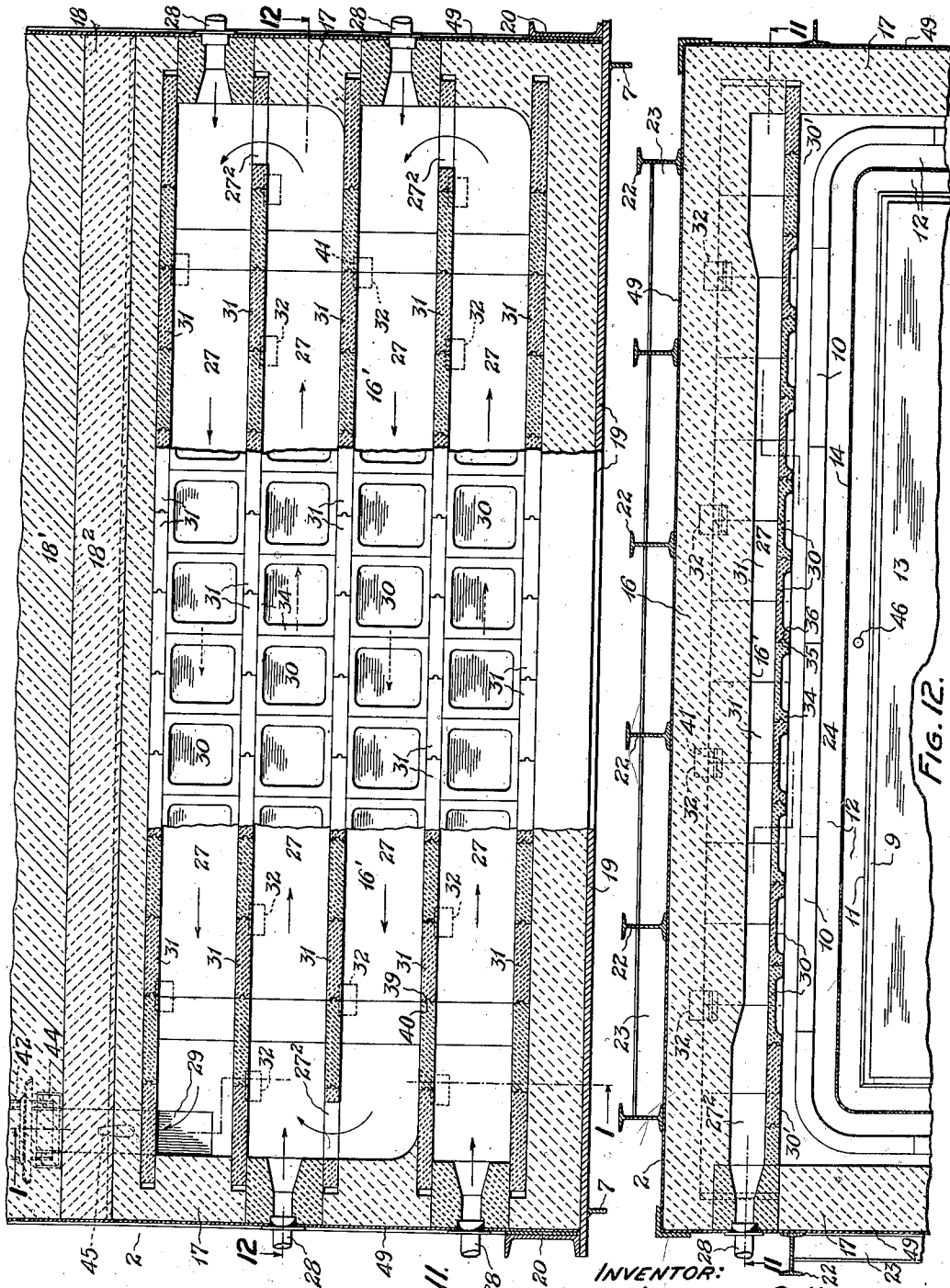


FIG. 11.

FIG. 12.

