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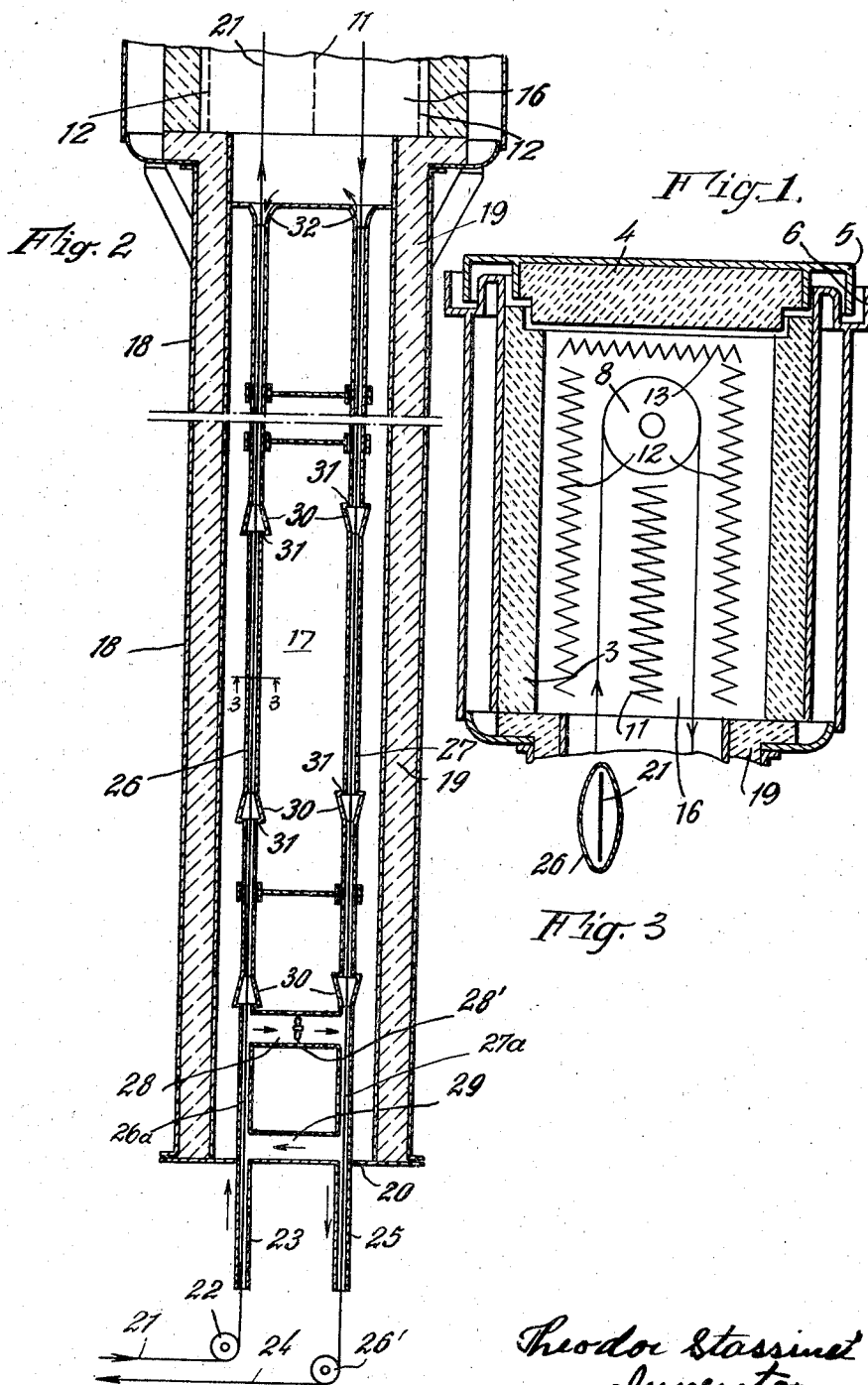
T. STASSINET

