

Nov. 18, 1924.

1,515,851

J. F. FERM

CONTINUOUS HEATING FURNACE

Filed May 2, 1923

3 Sheets-Sheet 1

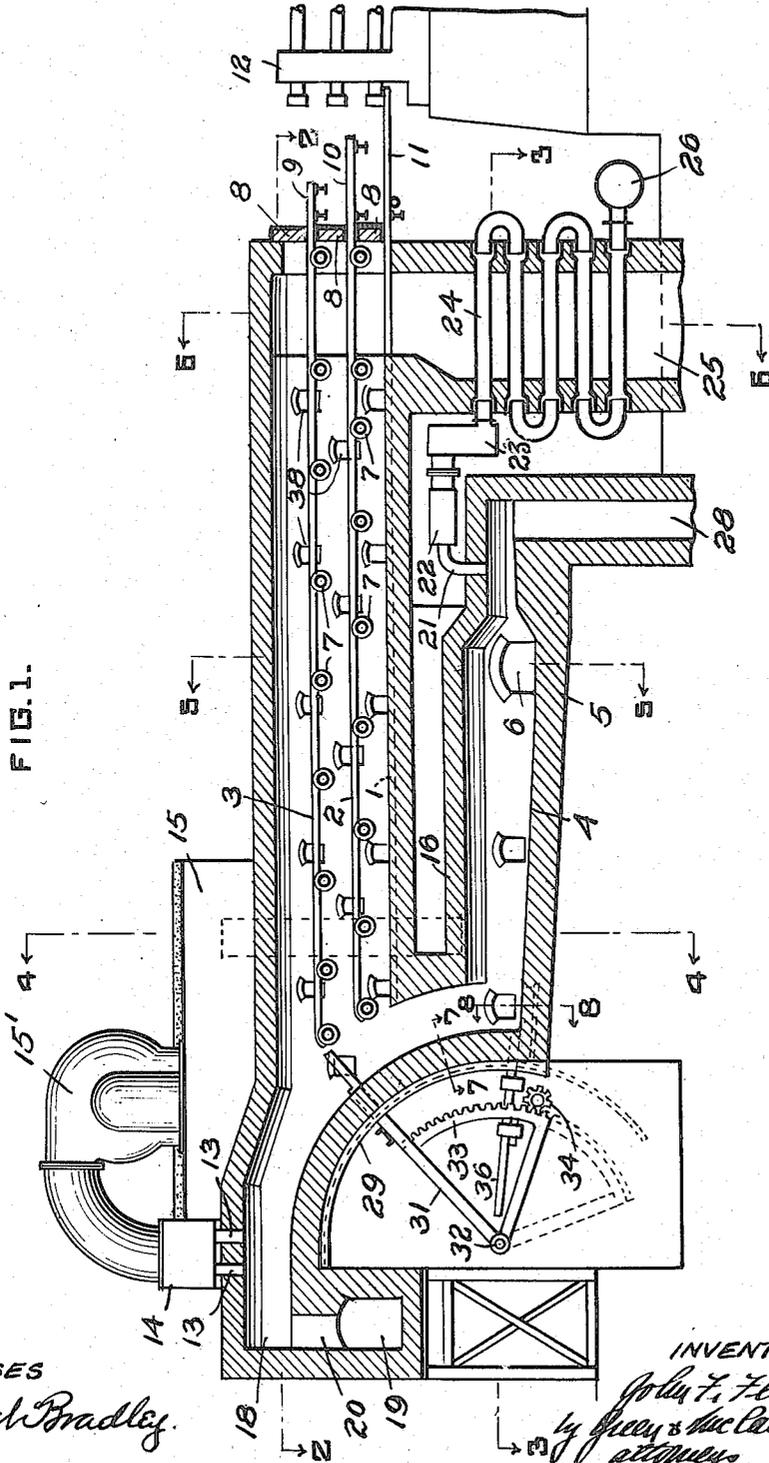


FIG. 1.

