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1,948,173

HEAT TREATING FURNACE

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2 Sheets-Sheet 1

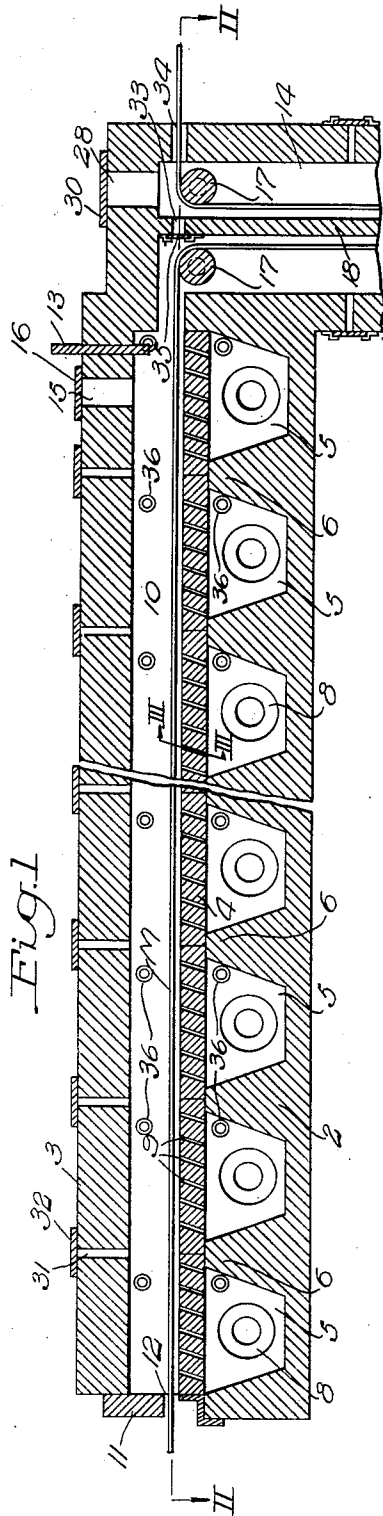
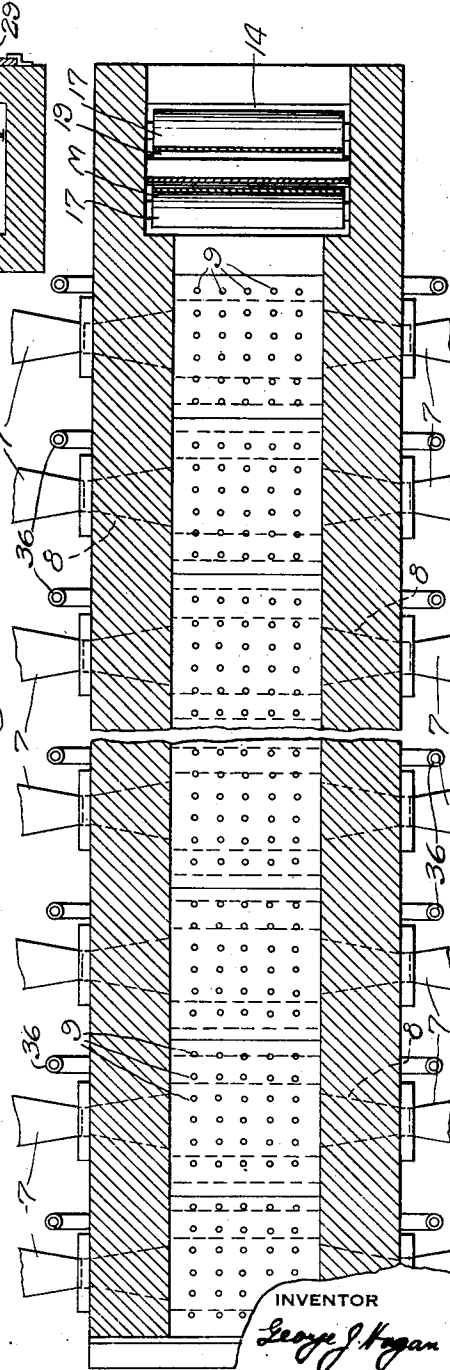


Fig. 2.