2,206,734

CONTINUOUS HEAT TREATING FURNACE OF THE VERTICAL TYPE

Filed Aug. 27, 1937

2 Sheets-Sheet 1



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by *Highly*

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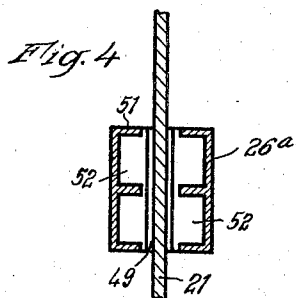
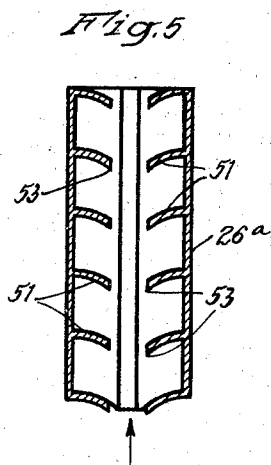
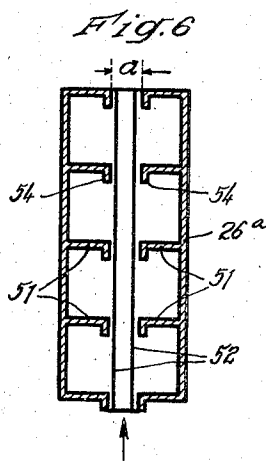
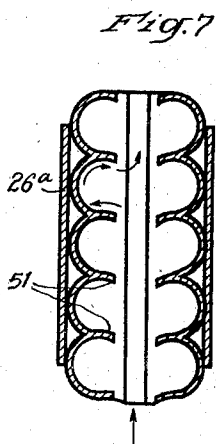
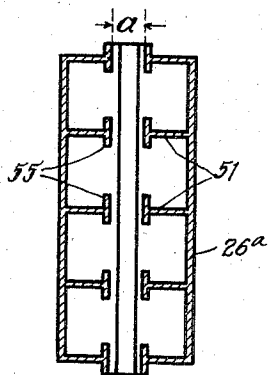
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CONTINUOUS HEAT TREATING FURNACE OF THE VERTICAL TYPE

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2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE

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CONTINUOUS HEAT TREATING FURNACE
OF THE VERTICAL TYPE

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6 Claims. (Cl. 266—3)

My invention relates to continuous heat treating furnaces of the vertical type, and more particularly to electric annealing furnaces.

5 An object of my invention consists in producing a vigorous gas circulation so as to attain an effective heat exchange between the upward moving cold material to be treated and the downward moving heated material.

10 Another object of my invention consists in reducing the ingress of air and the egress of gas at the lower end of the furnace by means of a novel and advantageous arrangement of a gas circulation device.

15 Another object of my invention is to lessen to a further extent the disadvantages incident to the egress of gas and to the ingress of air by gas sealing devices at points where the material enters and leaves the furnace.

20 Further objects will become apparent from the following specification set forth in reference to the accompanying drawings in which:

25 Fig. 1 is a sectional elevation in smaller scale than in Fig. 2 of the annealing chamber of an electric furnace of the vertical type for annealing metal strips and which is combined with a heat exchange chamber shown in Fig. 2 arranged below the annealing chamber.

30 Fig. 2 is a vertical sectional view of the heat exchange member arranged below the annealing chamber shown in Fig. 1 and which contains the gas circulation device and the devices for preventing the egress of gas and the ingress of air, which form the subject matter of the present invention.

35 Fig. 3 is an enlarged sectional view of a detail shown in Fig. 2 on line 3—3 in that figure.

Fig. 4 is a sectional view of a modification of the tubes 26a and 27a in Fig. 2.

40 Figs. 5 to 8 show four other modifications of the tubes 26a and 27a.

In Fig. 1, the continuous heat treating furnace of the vertical type consists of an annealing chamber 16 surrounded by a metallic outer jacket 2, of a heat insulating brickwork 3 and of an inner jacket 7 made of refractory material and closed at its upper end by a cover 4 whose flange 5 engages in the sealing cup 6. At the upper end of the annealing chamber is arranged a pulley 8 over which passes the metal strip to be 50 annealed and whose upward and downward moving portions are denoted by the numeral 21. The electric heating elements 11, 12 and 13 independent of each other as to the current supply and the temperature control are assumed to be arranged between the two portions of the ma-

terials to be annealed and partly above the upper pulley 8 and laterally of the strip material 21 between the latter and the furnace wall. At the lower end of the annealing chamber and where the strip enters and leaves the furnace are arranged gas sealing devices to be hereinafter described.

Fig. 2 shows the lower portion of the annealing chamber 16 of the furnace with the electric heaters 11 and 12, and also the heat exchange chamber 17 arranged below the annealing chamber 16, which latter has a larger diameter than the heat exchange chamber 17. The upper part of the heat exchange chamber 17 consists of a brickwork 19 surrounded by a gas-tight metal jacket 18 and the lower part thereof is closed by a cover 20. The upward moving portion of the metal strip enters the furnace over a pulley 22 through a narrow tube 23. The downward moving portion of the strip 24 after passing through the heat exchange chamber 17 and the heating zone 16 leaves the furnace through a second narrow tube 25 and passes over a second pulley 26'.