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3 Sheets-Sheet 2

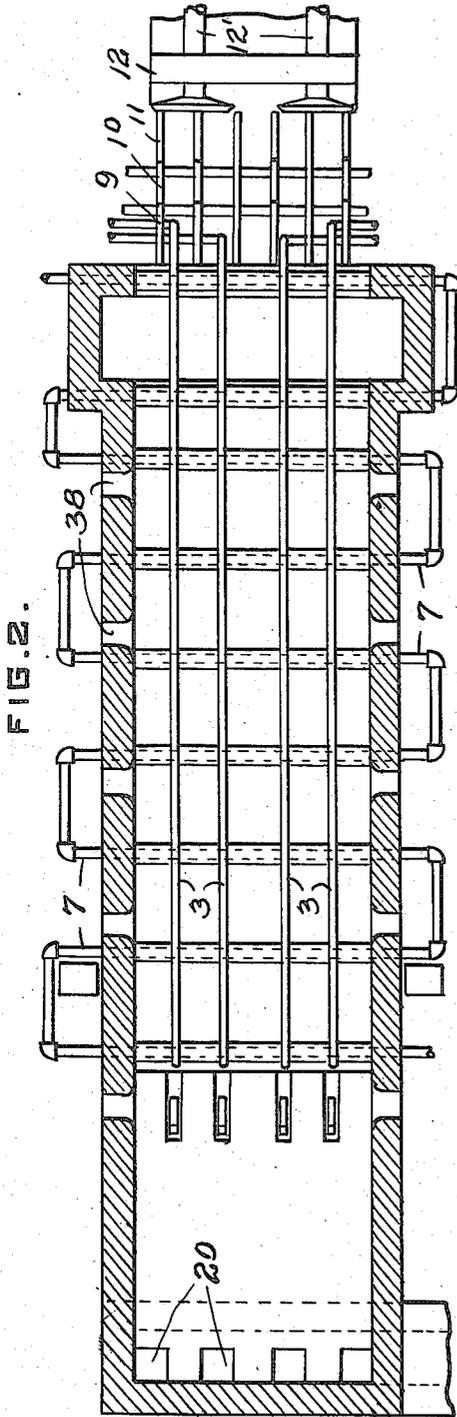


FIG. 2.

WITNESSES
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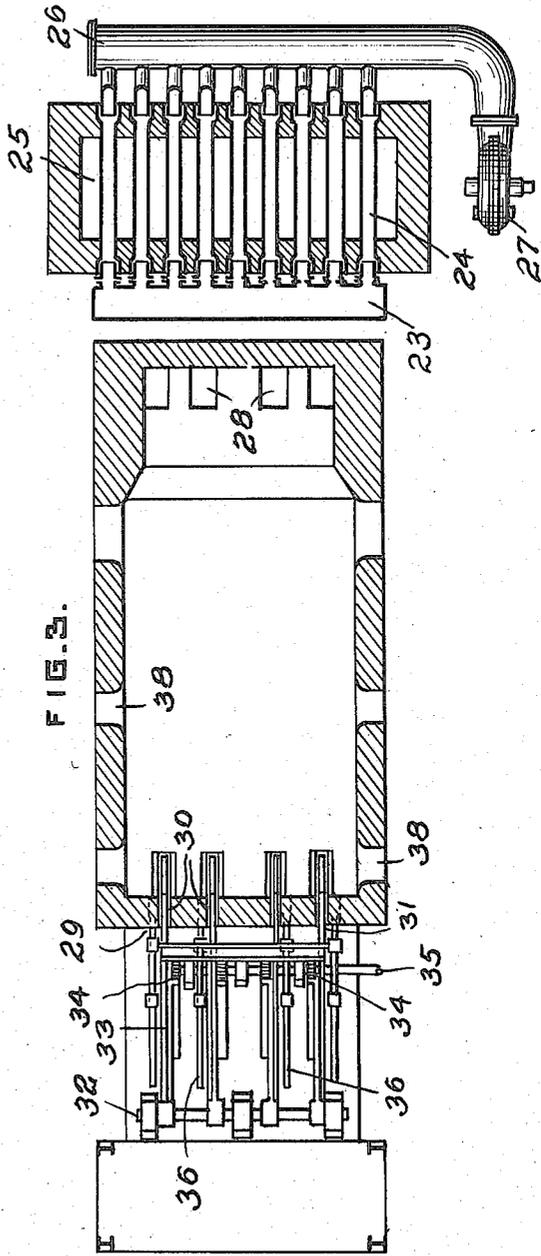