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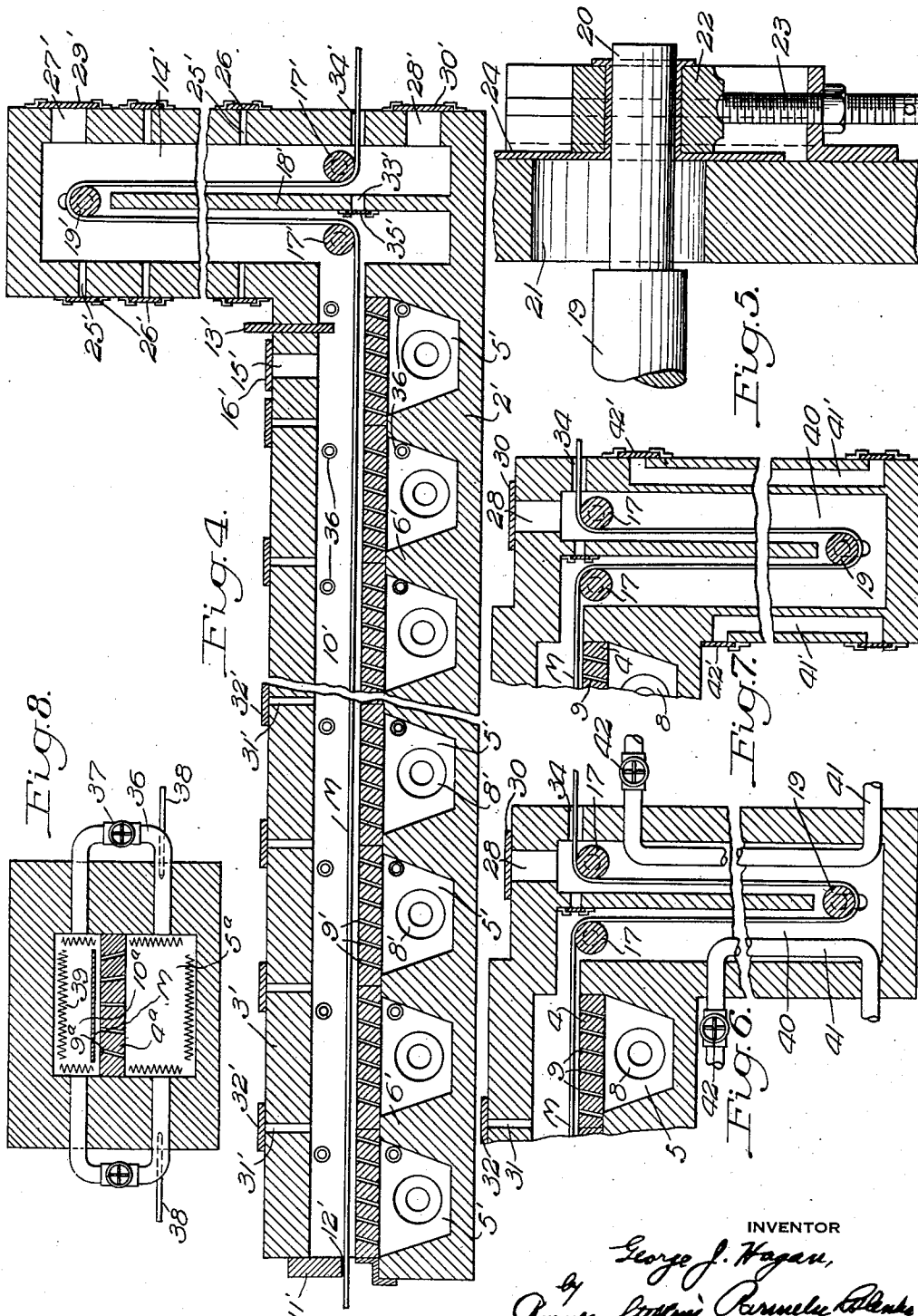
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HEAT TREATING FURNACE

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2 Sheets-Sheet 2



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HEAT TREATING FURNACE

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24 Claims. (Cl. 266—3)

The present invention relates broadly to the art of metal treatment, and more particularly to an improved apparatus for the heating and heat treating of metal.