Both the upward moving portion and the downward moving portion of the strip pass within the heat exchange zone 17 through the tubes 26, 27, 26a and 27a respectively which form a continuation of the tubes 23 and 25. The upper ends of the tubes 26 and 27 communicate with the heating zone 16 of the furnace. The tubes 26 and 27, of oval cross-section as shown in Fig. 3, which protects them against the deformation of the wall under the action of the heat, are connected in the neighborhood of the furnace end by two transverse ducts 28 and 29 located at different distances from the heating zone 16. In the upper transverse duct 28 is arranged a blower 28', whose prime mover is not shown. When this blower is in operation, the furnace atmosphere in the longitudinal tubes 26 and 27 as well as in the transverse ducts 28 and 29 circulates in the direction indicated by the arrows. Consequently, the gases in the furnace tubes 26 and 27 circulate above the transverse duct 29 in a direction opposite to the motion of the strip with the result that an effective heat exchange occurs, since the hotter gases come into contact with the entering strip and the already more cooled down gases with the strip leaving the furnace.

The tubes 26 and 27 possess several nozzle-shaped enlargements 30 pointing in the direction in which the gas circulates, one end of the enlargement being provided with a circular flange 31. The distance between two such nozzle-

shaped enlargements 30 decreases from the top to the bottom of the furnace. These enlargements cause a considerable whirling of the gases, whereby the intensity of the heat exchange is materially increased. The tubes 26a and 27a arranged between the transverse ducts are so designed that they present an increased resistance as is hereinafter described, for instance, in connection with Fig. 4 or with modifications shown in Figs. 5 to 8. At the upper end of the furnace tubes 26 and 27 are arranged nozzle-shaped enlargements 32 flaring towards the heating zone.

The above-described arrangement has the effect that the egress of gas and the ingress of air at the lower end of the furnace is limited to a great extent in spite of the vigorous gas circulation brought about by the blower 28' and which supports the heat exchange between both portions of the material to be treated.

Fig. 4 is a detail sectional view of the tubes 26a or 27a of Fig. 2, whose inner walls are provided with projections or ribs 51. The clear path itself for the strip 21 is denoted by the numeral 49. To prevent rough running which might be caused by the welded joints of the strip 21 and which might give rise to jamming of the strip 21, walls 52 extending in longitudinal direction of the path 49 and substantially at right angles to and beyond the ribs 51 are provided at both sides of the strip 21. In this case also a plurality of such walls may be arranged in the longitudinal direction.

A still better action of the gas sealing device may be obtained, if the ribs 51 are not straight as shown in Fig. 4 but bent as shown in Fig. 5. The ends 53 of the ribs 51 are bent in a direction opposite to the direction of the flow of gas to be prevented.

Fig. 6 shows a somewhat modified form of the ribs 51. Here the ribs are arranged substantially transversely to the direction of motion of the strip and are bent at their ends as indicated at 54.

The arrangement shown in Fig. 7 differs from that according to Fig. 6 in that parts of the ribs or projections such as 54 in Fig. 6 extending in parallel relation to the direction of motion of the strip are avoided and that the ribs are exclusively made of bent sheet material and curved as shown which cause a whirling in the direction as indicated by the arrows, and thereby prevent the flow of a straight current.

While the arrangement shown in Figs. 5 to 7 are preferably employed in cases where a motion of gas is to be expected substantially in the direction as indicated by the arrows, Fig. 8 shows an arrangement which may be employed to advantage if the flow of gas to be prevented can take place in both directions. Here, the longitudinally directed portion 55 which extends from the ribs 51 arranged transversely to the direction of motion of the strip is so shaped that it extends both in the direction of the flow of air entering the furnace and in the direction of the flow of gas leaving the same.

The distance between the transverse walls is preferably chosen of the order of $1.5-3a$, where a is the smallest dimension of the opening between the inner edges of opposite transverse walls or the smallest dimension of the opening between the inner edge of a transverse wall and the opposite wall of the opening space if the latter has no transverse wall. The width of the bent edge of the transverse wall or the width of

the flange in front of the transverse wall is taken preferably at $0.5-0.75a$.

I claim as my invention:

1. In an elongated continuous heat-treating furnace having a heating chamber at one end and two longitudinal ducts leading from the other furnace end to and away from said heating chamber and freely opening into the latter and serving for supplying and discharging the material under treatment, at least two transverse ducts located at different distances from the heating chamber and connecting said longitudinal ducts, and means in the transverse duct nearer the heating chamber, for producing a flow of gas through said transverse duct whereby two gas circuits are formed, one including the heating chamber and the adjacent portions of said longitudinal ducts, and the other including the second transverse duct and the longitudinal duct portions located between said transverse ducts and traversing said longitudinal ducts opposite to the directions in which the gas in the first-named circuit flows respectively through said longitudinal ducts.

2. In an elongated continuous heat-treating furnace having a heating chamber at one end and two longitudinal ducts leading from the other furnace end to and away from said heating chamber and freely opening into the latter and serving for supplying and discharging the material under treatment, at least two transverse ducts located at different distances from the heating chamber and connecting said longitudinal ducts, and means in the transverse duct nearer the heating chamber, for producing a flow of gas whereby two gas circuits are formed, one including the heating chamber and the adjacent portions of said longitudinal ducts, and the other including the second transverse duct and the longitudinal duct portions located between said transverse ducts and traversing said longitudinal ducts opposite to the directions in which the gas in the first-named circuit flows respectively through said longitudinal ducts, and means for producing in the portions of the longitudinal ducts located between said transverse ducts a greater resistance to the gas flow than prevails in the longitudinal duct portions included in the first-named gas circuit, whereby the escape of gas from the interior of the furnace is substantially blocked.