FIG. 3.

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1,515,851

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3 Sheets-Sheet 3

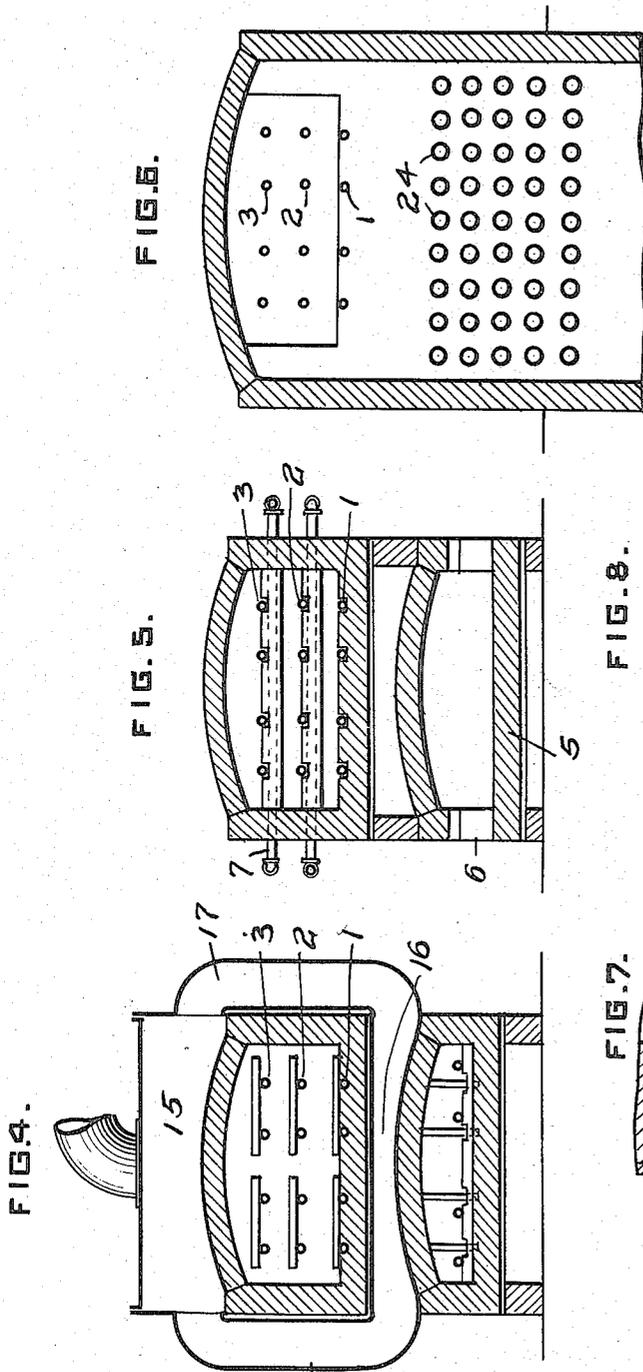


FIG. 6.

FIG. 5.

FIG. 4.

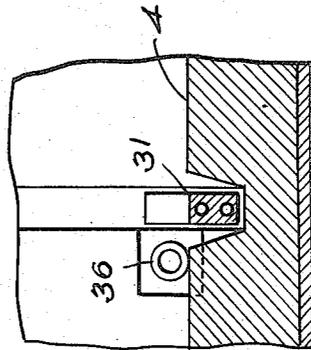


FIG. 8.