The art of heating and heat treating metallic bodies for purposes of annealing, normalizing, or special heat treating operations is receiving more and more attention in the art in view of the manufacturing specifications which are being provided. With all of the furnaces with which I am familiar it has been necessary to provide special conveying means having supporting contact with the material undergoing treatment. Such conveying means is subject to the accumulation thereon of scale and the like, which produces pitting or other surface defects in the material undergoing treatment. With any appreciable temperature difference between the material and the supporting means, the pitting to which the material is subjected is increased.

It is one of the objects of the present invention to provide an improved apparatus effective for maintaining the material undergoing treatment out of any such supporting engagement with conveying means or other surfaces as would tend to mar the finish thereon or produce any surface defects therein.

The invention also has for one of its objects the provision of an improved apparatus capable of being so controlled that different portions of the material may be subjected to different temperature conditions in different portions of the apparatus, all portions of the apparatus being subject to effective and accurate control.

In the accompanying drawings I have shown, for purposes of illustration only, certain preferred embodiments of the present invention.

In the drawings, Figure 1 is a longitudinal sectional view through one form of furnace constructed in accordance with the present invention;

Figure 2 is a horizontal sectional view on the line II—II of Figure 1;

Figure 3 is a detail sectional view on the line III—III of Figure 1;

Figure 4 is a view similar to Figure 1, illustrating a slightly modified embodiment of the invention;

Figure 5 is a detail sectional view, on an enlarged scale, illustrating one form of adjustment adapted to be utilized with furnaces of the character shown in Figures 1 to 4, both inclusive;

Figure 6 is a detail sectional view, partly broken away, illustrating still another embodiment of the invention;

Figure 7 is a view similar to Figure 6, showing a further modification; and

Figure 8 is a transverse sectional view through still another type of furnace showing in greater detail pressure producing and circulating means.

In carrying out the present invention, there may be provided a furnace of the construction illustrated, for example, in Figures 1 to 3 both inclusive. In these figures the furnace is illustrated as comprising a base 2, a roof 3, and a hearth 4. I preferably construct the base 2 in such manner as to provide therein a plurality of more or less independent chambers 5 some or all of which may be utilized as combustion or heating chambers. These chambers are illustrated as being separated by pillars or supports 6, the supports at their upper ends being so located as to provide adjacent supporting means for the hearth 4, the hearth conveniently being formed in sections each of such dimensions as to cooperate with one of the chambers 5. By those skilled in the art it will be understood that the hearth may be constructed either of non-metallic refractory sections, or of metallic sections having suitable heat resisting properties, at the pleasure of the designer. In either case they may be suitably secured in position in any desired manner, not herein illustrated, since the particular securing means constitutes no part of the present invention.

In the form of the invention illustrated in Figures 1 and 2, each of the chambers 5 is illustrated as having cooperating therewith burners 7 of such construction as to deliver to the chambers 5 a combustible mixture under pressure. For purposes of convenience, the burners are preferably so located as to cooperate with burner ports 8 on opposite sides of the respective chambers.

The hearth sections 4 are formed with a series of openings 9 therethrough adapted to permit the passage of a heating atmosphere upwardly from the chambers 5 into the furnace chamber 10. While these ports may extend in any desired relationship one to the other, I preferably incline all of the ports forwardly in the direction of travel of the material, whereby gases issuing through the ports under pressure will tend to move the material forwardly. As illustrated in Figure 3, the ports preferably not only extend forwardly, but also project inwardly, the angle of inclination of the outermost ports being greater than the angle of the other ports.

These ports in addition to providing means for the passage of gases from the chambers 5 into the furnace chamber 10, also serve three

other functions when disposed in the manner just described. In the first place, they exert a propelling action on material M passing through the furnace; in the second place they tend to maintain the material elevated from the hearth as indicated for example in Figure 1; and in the third place the angular relationship of the ports is such as to tend to maintain the material in central position with respect to the chamber 10. This latter operation is particularly desirable in the treatment of sheets or plates in that it tends to maintain the sheet or plate centralized with respect to the chamber 10 during its travel there-through, and thereby maintains it out of contact with the walls of the furnace.

