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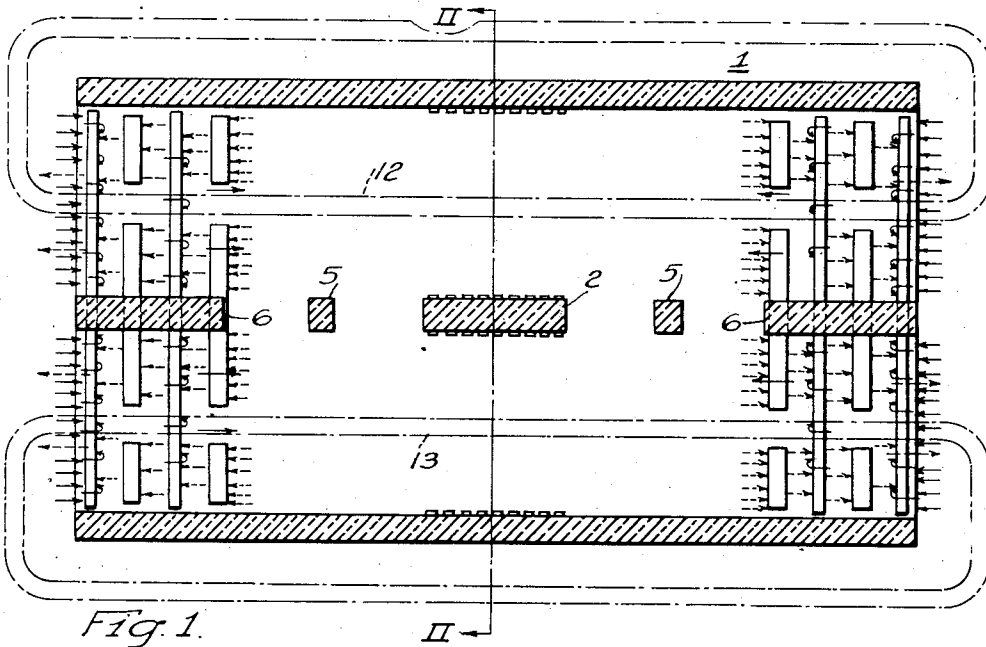
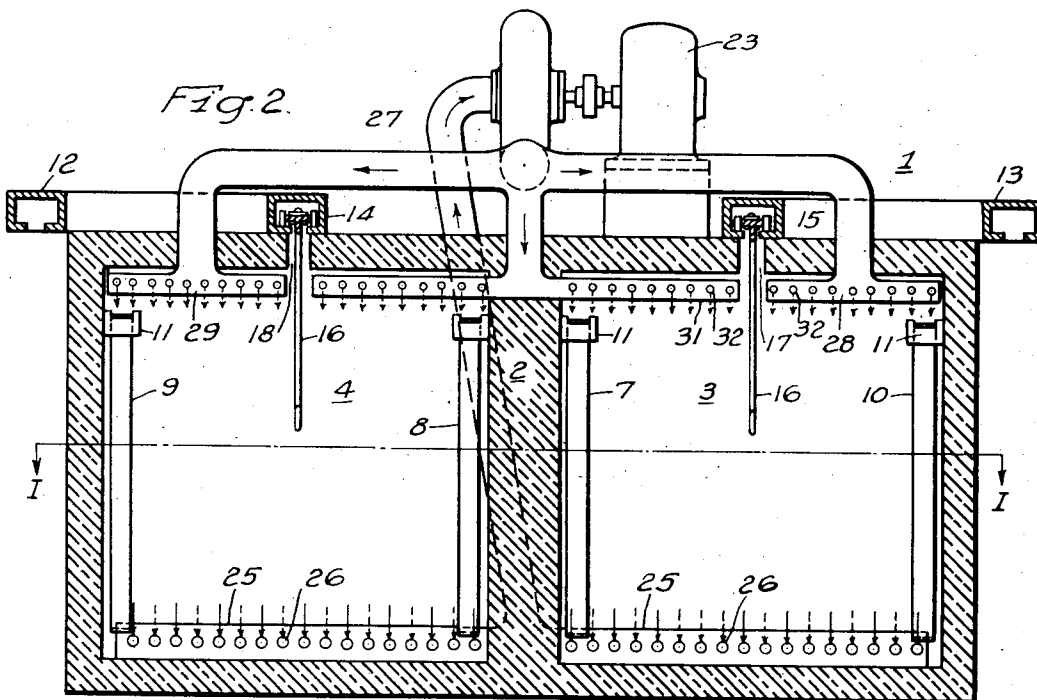
C. H. CARPENTER ET AL