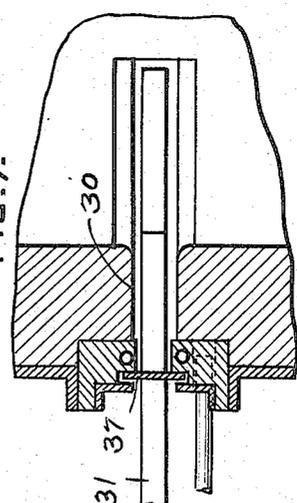


FIG. 7.

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UNITED STATES PATENT OFFICE.

JOHN F. FERM, OF PITTSBURGH, PENNSYLVANIA.

CONTINUOUS-HEATING FURNACE.

Application filed May 2, 1923. Serial No. 636,055.

To all whom it may concern:

Be it known that I, JOHN F. FERM, a citizen of the United States, and a resident of Pittsburgh, in the county of Allegheny and the State of Pennsylvania, have made a new and useful Invention in Continuous-Heating Furnace, of which the following is a specification.

My invention relates to a continuous heating furnace for preheating ingots, blooms, slabs, or billets prior to rolling or forging.

An object of my invention is to construct a multiple hearth furnace having any desired capacity and which occupies no more floor space than is necessary for a single hearth furnace of the old type. Another object is to provide a multiple hearth furnace of any desired capacity which will require less labor than the number of furnaces of the old type required for a light capacity and to decrease the fuel necessary by decreasing the radiating surface and at the same time decreasing the first cost of installation.

These and other objects I attain by my invention, one embodiment of which is illustrated in the accompanying drawings in which Figure 1 is a vertical longitudinal section through the center of the furnace. Fig. 2 is a horizontal section along the line 2—2 of Fig. 1 looking in the direction of the arrows. Fig. 3 is a horizontal section on a line 3—3 of Fig. 1 looking in the direction of the arrows. Fig. 4 is a vertical section on the line 4—4 of Fig. 1 looking in the direction of the arrows. Figs. 5 and 6 are similar views along the lines 5—5 and 6—6 respectively of Fig. 1. Fig. 7 is an enlarged section on the line 7—7 of Fig. 1 showing the slots in the furnace wall through which the transfer mechanism extends and the means for sealing these slots. Fig. 8 is an enlarged section on the line 8—8 of Fig. 1 showing the transfer arms in their lowest position.

The furnace illustrated comprises a bottom hearth 1 and upper hearths composed of water cooled skids 2 and 3. At the bottom of the furnace is provided a finishing hearth 4 for removing the black spots on slabs or billets which are caused by contact with the water cooled skids which form the upper preheating hearths. The bottom of the finishing hearth 4 has non-water cooled skids, or if desired may be covered with magnesite to prevent excessive wear. The

finishing hearth 4 slopes downwardly toward a flat portion 5 which is opposite the discharge door 6.

The skids, 2 and 3 which form the upper hearths are supported on water cooled supports 7 which may be covered with a refractory insulation to prevent heat loss, if desired. Charging doors 8 are provided at one end of the furnace for charging the preheating hearths. Outside each set of charging doors 8, I provide skids 9, 10 and 11 for supporting the cold stock preparatory to its being placed in the furnace. A triple ram pusher 12 is provided for pushing the cold stock into the furnace.

Two or more charging rams 12' are provided for each hearth. Each charging ram is independently operable so that if there is more than one row of material on a preheating hearth each row can be independently advanced.

At the end of the furnace opposite the charging doors are the air ports 13 for directing the air blast into the combustion chamber for the main furnace. These air ports 13 are connected with an air header 14 for preheated air which is drawn from a preheating chamber 15 by a fan or blower 15'. The air is preheated in this chamber by radiation from the hottest part of the roof of the main furnace chamber. The preheating chamber 15 connects with a similar chamber 16, constructed in the furnace between the lowest preheating hearth 1 and the finishing hearth 4, by up-takes 17 on the sides of the main furnace. Fuel gas for the combustion chamber 18 of the main furnace is admitted through a fuel flue 19 and fuel ports 20.