The inlet end of the furnace may be provided with a suitable closure 11 mounted in any manner so as to be adjustable at the pleasure of the operator to provide a smaller or larger opening 12 through which the material enters. Adjacent the discharge end of the furnace there is conveniently provided a damper 13, also adjustable in any desired manner for the purpose of controlling the flow of gases from the chamber 10 into the exit chamber 14. This exit chamber in Figures 1 and 2 is illustrated as extending downwardly below the level of the main furnace, while in Figure 4, in which parts of the invention corresponding to parts already described are designated by the same reference characters having a prime affixed thereto, the exit chamber extends in the opposite direction. Adjacent the respective dampers 13 and 13' are ports 15 and 15' adapted to be controlled by dampers 16 and 16' at the pleasure of the operator. These ports may either lead directly to the atmosphere, or to suitable stacks or exhausting means not shown.

By controlling the extent of opening of such ports and the position of the dampers 13 and 13', the rate of flow of the gases through the chamber 10 or 10' may be either increased or decreased at the pleasure of the operator and their effective propelling action correspondingly modified. In addition to this, the withdrawal of the gases through the ports just referred to correspondingly diminishes the passage of such gases into the exit chamber, and thereby lowers the temperature of the exit chamber. With certain materials it is desirable that the temperature of the material before it passes to the atmosphere shall be materially below a red heat, so that any possibility of scaling upon contact with the atmosphere is prevented.

The exit chambers are preferably so constructed as to provide side rolls 17 located substantially in the horizontal plane in which the material is conveyed through the chamber 10, and on opposite sides of a baffle 18, the baffle extending between the rolls 17 and thereby causing the gases which are permitted to flow from the chamber 10 to follow the material during its travel through the exit chamber. Adjacent the end of the baffle is a bottom roll 19 as illustrated in Figure 1 or a top roll 19' as illustrated in Figure 4, such rolls guiding the material during its travel around the baffle.

In Figure 5 of the drawings there is illustrated in detail a suitable mounting for either the roll 19 or 19', the mounting herein being illustrated as used in connection with the roll 19. Such roll is provided on each of its opposite ends with a neck 20 adapted to project through a suitable slot 21 in the side wall of the exit cham-

ber, and into a bearing 22 adapted to be vertically adjusted in any desired manner as, for example, by means of a screw 23. Cooperating with the bearing 22 is a sealing plate 24 whereby, irrespective of the position to which the roll is adjusted, the entire area of the opening 21 may be sealed against the inflow of air.

The exit chambers are also illustrated as provided with a series of ports 25 each having an individual controlling damper 26, by means of which either atmospheric air may be admitted to the exit chambers when the furnace is being operated under a minus pressure, or by means of which gases may be passed outwardly when the furnace is being operated under a plus pressure. There may be also provided ports 27 and 28 controlled by suitable dampers 29 and 30, respectively, which ports may either communicate directly with the atmosphere or with exhausters in accordance with the particular problems to be met.

The roof of the chamber 10 is also conveniently provided with a series of ports 31 controlled by dampers 32 by means of which gases may be permitted to escape from the chamber 10 at different points throughout its length.

In many cases it is desired to by-pass the exit chamber completely, and for this purpose the baffles 18 and 18' are preferably formed with an opening 33 or 33' located substantially in the plane of travel of the material and adapted to permit the material to pass directly from the chamber 10 through the baffle to the exit opening 34 or 34'. When this by-passing operation is not being performed, the openings 33 and 33' are closed by suitable slides 35 and 35'.

It will be apparent to those skilled in the art that a furnace of the character illustrated provides convenient means for the heating or heat treating of a wide variety of different materials either in the form of strips, plates or sheets. The material, regardless of its characteristics, is maintained out of supporting contact during travel through the furnace, and may be either passed from the chamber 10 substantially directly to the atmosphere, or in the case of strip material caused to travel through the length of the exit chamber. During such travel it gradually gives up more and more of its heat until by the time the exit opening is reached the material has been reduced to such a temperature that scaling is effectively prevented.

In many cases, and particularly where the exit chambers are being by-passed, it is desirable to so operate the furnace that a portion of its length constitutes a heating means and another portion a cooling means. It is obvious, however, that if the burners 7 supplying certain of the chambers 5 adjacent the exit chamber were cut out of operation, there would not be pressure means for floating the material during its travel through the furnace. I therefore preferably provide for each of the chambers 5 one or more circulating connections 36 communicating at one end with the chamber 5 and at the opposite end with the chamber 10. Each of these circulating connections is provided with a valve 37 as illustrated in detail in Figure 8, and heat circulating means 38, herein illustrated as comprising a nozzle through which a jet of suitable gaseous material or steam may be delivered. It will be understood, however, that any other form of circulating means, such as a high temperature blower or the like, not shown, may be

substituted at the pleasure of the furnace designer.