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UNITED STATES PATENT OFFICE

2,091,979

ANNEALING FURNACE

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Application June 6, 1935, Serial No. 25,250

6 Claims. (Cl. 266—5)

My invention particularly relates to annealing furnaces adapted for the heat treatment or annealing of metal plates, sheets, strips, etc. in a controlled non-oxidizing atmosphere. It is the design of the invention to provide a furnace of this nature which is easy to build and in which the heat treating operations may be satisfactorily effected with a maximum of economy and the greatest convenience, together with a minimum of deterioration in operating equipment. Particularly, the invention includes an improved heat-radiating structure in which, by the circuitous circulation of the heating gases, fewer individual radiating units and, hence, fewer burners are required than in any other satisfactory furnace of this nature with which I am acquainted. Furthermore, my invention includes improved radiating units which are subject to far less deterioration in effective heating operations than any other radiating units with which I am acquainted.

The annexed drawings and the following description set forth in detail certain means embodying my improved annealing furnace, such means constituting, however, but one of the various forms in which the principle of the invention may be illustrated.

In said annexed drawings:

Figure 1 is a transverse vertical section of a form of my improved annealing furnace in which the radiating elements are formed of multiple interlocking units made from refractory material;

Figure 2 is a detached vertical section of one of certain vertical panelled radiating units shown in Figure 1, the unit being of tile construction, the section being taken in the plane indicated by the line 2—2, Figure 3;

Figure 3 is a side elevation of the panelled unit shown in Figure 2;

Figure 4 is a plan section of the unit shown in Figures 2 and 3, the section being taken in the plane indicated by the line 4—4, Figure 3;

Figure 5 is a plan view of the unit shown in Figure 3;

Figure 6 is a detached vertical section of one of certain anchoring units shown in Figure 1, the section being taken in the plane indicated by the line 6—6, Figure 7;

Figure 7 is a plan view of the anchoring unit shown in Figure 6;

Figure 8 is a detached vertical section of one of certain horizontal partition units shown in Figure 1, the section being taken in the plane indicated by the line 8—8, Figure 9;

Figure 9 is a plan view and Figure 10 a side elevation of the partition unit shown in Figure 8;

Figure 11 is a longitudinal vertical section of one of the radiating elements shown in Figure 1, but showing the radiating wall of the furnace partially in elevation, the view being taken in the planes indicated by the line 11—11, Figures 1 and 12; and

Figure 12 is a fragmentary view of the furnace, partially in plan and partially in horizontal section, the view being taken in the plane indicated by the line 12—12, Figures 1 and 11.

Referring to the annexed drawings in which the same parts are indicated by the same respective numbers in the several views, my improved annealing furnace includes a cover 2, and a base 1 therefor having a foundation of insulating concrete 3 supported upon a steel plate 4. The plate 4 is supported upon longitudinal I-beams 5 reinforced by transverse beams 6. A stock plate 9 is supported upon the top of the insulating base portion 3, and is of an area greater than the area of the stock to be treated, and extends at its edges over sectional troughs 10 preferably formed of refractory material and provided with sand seals 12, the stock plate 9 being formed with skirts 11 depending into the seals 12. The troughs 10 are seated in beds of cushion sand 47 disposed on end shoulders 3' of the insulating base 3. The cover 2 is formed with base plates 19 resting upon the shoulders 3' of the insulating base portion 3 and extended outwardly therefrom and having depending skirt portions 7 dipping into sand seals 8. Seals 8 are located in channels 8' abutting the plates 19 at one upper edge and secured to the outer faces of the insulating shoulders and supported on the bottom by longitudinal I-beams 5.

Upon the stock plate 9 the pack 13 of sheets is adapted to be supported for the annealing operation, an inner cover 14 being provided which encloses the pack 13 and dips into the said seals 12 and is supported upon the bottom of the troughs 10. This inner cover 14 permits more expeditious use of the outer cover 2 and also makes unnecessary an absolutely gas-tight outer cover 2, as is well-known to those skilled in the art.

The main or outer cover 2 is adapted to be lifted from the insulating shoulders 3' of the base 1 and replaced thereon, when necessary for effecting the placement and removal of the pack 13, or when transferring the cover 2 to another base 1, by suitable crane-cable grabs 15 provided upon the top of the roof 18 of the cover 2.