The air blast is admitted to the finishing hearth through air pipes 21, which are connected to an air header 22 which in turn is connected to a header 23 for the preheated air. The air for the finishing hearth is preheated in a coil 24 located in the flue 25 of the furnace. This coil receives its air from the cold air header 26 connected to a fan or blower 27 for furnishing the air for combustion purposes in the finishing hearth. Fuel gas is admitted to the finishing hearth through ordinary fuel ports 28.

The furnace opposite the charging end is provided with an arcuate wall 29 having slots 30 (Figs. 2, 3 and 7). Through these slots extend water cooled arms 31 for transferring material from the preheating

hearths to the lower finishing hearth 4. These transferring arms 31 are pivoted to a shaft 32 outside the furnace wall and have geared segments 33 fastened to them. Pinions 34 are secured to a motor driven shaft 35 and mesh with the geared segments for oscillating the arms. Pushers 36, which may be either hydraulic or motor driven, are provided for pushing the preheated material from the arms onto the finishing hearth 4, when the transfer arms are in their lowest position and at the same time moving the preceding slabs or billets, which are already on the finishing hearth 4, toward the discharge door 6.

Segment slides 37 are secured to the transfer arms 31 and form air seals for the slots 30 in the arcuate wall 29 of the furnace through which the arms 31 extend. These slides 37 extend above and below the arms 31 so as to seal the slots in any position of the arms.

The usual inspection doors 38 are provided for observing the condition of the material within the furnace.

Assuming that the three preheating hearths and the finishing hearth are covered with one or two solid rows of billets, slabs or the like, depending upon the length of the stock being heated, as soon as heated stock is discharged from the furnace through the discharging door 6, by means of an ordinary pinch roller pusher, in the usual manner the operator inspects the upper preheating hearths through the peep holes or inspection doors 38 and rotates the motor driven arms 31 up opposite the hearth with the hottest material. The ram for the corresponding hearth on the furnace charger 12 is then pushed forward thereby charging cold stock into the furnace on that hearth and at the same time pushing hot stock from the other end of that hearth on to the transfer arms 31. By rotating the pinions 34 which are in mesh with the segments 33 on the transfer arms 31 these arms are lowered with the preheated material to the bottom or finishing hearth 4. At this point the pushers 36 shove one billet at a time off the arms onto the finishing hearth thereby advancing one row of material along the finishing hearth. When the arms 31 are empty the operation is repeated.

It is obvious that if the stock is not too wide three or four billets or slabs can be transferred at one time from the upper preheating hearths to the lower finishing hearth, in this way reducing the number of times the charging doors 8 must be opened and thus preventing an undue amount of cold air from entering the furnace. This, however, does not prevent the pushers 31 from delivering stock at a given place for discharging through the door 6.

The stock will be heated to practically

rolling or forging temperature on the preheating hearths, except for black spots, or unheated spots, which are due to contact with the water cooled skids 1, 2 and 3 which form the preheating hearths. The finishing hearth is provided to remove these black spots by having the billets slide on plane non-water cooled skids set in an ordinary fire brick hearth or on magnesite for final heating.

The heat for the main hearths is furnished by the products of combustion from the finishing hearth, which should be at a high temperature, and also a second firing arrangement as has been herein above described. The proportion of heat furnished by each source is dependent on the tonnage of hot product required and the variation should be made in fuel used at the upper firing chamber 18 in order to maintain a constant temperature on the finishing hearth by a practically non-variable fuel consumption in the lower firing chamber for producing a uniformly heated product. The products of combustion from both sources sweep along on all sides of the billets on the skids 1, 2 and 3. In this way any uneven temperature of one hearth is regulated by radiation to the next hearth, thus tending to maintain an even temperature at various distances from the sources of heat. This results from having the upper preheating hearths made only of skids so as to expose all sides of the material to be heated. At the charging end the products of combustion passed down around the ends of the stock at the widened section of the furnace to the flue and then to the stack.