It may be assumed for example that the two end chambers 5 shown next to the exit chamber 14 in Figure 1 are those defining a cooling zone. In such case the burners 7 communicating therewith will be cut out of operation, the valves 37 in the circulating connections opened, and the circulating means brought into play. This will produce a circulation of gases from the chamber 10 into the chambers 5 and thence upwardly through the openings 9 under sufficient pressure to hold the material out of contact with the hearth as before described.

Likewise, in case it is not desired to operate the burners at such a pressure that they will be effective for floating the material, they may be operated at a lower pressure, and the circulating connections utilized for making up the difference. When the circulating connections are not being utilized, the valves therein are closed to prevent the by-passing of gases from the chambers 5 directly into the chamber 10 without going through the ports 9.

Such circulating connections are also highly desirable in case it is desired to heat by electrical heating means 39 as illustrated in Figure 8. In such case a pressure supply of gases would ordinarily not be available. With the circulating connections, however, the heating means may be located either in the bottom chambers 5a or in the material chamber 10a, the circulating connections in either case causing the heated gases to come into contact with the material by means of the ports 9a in the hearth 4a. Thus the principle of the present invention is adapted either to combustion furnaces or to electric furnaces, the ability to float the material out of supporting contact with conveying means or the like being present in both cases.

The adjustable mounting illustrated in Figure 5 is desirable since by means of it the complete length of travel of the material may be varied and either shortened or lengthened at the pleasure of the operator, depending upon the particular result which it is desired to produce.

In Figure 6 of the drawings there is illustrated still another embodiment of the invention, the modification consisting in providing the exit chamber 40 with indirect heating or cooling means in the form of tubes or pipes 41 through which either a heating or cooling medium may be circulated to control the temperature conditions existing within the exit chamber. Each of these tubes or pipes is provided with a suitable valve 42 whereby when it is not desired to circulate any medium therethrough, the tubes may be closed.

In Figure 7 there is illustrated a slightly different embodiment of the invention in which the tubes 41 are replaced by passageways or channels 41' formed directly in the walls of the exit chamber 40. These passageways are each adapted to be controlled by a suitable damper 42' whereby during periods of nonuse of the passageways the flow of liquids or gases therethrough may be prevented.

The present invention thus not only provides convenient means for effectively controlling the temperature in any portion of the furnace, but a construction in which any portion may be utilized either as a heating chamber or as a cooling chamber. By this construction, the heating period may be either lengthened or shortened

and the cooling period correspondingly changed. In some cases it is desirable to utilize a heating period which is longer than the cooling period, while in other cases the cooling period is either of substantially the same duration or of less duration than the heating period. In accordance with the construction herein shown, the operator may determine the conditions of operation and thereupon make adjustments to obtain such conditions.

The by-passing of the exit chamber also enables the furnace to be utilized for the heating or heat treating of material which cannot practically be caused to pass through the exit chamber around the rolls provided therein.

The provision of the various ports and dampers enables the pressure conditions within the furnace to be varied at will and enables the velocity of the gases in different portions of the furnace to be varied with a corresponding variation in the heating effect produced thereby as well as in the propulsion effect exerted on the material.

All of the foregoing advantages are obtained in a furnace in which, regardless of the characteristic of the heating means, or the conditions under which such heating means is operated, it is possible to provide conditions such that the material may be maintained out of supporting engagement with any surface or conveying means such as would tend to pit or otherwise disfigure the same.

While I have herein illustrated certain preferred embodiments of the present invention, it will be understood that changes in the construction and operation disclosed may be made as found desirable or necessary. As indicative of one such change contemplated by me, I have shown the exit chambers as broken, for the purpose of illustrating that their length may be varied to meet different operating conditions. Other changes, however, such as the dimensions of the various parts, the location and arrangement of the ports, heating means, dampers, circulating means and the like, will readily suggest themselves to those skilled in the art in view of the disclosure of the invention herein given.