3. In an elongated continuous heat-treating furnace having a heating chamber at one end and two longitudinal ducts leading from the other furnace end to and away from said heating chamber and freely opening into the latter and serving for supplying and discharging the material under treatment, at least two transverse ducts located at different distances from the heating chamber and connecting said longitudinal ducts, and means in the transverse duct nearer the heating chamber, for producing a flow of gas whereby two gas circuits are formed, one including the heating chamber and the adjacent portions of said longitudinal ducts, and the other including the second transverse duct and the longitudinal duct portions located between said transverse ducts and traversing said longitudinal ducts opposite to the directions in which the gas in the first-named circuit flows respectively through said ducts, the longitudinal duct portions located between said longitudinal transverse ducts having a plurality of transverse inner ridges spaced apart longitudinally of the duct, and extending inwardly from the duct

walls on at least a portion of the duct lengths and a plurality of longitudinal guide walls circumferentially spaced on the inner duct wall and extending substantially at right angles to said ridges and toward the center of the duct, for producing a greater resistance to the gas flow than prevails in the longitudinal gas duct portions included in the first-named gas circuit, whereby the escape of gas from the interior of the furnace is substantially blocked.

4. In an elongated continuous heat-treating furnace having a heating chamber at one end and two longitudinal ducts leading from the other furnace end to and away from said heating chamber and freely opening into the latter and serving for supplying and discharging the material under treatment, at least two transverse ducts located at different distances from the heating chamber and connecting said longitudinal ducts, and means in the transverse duct nearer the heating chamber, for producing a flow of gas whereby two gas circuits are formed, one including the heating chamber and the adjacent portions of said longitudinal ducts, and the other including the second transverse duct and the longitudinal duct portions located between said transverse ducts and traversing said longitudinal ducts opposite to the directions in which the gas in the first-named circuit flows respectively through said longitudinal ducts, the longitudinal duct portions located between said transverse ducts having a plurality of transverse inner ridges spaced apart longitudinally of the duct, and extending inwardly from the duct walls on at least a portion of the duct lengths and a plurality of longitudinal guide walls circumferentially spaced on the inner duct wall and extending substantially at right angles to said ridges and toward the center of the duct, the inner edges of said ridges being bent over against the direction of the gas flow for producing a greater resistance to the gas flow than prevails in the longitudinal gas duct portions included in the first-named gas circuit, whereby the escape of gas from the interior of the furnace is substantially blocked.

5. In an elongated continuous heat-treating furnace having a heating chamber at one end and two longitudinal ducts leading from the other furnace end to and away from said heating chamber and freely opening into the latter and serving for supplying and discharging the

material under treatment, at least two transverse ducts located at different distances from the heating chamber and connecting said longitudinal ducts, and a blower in the transverse duct nearer the heating chamber, for producing a flow of gas whereby two gas circuits are formed, one including the heating chamber and the adjacent portions of said longitudinal ducts, and the other including the second transverse duct and the longitudinal duct portions located between said transverse ducts and traversing said longitudinal ducts opposite to the directions in which the gas in the first-named circuit flows respectively through said ducts, said longitudinal ducts having a plurality of flared wall portions spaced apart at suitable distances, each of said portions being flared in the direction of the gas flow and the extreme end of the flared portion being suddenly reduced to the normal cross section of the duct, whereby the escape of gas from the interior of the furnace is substantially blocked.

6. In an elongated continuous heat-treating furnace having a heating chamber at one end and two longitudinal ducts leading from the other furnace end to and away from said heating chamber and freely opening into the latter and serving for supplying and discharging the material under treatment, at least two transverse ducts located at different distances from the heating chamber and connecting said longitudinal ducts, and a blower in the transverse duct nearer the heating chamber, for producing a flow of gas whereby two gas circuits are formed, one including the heating chamber and the adjacent portions of said longitudinal ducts, and the other including the second transverse duct and the longitudinal duct portions located between said transverse ducts and traversing said longitudinal ducts opposite to the directions in which the gas in the first-named circuit flows respectively through said ducts, said longitudinal ducts having a plurality of flared wall portions spaced apart at suitable distances, each of said portions being flared in the direction of the gas flow and the extreme end of the flared portion being suddenly reduced to the normal cross section of the duct, the distances between said flared portions decreasing toward the inlet and outlet of the furnace, whereby the escape of gas from the interior of the furnace is substantially blocked.

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