1,725,129

FURNACE

Filed March 27, 1928

2 Sheets-Sheet 1



INVENTORS

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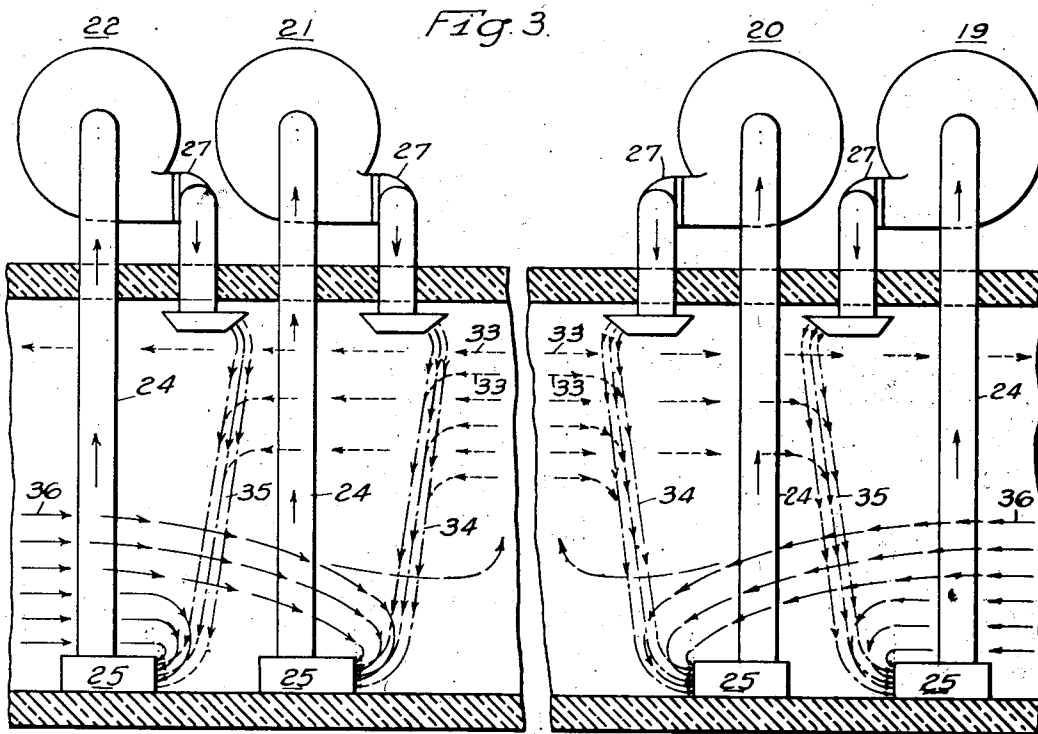
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-----> Hot Air.  
—————> Cold Air.  
- · - · -> Warmed Air.

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## UNITED STATES PATENT OFFICE.

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## FURNACE.

Application filed March 27, 1928. Serial No. 265,055.

Our invention relates to furnaces and particularly to means for checking or preventing the loss of heat through door openings of the furnaces caused by the natural circulation of air from the atmosphere outside of the furnace, through the door openings and out to the atmosphere, as heated air.

5 An object of the invention is to provide means for checking or minimizing the loss of heat, in the form of heated air, through door openings in furnaces without hindering or obstructing the movement of material, to be heated in the furnace, through the openings.

15 Another object of the invention is to substantially check the escape of heat, in the form of heated air, from furnaces through their door openings while material to be heated is being inserted and withdrawn from the furnaces through the openings.

20 A further object of the invention is to provide for the circulating of air within furnaces and so directing its flow that a wall or screen of continuously circulating air is effected near the door openings or the entrances to the furnace to substantially prevent the ingress and egress of air to and from the furnace; and

30 A further object of the invention is to provide a plurality of spaced walls of circulating air disposed adjacent to openings in furnaces and in planes adapted to obstruct the natural circulation of air from the outside atmosphere through the furnace and out to the atmosphere, whereby heat losses from the furnaces, in the nature of heated air, are substantially reduced, and for practical purposes prevented.

40 For a fuller understanding of the invention, reference may be had to the following description taken in conjunction with the accompanying drawings, in which:

Figure 1 is a view, in section, of a furnace structure embodying the invention, taken on line I—I of Fig. 2;

45 Fig. 2 is an enlarged view, in section, of the same structure taken on line II—II of Fig. 1; and

50 Fig. 3 is a partial, enlarged longitudinal view, in section, of the furnace structure illustrated in Figs. 1 and 2, showing diagrammatically the effect of circulating walls of air, disposed near the openings to the furnace, upon the natural circulation of air

from the atmosphere through the openings and into the furnace.