The main outer cover 2 includes side walls 16 and end walls 17 and a roof 18, all of refractory material, there being welded or otherwise suitably secured upon and adjacent the outer peripheral edges of the base plates 19 the lower flanges of horizontally-disposed channels 20 which are secured to the lower parts of outer metal casings 49 abutting the outer faces of walls 16 and 17. The horizontal channels 20 have welded to their upper flanges vertical I-beams 22 reinforced by horizontal I-beams 23. This supporting and enclosing structure is reinforced by lower gusset plates 21 secured to the base plates 19 and to the inner faces of the metal casings 49.

The roof 18 is of arched construction having a lower brick arch 18² and an upper insulating member 18', preferably of asbestos, the roof 18 being confined by upper exterior longitudinal channels 25 welded to the vertical I-beams 22, and transverse I-beams 26 secured to the channels 25 and supporting a metal plate 43 above the arch 18² and insulating member 18'.

Referring to the accompanying drawings, I utilize for effecting annealing operations a heat-radiating structure of refractory tile units 30, 31, and 32, Figures 1 to 10, interlocked together, as hereinafter fully described, and forming, when assembled, in combination with the radiating faces 16' of the furnace walls 16, tortuous conduits 27 for the passage of the heating gases which are fired into the conduits from burners 28. The actual radiating units are those designated 30 and 31, of which units 30 are vertically disposed at a spaced inner distance from the radiating wall faces 16' and are interlocked with vertically-spaced horizontal partition units 31, the latter being supported at their outer ends in the walls 16 and interlocking at their bottom faces with the units 32 which are anchoring units and are seated within the interior of the walls 16. The chamber between the inner radiating faces 16' of the walls 16 and the outer faces of the vertical radiating units 30 forms, by reason of the spaced horizontal partition units 31, a tortuous passage 27 for the movement of the heating gases repeatedly between the end walls 17, as clearly shown in Figure 11, it being noted that alternately at the ends of the partitions 31, openings 27² are provided whereby the gases can pass, adjacently the end walls 17, from between two adjacent horizontal partitions 31, to the space between the next higher adjacent horizontal partitions 31. In order that more intense heating may be provided intermediate the ends of the furnace than at the extreme end portions thereof, the walls 16 are thickened intermediate their ends, as clearly indicated in Figure 12, so as to restrict the intermediate area of the passage 27, and thus speed up the gas velocity in this intermediate area.

For purposes of illustration, I have shown a length of conduit 27 which is substantially four times the length of the furnace, the burning gases entering the conduit 27 at the bottom and passing from the conduit 27 at the top into a flue 29 passing through the roof 18. One of the conduits 27 is provided at each side of the furnace, and heating gases are furnished to the conduits 27 repeatedly, and adjacent one end of each section of the conduit 27, as clearly seen in Figure 11, there being thus provided four burners 28 for each conduit 27, two burners at each end thereof arranged in vertically-staggered relation to the burners at the other end.

The refractory units 30, 31, 32 are interlocked

into a complete radiating assembly by the following means: The vertical unit 30 is of rectangular formation and comprises a peripheral portion 34 and a comparatively thin panelled body portion 33, thus being in effect a saucer-shaped tile, clearly shown in Figures 2 and 3. This unit 30 is formed with an exteriorly-extending tongue 35 upon three of its sides and with a groove 36 upon the fourth side. This groove 36 interlocks with the tongue 35 upon the adjacent side of one of the horizontally-adjacent tiles 30, thus to form of one tier of the tiles 30 a closed wall facing the interior of the heating chamber 24 of the furnace. The tongue 35 on the other two sides of the unit 30 interlock with grooves 37 formed respectively upon the adjacent upper and lower horizontal partition units 31 and adjacent one end thereof, as clearly shown in Figure 1. These partition units 31 are rectangular unpanelled tile of uniform thickness throughout. The units 31 are also formed in their lower faces, and adjacent the outer ends thereof, with grooves 38 which interlock with tongues 41 formed upon the top of the anchoring tile 32. For the purpose of interlocking adjacent partition tiles 31, the latter are formed with tongues 40 extending from one end, and on the opposite end are formed with complementary grooves 39.

In order to reduce the heat transfer at the ends of the furnace, solid tile 30' are used adjacent each of the end bends of the tortuous conduit 27, instead of the panelled tile 30, as clearly indicated in Figure 12.