I have illustrated a furnace equipped for gas firing but it is obvious that my invention is equally suitable for furnaces using other fuels.

Having thus described one embodiment of my invention what I claim is:—

1. A continuous heating furnace having a plurality of super-imposed hearths, a charging opening for each hearth and a common discharge opening.

2. A continuous heating furnace having a plurality of super-imposed preheating hearths and a finishing hearth for finishing material received from said preheating hearths.

3. A continuous heating furnace having a plurality of super-imposed preheating hearths and a finishing hearth communicating with said preheating hearths.

4. A continuous heating furnace having a plurality of preheating hearths, a combustion chamber therefor, a finishing hearth, an independent combustion chamber for the finishing hearth and a common flue for the products of combustion.

5. A continuous heating furnace having a plurality of super-imposed preheating

- hearths, a finishing hearth for receiving material from said preheating hearths, charging openings for each preheating hearth, and a discharge opening for said finishing hearth.
6. A continuous heating furnace having a plurality of preheating hearths, a downwardly inclined finishing hearth having a flat portion, for receiving material from said preheating hearths, charging openings for each preheating hearth and a discharge opening for said finishing hearth opposite said flat portion.
7. A continuous heating furnace having a plurality of preheating hearths, a finishing hearth for receiving material from said preheating hearths, a plurality of independent sets of combustion ports, a common flue for the products of combustion, charging openings for each preheating hearth and a discharge opening for said finishing hearth.
8. A continuous heating furnace having a preheating hearth, means for feeding material along said preheating hearth, a finishing hearth and means for conveying material from said preheating hearth to said finishing hearth.
9. A continuous heating furnace having a plurality of preheating hearths, means for feeding material along said preheating hearth, a finishing hearth, and means for conveying material from any desired preheating hearth to said finishing hearth.
10. A continuous heating furnace having a plurality of super-imposed preheating hearths, a finishing hearth and means for transferring material from any desired preheating hearth to said finishing hearth.
11. A continuous heating furnace having a plurality of preheating hearths, a finishing hearth for receiving material from said preheating hearths, means for transferring material from any desired preheating hearth to said finishing hearth and means for feeding material onto said finishing hearth from said transfer means.
12. A continuous heating furnace having a plurality of super-imposed preheating hearths, a finishing hearth beneath said preheating hearths and means for transferring material from any desired preheating hearth to said finishing hearth.
13. A continuous heating furnace having a plurality of preheating hearths, a finishing hearth for receiving material from said preheating hearths, pivoted arms for transferring material from any desired preheating hearth to said finishing hearth and means for feeding material from said transfer arms to said finishing hearth.
14. A continuous heating furnace having a plurality of super-imposed preheating hearths, a finishing hearth beneath said preheating hearths and means for transferring material from any desired preheating hearth to said finishing hearth comprising pivoted arms and means for oscillating said arms.
15. A continuous heating furnace having a plurality of preheating hearths, air supply means therefor including an air preheating means embracing said preheating hearths, a finishing hearth and means for supplying preheated air thereto.
16. A continuous heating furnace having a plurality of super-imposed preheating hearths, air supply means therefor including an air preheating means for said preheating hearths, a finishing hearth and means for supplying preheated air thereto.
17. A continuous heating furnace having a plurality of super-imposed preheating hearths, air supply means therefor including an air preheating means embracing said preheating hearths, a finishing hearth beneath said preheating hearths and means for supplying preheated air thereto.
18. A continuous heating furnace having a plurality of preheating hearths, a finishing hearth, pivoted arms for transferring material from any desired preheating hearth to said finishing hearth, a geared segment secured to said arms and a pinion in mesh with said segment for oscillating said arms.
19. A continuous heating furnace having a plurality of super-imposed preheating hearths, a finishing hearth, horizontally pivoted arms for transferring material from any desired preheating hearth to the finishing hearth, geared segments secured to said arms and pinions meshing with said segments for oscillating said arms.
20. A continuous heating furnace having a plurality of preheating hearths, a finishing hearth, transfer arms horizontally pivoted outside the furnace and extending inwardly through slots in the furnace wall for transferring material from any desired preheating hearth to the finishing hearth, means on said arms for sealing said slots and means for oscillating said arms.
21. A continuous heating furnace having a plurality of super-imposed preheating hearths, a finishing hearth beneath said preheating hearths, transfer arms horizontally pivoted outside the furnace and extending inwardly through slots in the furnace wall for transferring material from any desired preheating hearth to the finishing hearth, means on said arms for sealing said slots and means for oscillating said arms.
22. A continuous heating furnace having a plurality of preheating hearths, a finishing hearth, transfer arms pivoted outside the furnace and extending inwardly through slots in the furnace wall for transferring material from any desired preheating hearth to the finishing hearth, slides on said arms for sealing said slots, geared segments secured to said arms and pinions meshing with said segments for oscillating said arms.