In the drawings, a furnace 1, of the tunnel type, is illustrated that comprises top, bottom and side walls of suitable refractory heat resistant material. The central portion of the furnace structure is provided with a wall 2 of suitable refractory heat resistant material that extends from the top to the bottom walls, thereby defining two separated passageways or tunnels 3 and 4 at the middle portion of the furnace. The ends of the furnace may be provided with intermediate walls 5 and 6 for supporting the top wall of the furnace at the ends thereof.

60 The furnace may be heated electrically by resistors 7, 8, 9 and 10 which may be suspended from the side walls and the wall 2 in any suitable manner. In the preferred form of the invention, the resistors may be of such material as nickel chromium, in ribbon form, and may be supported by lugs 11 projecting from the walls. The lugs may be of the same material as the walls of the furnace, provided the material possesses proper electrical-insulating properties.

70 In order that material to be heated in the furnace may be conveyed therethrough, endless conveyors comprising tracks 12 and 13, respectively, each provided with a plurality of carriers 14 and 15, only one of which is shown on each track, are provided, the carriers 14 may be connected together by flexible chains or any other suitable means of coupling. The carriers 14 and 15 may be provided with hooks 16 which project into the furnace chambers or tunnels 3 and 4 through slots 17 and 18, respectively, which extend the full length of the top wall of the furnace 1.

85 Since the resistors 7, 8, 9 and 10 are located at substantially the middle portion of the furnace structure 1, the temperature within the furnace will be a maximum at its middle portion, and a minimum out at the ends thereof. Therefore, the temperature at any point between the middle and the ends of the furnace will be an inverse function of the distance from the middle section in which the resistors are located.

100 In the particular furnace structure illustrated in the drawings, both of its ends are open in order that the conveyor hooks 16 may travel continuously through the tunnels

or chambers 3 and 4. Since the ends of the furnace are open and since the temperature within the furnace is high relatively to the atmosphere surrounding the furnace walls, cold air will enter through the bottom portion of the furnace openings and flow along the bottom wall to the central region of the furnace in which the heating units are located. In this region, the air will become heated, rise to the upper portion of the furnace chambers or tunnels 3 and 4, expand and travel outwardly towards the end of the furnace and through the openings to the atmosphere. It has been found that the heated air leaving the furnace travels at a rate of approximately 300 feet per minute under certain conditions of operation. Since the furnace chambers are relatively large in volume, a large number of cubic feet of air will circulate through the furnace and carry off heat, thereby reducing the efficiency of the furnace and also its temperature.

In order to check or prevent the circulation of air from the atmosphere into the furnace chamber and out again to the atmosphere, a plurality of blowers 19, 20, 21 and 22 are provided. As shown, the blowers are supported on the top wall of the furnace structure 1 in any suitable manner. The blowers may be driven by individual motors 23, only one of which is shown, which may be directly connected thereto in any suitable manner.

The intake side of each of the blowers may be connected by a pipe or a conduit 24 to a pipe 25 extending across the bottom wall of the furnace and in close proximity to the openings thereof, two pipes being located at each end of the furnace. The pipe 25 may be provided with a plurality of openings 26 through which air may enter (see Fig. 2).

The exhaust or discharge side of the blowers 19 to 22, inclusive, may be connected to headers 27 extending laterally across the top wall of the furnace 1. The ends of the headers 27 may be connected to exhaust discharge pipes 28 and 29 located near the ceiling of the furnace structure and the middle portions of the headers may be connected to exhaust pipes 31. As shown, the ends of the exhaust pipes 28, 29 and 31 are separated in order that the hooks 16 of the conveyor may pass through the furnace in the manner hereinbefore set forth. The pipes 28, 29 and 31 may be provided with a plurality of openings 32 through which air from the blowers may be discharged.

In the preferred form of the invention, the blowers 19 to 22, inclusive, are of the low pressure large volume type, that is, they are adapted to deliver a relatively large volume of air at low pressure. As shown in Figs. 1 and 3 of the drawings, the air which is being discharged from the blow-

ers is directed at an angle towards the center of the furnace structure 1. The air, as it leaves the pipes 28, 29 and 31, strikes against the relatively large volume of heated high velocity air indicated by the arrows 33 and causes the latter to move downwardly towards the bottom wall of the furnace and into the intake pipes 25. The air is then drawn through the blower and again discharged against the outwardly moving stream of heated air 33. The low pressure air is thus so circulated and recirculated that walls of low velocity, large volume, air 34 and 35 are provided at each end of the furnace adjacent to the open ends thereof.