I claim:

1. In a furnace, heating means, a chamber cooperating therewith, and a hearth intermediate said heating means and chamber, said hearth being provided with a plurality of relatively small openings for the passage therethrough of the gaseous heating medium, certain of said openings being angularly disposed toward the longitudinal axis and toward one another whereby the emerging gases serve to assist in guiding and supporting the material passing through the chamber.

2. In a furnace, heating means, a chamber cooperating therewith, a hearth intermediate said heating means and chamber, said hearth being provided with a plurality of relatively small openings for the passage therethrough of the gaseous heating medium, and ports in said chamber wall for controlling the pressure conditions in said chamber.

3. In a furnace, heating means, a chamber cooperating therewith, a hearth intermediate said heating means and chamber, said hearth being provided with a plurality of relatively small openings for the passage therethrough of the gaseous heating medium, and control means for the pressure conditions in said chamber, said control means comprising a series of ports in the chamber wall each provided with a regulating damper.

4. In a furnace for the heat treatment of sheet material, a heating chamber extending in one

plane, means for heating said chamber, a supplemental chamber cooperating therewith and extending angularly to said first-mentioned chamber, and means for supplying fluid to said heating chamber constituting the sole support for material passing through the heating chamber.

5. In a furnace, a heating chamber extending in one plane, means for heating said chamber, a supplemental chamber cooperating therewith and extending angularly to said first-mentioned chamber, and fluid supply ports connecting the heating medium and the heating chamber, said ports being inclined in a common direction to feed material through the heating chamber, certain of said ports being inclined at an angle to each other for guiding the material.

6. In a furnace, heating means, a chamber cooperating therewith, a hearth intermediate said heating means and chamber, said hearth being provided with a plurality of relatively small openings angularly disposed toward one another for the passage therethrough of the gaseous heating medium and control means for the pressure conditions in said chamber, said control means comprising a series of ports in the chamber wall each provided with a regulating damper.

7. In a furnace, a furnace chamber through which material to be heated may be passed, a plurality of nozzles for directing a current of gas against material in the furnace chamber, and means for recirculating the gas under pressure from the furnace chamber to the nozzles.

8. In a furnace for the heat treatment of sheet material, a substantially horizontally extending chamber and a substantially vertically extending chamber cooperating therewith and constituting a continuation thereof and forming a unitary structure therewith, heating means in said first chamber, means in the first-mentioned chamber for maintaining a fluid pressure against the sheet material for supporting the material substantially out of contact with the bottom of said horizontally extending chamber, and means in said vertically extending chamber for supporting the material out of contact with the walls thereof.

9. In a furnace for the heat treatment of sheet material, a substantially horizontally extending chamber and a substantially vertically extending chamber cooperating therewith and constituting a continuation thereof and forming a unitary structure therewith, heating means in said first chamber, means in the first-mentioned chamber for maintaining a fluid pressure against the sheet material for supporting the material substantially out of contact with the bottom and walls of said horizontally extending chamber, means in said vertically extending chamber for supporting the material out of contact with the walls thereof, and means for recirculating said fluid medium under pressure.

10. A continuous furnace for heat treating sheet material comprising a furnace chamber extending in one plane, means for heating said chamber, and a supplemental chamber extending angularly to said first mentioned chamber, said chambers being connected at one end to permit the material being treated to pass continuously from one chamber to the other, the supplemental chamber having a division wall extending from the end adjacent to the heating chamber to adjacent the other end thereof for dividing the supplemental chamber into up and down-travel chambers.

11. A continuous furnace for heat treating

sheet material comprising a furnace chamber extending in one plane, means for heating said chamber, and a supplemental chamber extending angularly to said first mentioned chamber, said chambers being connected at one end to permit the material being treated to pass continuously from one chamber to the other, the supplemental chamber having a division wall extending from the end adjacent to the heating chamber to adjacent the other end thereof for dividing the supplemental chamber into up and down-travel chambers, said division wall being provided with an opening through which the material may travel when it is desired to bypass said angularly disposed chamber.

12. In a furnace for the heat treatment of sheet material, a furnace chamber extending in a horizontal plane and in which relatively high temperature may be maintained, means for heating said chamber, a supplemental chamber cooperating therewith and extending substantially normal to said first mentioned chamber and forming a unitary structure therewith, and means in said supplemental chamber for supporting the sheet material out of contact with the walls thereof.