23. A continuous heating furnace having a plurality of super-imposed preheating hearths, a finishing hearth, transfer arms horizontally pivoted outside the furnace and extending inwardly through slots in the furnace wall for transferring material from any desired preheating hearth to the finishing hearth, slides on said arms for sealing said openings, geared segments secured to said arms and pinions meshing with said segments for oscillating said arms. 70
24. A continuous heating furnace having a plurality of preheating hearths, a finishing hearth, transfer arms pivoted outside the furnace and extending inwardly through slots in the furnace wall for transferring material from any desired preheating hearth to the finishing hearth, slides on said arms for sealing said openings, geared segments secured to said arms, pinions meshing with said segments for oscillating said arms and pushers for feeding the preheated material on to said finishing hearth. 80
25. A continuous heating furnace having a plurality of super-imposed preheating hearths, a finishing hearth, transfer arms horizontally pivoted outside the furnace and extending inwardly through slots in the furnace wall for transferring material from any desired preheating hearth to the finishing hearth, slides on said arms for sealing said openings, geared segments secured to said arms, pinions meshing with said segments for oscillating said arms and pushers for feeding the preheated material on to said finishing hearth. 85
26. A continuous heating furnace having a plurality of preheating hearths, a finishing hearth, for finishing material received from the preheating hearths, fuel ports and air inlet ports for said preheating hearths, independent fuel ports and air inlet ports for said finishing hearth, and a common flue for the products of combustion. 90
27. A continuous heating furnace having a plurality of super-imposed preheating hearths, a finishing hearth beneath said preheating hearths for finishing material received from the preheating hearths, fuel ports and air inlet ports for said preheating hearths, fuel ports and air inlet ports for said finishing hearth and a common flue for the products of combustion. 95
28. A continuous heating furnace having a plurality of super-imposed preheating hearths, a finishing hearth beneath said preheating hearths for finishing material received from the preheating hearths, independent fuel ports and air inlet ports for said preheating hearths, fuel ports and air inlet ports for said finishing hearth, air preheating means for each set of air inlet ports, charging openings for each preheating hearth, a discharge opening for said finishing hearth and means for transferring material from said preheating hearths to said finishing hearth. 100
29. A continuous heating furnace having a plurality of preheating hearths, a finishing hearth for finishing material received from the preheating hearths, fuel ports and air inlet ports for said preheating hearths, an air preheating means embracing said preheating hearths and connected to said air inlet ports, fuel ports and air inlet ports for said finishing hearth and air preheating means for said second air inlet ports. 105
30. A continuous heating furnace having a plurality of super-imposed preheating hearths, a finishing hearth beneath said preheating hearths for finishing material received from the preheating hearths, fuel ports and air inlet ports for said preheating hearths, and air preheating means embracing said preheating hearths and connected to said air inlet ports, fuel ports and air inlet ports for said finishing hearth and air preheating means for said second air inlet ports. 110
31. A continuous heating furnace having a plurality of preheating hearths, a finishing hearth for finishing material received from said preheating hearths, fuel ports and air inlet ports for said preheating hearths, fuel ports and air inlet ports for said finishing hearth, air preheating means for each set of air inlet ports, charging openings for each preheating hearth, a discharge opening for said finishing hearth and means for transferring material from said preheating hearths to said finishing hearth. 115
32. A continuous heating furnace having a plurality of super-imposed preheating hearths, a finishing hearth, beneath said preheating hearths for finishing material received from said preheating hearths, fuel ports and air inlet ports for said preheating hearths, fuel ports and air inlet ports for said finishing hearth, air preheating means for each set of air inlet ports, charging openings for each preheating hearth, a discharge opening for said finishing hearth, and means for transferring material from said preheating hearths to said finishing hearth. 120
33. A continuous heating furnace having a plurality of preheating hearths composed of water cooled skids, a finishing hearth and means for conveying material from said preheating hearths to said finishing hearth. 125
34. A continuous heating furnace having a plurality of super-imposed preheating hearths, composed of water cooled skids, an uncooled finishing hearth and water cooled means for transferring material from said preheating hearths on to said finishing hearth. 130
35. A continuous heating furnace having a plurality of super-imposed preheating hearths composed of water cooled skids, an uncooled finishing hearth beneath said preheating hearths, and water cooled means for