It is to be noted that the walls 34 and 35 come in contact with the incoming cold air represented by the arrows 36 and deflect it downwardly into the pipes 25, therefore, the walls 34 and 35 not only check or prevent the heated air 33 from leaving the furnace chambers, but they also check or prevent the cold air 36 from entering the furnace chamber beyond the pipes 25 located farthest in the furnace chamber.

For purposes of illustration, it may be assumed that six units of cold air are entering the furnace 1 as shown in Fig. 3 of the drawings. Then it may be assumed that three of these units are checked by the walls 35 and that three of these units continue, two of them being drawn into the pipes 25 connected to the blowers 19 and 20, respectively, and the sixth unit continuing into the hot region or middle portion of the furnace. The air is here heated, wherefore it rises to the top of the furnace chamber and increases in volume, which volume may be represented by the summation of the arrows 33. As shown, the heated air travels outwardly towards the open ends of the furnace.

Again, it may be assumed that three units of the heated air 33 are directed downwardly by the walls 34 into the pipes 25 connected to the blowers 20 and 21, three of them continuing to the walls 35, two of which are directed downwardly into the pipes 25 connected to the blowers 19 and 22, respectively. Therefore, one unit of air escapes to the atmosphere.

By providing two walls or screens of circulating air 34 and 35 at each end of the furnace, it has, by example, been shown that, whereas six units of air would ordinarily enter the furnace chamber and be heated and circulate out into the atmosphere, by utilizing the walls of air for checking or preventing the air from entering the furnace from the atmosphere, only one unit of air has been heated. In utilizing these walls of air (by example), only  $\frac{1}{6}$  of the amount of air is heated as compared with the furnace structure in which no walls of air are utilized to prevent the circulation of air

from the atmosphere into the furnace with the result that efficiency of the furnace is increased.

With proper spacing of the walls of air 5 34 and 35, one wall will check the circulation of air from the atmosphere through the furnace, while the other wall strikes or contacts with heated material, carried by the hooks 16 on conveyor 12, and is deflected 10 into the chambers 3 onto cold material carried by the hooks on the conveyor track 13, it being understood that the conveyor tracks 12 and 13 move in opposite directions so that when cold work is entering at one end 15 of the furnace, hot work is leaving at the same end. For example, when material carried by the hooks 16 strikes or passes through the walls of air 34, the air is dispersed and caused to churn or swirl within 20 the chamber to such an extent that the air heated by the material carried on the hooks is blown over to the material carried by the hooks in the chamber 3. While this air is being swirled and churned about, the wall 25 35 remains intact and prevents heated air from escaping to the atmosphere. By the time the material has reached the walls 35, the wall 34 will have become intact and uniform again when the walls 35 become 30 disrupted and dispersed by the material. In this case, the walls 35 tend to prevent the escape of heated air to the atmosphere.

While it is preferable to use low velocity, large volume walls of air for checking the 35 ingress and egress of air from the atmosphere to the furnace chamber, it is to be understood that high velocity, relatively small volume walls of air may be utilized if desired.

40 It is to be understood also that whereas the specific application of the invention

herein described has been made to an open-ended furnace of the tunnel type, the invention may be applied to furnaces having only one opening where economy permits. 45

By this invention, the efficiency of industrial furnaces may be improved by circulating and recirculating walls of air adjacent to the openings thereof through which work to be heated may be inserted and withdrawn, 50 the walls serving to block off the incoming cold air and the outgoing heated air.

Various modifications may be made in the system embodying our invention without departing from the spirit and the scope 55 thereof. It is desired, therefore, that only such limitations shall be placed thereon as are imposed by the prior art and the appended claim.

We claim as our invention: 60

In a furnace provided with heating means and an opening through which work may be inserted and withdrawn from the furnace, in combination, an intake pipe located at the top of the furnace chamber, an exhaust 65 pipe located at the bottom of the furnace chamber, means for drawing air through the intake pipe and exhausting it through the exhaust pipe, and means for directing the air so drawn and exhausted across the incoming and outgoing streams of cold and 70 heated air so that a wall of air is provided whereby the streams tending to enter and leave at the bottom and top of the furnace chamber are substantially checked from 75 penetrating the furnace beyond the air wall.

In testimony whereof, we have hereunto subscribed our names this 14th day of March, 1928.

CRANSTON H. CARPENTER.  
ALVIN D. KEENE.

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CERTIFICATE OF CORRECTION.

Patent No. 1,725,129.

August 20, 1929.

CRANSTON H. CARPENTER, ET AL.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 3, line 65, the claim, for "top" read "bottom", and line 66, for "bottom" read "top"; and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 28th day of February, A. D. 1933.

(Seal)

M. J. Moore,  
Acting Commissioner of Patents.