The flues 29 from the passages 27 communicate with the interiors of pipes 42 which extend upwardly through the roof 18, and which are welded to the cover plate 43 and dip at their lower ends into sand seals 44 provided in, and adjacent one end of, the cover 18. For controlling the vacuum in the radiating element and inducing suitable draft, I provide inspirators 45 projecting into the flues 29 through the brick walls 16.

De-oxidizing gases are supplied to the interior of the inner cover 14 by means of tubes 46 passed through the insulating base 3 and the troughs 10. A tube 50 is provided for pyrometer leads 48 which are passed into the pack 13 and connect with thermo-couples 48'.

What I claim is:

1. Heating means for an annealing furnace consisting of the combination with a furnace side wall and adjacent portions of the two furnace end walls, of a series of vertically-spaced horizontal refractory tile supported by and extended from said side wall, vertical tile interlocked with said horizontal tile and disposed intermediate the extended ends of the respective vertically-adjacent horizontal tile, the upper and lower horizontal tile forming a top and a base, respectively, for the heating means, the intermediate horizontal tile being formed with end openings, said openings being arranged alternately at opposite ends of the horizontal tile so as to form a tortuous conduit for the travel of the heating medium between the bottom and the top of the heating means.

2. An annealing furnace comprising a base provided with a stock plate, a removable cover for the base and forming therewith a treating chamber disposed above the stock plate, a heating element positioned interiorly of the cover and consisting of communicating conduit sections extended repeatedly from end to end of the cover

and at successively different levels thereof to form a tortuous conduit between the bottom and top of the cover, a waste flue for said conduit, and a plurality of burners communicating with the conduit at each end of the cover and at respectively different levels thereof, the burners at one cover end being arranged in staggered relation to those at the other cover end.

3. An annealing furnace comprising a base provided with a stock plate, a removable cover for the base having end and side walls and a roof, heating elements disposed upon opposite sides of the cover and arranged interiorly of the side walls thereof, said elements each consisting of relatively vertical communicating conduit sections forming tortuous conduits running repeatedly back and forth along said side walls and extending between the bottom and the top of the latter, said side walls intermediate their ends being extended inwardly within the respective conduits to constrict the cross-sectional area of the latter, a waste flue communicating with each conduit, and a plurality of burners for each conduit which communicate with the conduit at different levels.

4. An annealing furnace comprising a stock-supporting base, a removable cover for the base having a side wall and a roof forming an interior treating chamber, a heating element positioned adjacently interiorly of said side wall and comprised of a plurality of superposed horizontal conduit sections, each section intermediate the top and bottom sections communicating at one end with an adjacently lower section and at the other end with an adjacently higher section, thus forming a tortuous conduit running vertically of the cover, burners firing into the conduit adjacent the respective areas where the two sections of adjacent pairs of sections communicate with each other, another burner firing into one end of the conduit, and a waste flue leading from the other end of the conduit.

5. An annealing furnace comprising a stock-supporting base, a removable cover for the base having a treating chamber, oppositely-disposed

heating elements positioned interiorly of the cover and located laterally of the treating chamber, said heating elements each comprised of a plurality of superposed horizontal conduit sections having communicating passages forming a tortuous conduit leading from the bottom to the top of the cover, each two vertically adjacent sections communicating at one end, a plurality of vertically-aligned burners firing into the conduits through the ends of the cover and into the conduit areas where the respective two sections of the adjacent pairs of conduit sections communicate with each other, other burners firing into one end of the respective conduits, and waste flues leading from the other ends of the respective conduits.

6. An annealing furnace comprising a stock-supporting base, a removable cover for the base having end and side walls and a roof, oppositely-disposed heating elements positioned adjacently interiorly of said side walls and defining an interior treating chamber, said heating elements each comprised of a plurality of superposed horizontal conduit sections, each two vertically-adjacent sections running between said end walls, each section intermediate the top and bottom sections communicating at one end with an adjacently lower section and at the other end with an adjacently higher section, thus forming a tortuous conduit running vertically of the cover, the side walls of the cover intermediate their ends being extended inwardly within the respective conduits to constrict the cross-sectional area of the latter, said heating elements including walls facing the treating chamber and extending from end to end thereof and which are thicker at their ends than in the intermediate portions thereof, burners firing into the conduits adjacent the respective areas where the two sections of adjacent pairs of sections communicate with each other, other burners firing into one end of the respective conduits, and a waste flue leading from the other end of each conduit.

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