transferring material from said preheating hearths to said finishing hearth.

36. A continuous heating furnace having a plurality of preheating hearths composed of water cooled skids, an uncooled finishing hearth, water cooled arms pivoted outside the furnace and extending through slots in the furnace wall, slides on said arms for sealing said slots, geared segments on said arms, pinions meshing with said geared segments for oscillating said arms and means for pushing material received from said preheating hearths off the arms on to said finishing hearth.

37. A continuous heating furnace having a plurality of preheating hearths, a finishing hearth and pivoted transfer mechanism for conveying material from any desired preheating hearth to said finishing hearth and means for operating said mechanism.

38. A continuous heating furnace having a plurality of preheating hearths, a finishing hearth, pivoted transfer mechanism for transferring material from any desired preheating hearth to said finishing hearth and means for feeding material onto said finishing hearth from said transfer mechanism.

39. A continuous heating furnace having a plurality of super-imposed preheating hearths, a finishing hearth beneath said preheating hearths horizontally pivoted transfer mechanism for transferring material from any desired preheating hearth to said finishing hearth and means for feeding material onto said finishing hearth from said transfer mechanism.

40. A continuous heating furnace having

a plurality of super-imposed preheating hearths, a finishing hearth beneath said preheating hearth, horizontally pivoted transfer mechanism for transferring material from any desired preheating hearth to said finishing hearth and means for operating said mechanism.

41. A continuous heating furnace having a plurality of preheating hearths, a lower finishing hearth and means for lowering material from any preheating hearth to said finishing hearth.

42. A continuous heating furnace having a plurality of super-imposed preheating hearths, a lower finishing hearth beneath said preheating hearths and means for lowering material from any preheating hearth to said finishing hearth.

43. A continuous heating furnace having a plurality of preheating hearths, a lower finishing hearth, means for lowering material from any preheating hearth to said finishing hearth and means for feeding material onto said finishing hearth from said lowering means.

44. A continuous heating furnace having a plurality of super-imposed preheating hearths, a lower finishing hearth beneath said preheating hearths, means for lowering material from any desired preheating hearth to said finishing hearth and means for feeding material onto said preheating hearth from said lowering means.

In testimony whereof, I have hereunto subscribed my name this 26th day of April, 1923.

JOHN F. FERM.