13. In a furnace for the heat treatment of sheet material, a furnace chamber extending in a horizontal plane and in which relatively high temperature may be maintained, means for heating said chamber, a supplemental chamber cooperating therewith and extending substantially normal to said first mentioned chamber and forming a unitary structure therewith, means in said supplemental chamber for supporting the sheet material out of contact with the walls thereof, and means for varying the temperature in said supplemental chamber.

14. In a furnace for the heating of sheet material, a continuous furnace chamber, a hearth forming the bottom of said chamber, a plurality of separate transverse compartments under the hearth, the hearth having relatively small ports therethrough through which gases may pass from the several compartments to the furnace chamber, and separate burner means for each compartment.

15. In a furnace for the heat treatment of sheet material, a horizontally extending chamber, heating means in said chamber, a substantially vertically extending chamber cooperating with the horizontal chamber and together forming a unitary structure, and means for admitting a fluid to said horizontal chamber under a pressure sufficient to cause the fluid medium to support material as it passes through the horizontal chamber of said furnace.

16. In a furnace for the heat treatment of sheet material, a substantially horizontally extending furnace chamber, heating means in the said chamber, a substantially vertically extending chamber cooperating with the horizontal chamber and together forming a unitary structure, means for admitting a fluid to said horizontal chamber under sufficient pressure to support thereon the material as it passes through the horizontal chamber of said furnace, and means for recirculating the fluid under pressure between the heating chamber and the furnace chamber.

17. In a furnace, a substantially horizontal extending chamber, a substantially vertically extending chamber cooperating therewith and together forming a unitary structure, means for admitting a fluid to said horizontal chamber at a pressure sufficient to cause the fluid medium to support the material as it passes through said

horizontal chamber, and ports in the walls of said horizontal chamber for controlling the pressure of the fluid medium.

18. In a furnace for the heat treatment of sheet material, a horizontally extending chamber, heating means in said chamber, a substantially vertically extending chamber cooperating with the horizontal chamber and together forming a unitary structure, and means for admitting a fluid to said horizontal chamber through the bottom thereof under a pressure sufficient to cause the fluid medium to support material as it passes through the horizontal chamber of said furnace.

19. In a furnace, a substantially horizontal extending chamber, a substantially vertically extending chamber cooperating therewith and together forming a unitary structure, means for admitting a fluid to said horizontal chamber through the bottom thereof at a pressure sufficient to cause the fluid medium to support the material as it passes through said horizontal chamber and ports in the walls of said horizontal chamber for controlling the pressure of the fluid medium.

20. In a furnace, a furnace chamber through which material to be heated may be passed, a plurality of nozzles for directing a current of gas against the material in the furnace chamber, under sufficient pressure to support the material thereon.

21. In a furnace, a furnace chamber through which material to be heated may be passed, a plurality of nozzles projecting through the bottom of the furnace chamber for directing a current of gas against the material in the furnace chamber, under sufficient pressure to support the

material out of contact with the walls of the furnace chamber.

22. In a furnace for the heat treatment of sheet material, a heating chamber extending in one plane, means for heating said chamber, a supplemental chamber cooperating therewith and extending angularly with said first-mentioned chamber, and fluid supply ports connecting the heating medium and the heating chamber, said ports being inclined in the direction of travel of the material through the heating chamber to assist in propelling the material through the furnace.

23. In a furnace for the heat treatment of sheet material, a furnace chamber extending in a horizontal plane, means for heating said chamber, a supplemental chamber cooperating therewith and extending substantially normal to said first-mentioned chamber and forming a unitary structure therewith and nozzles through the bottom of the furnace chamber for directing a fluid medium against the bottom of the material being treated to assist in propelling and guiding the material through the furnace chamber.

24. In a furnace for the heat treatment of sheet material, heating means, a heating chamber cooperating with the heating means, a hearth intermediate said heating means and said chamber, a plurality of ports in said hearth for the passage therethrough of the gaseous heating medium, said ports being inclined in the direction of travel of the treated sheets through the chamber to support the treated material out of contact with the walls of the chamber and to assist in propelling the material through the furnace.

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