

Aug. 11, 1931.

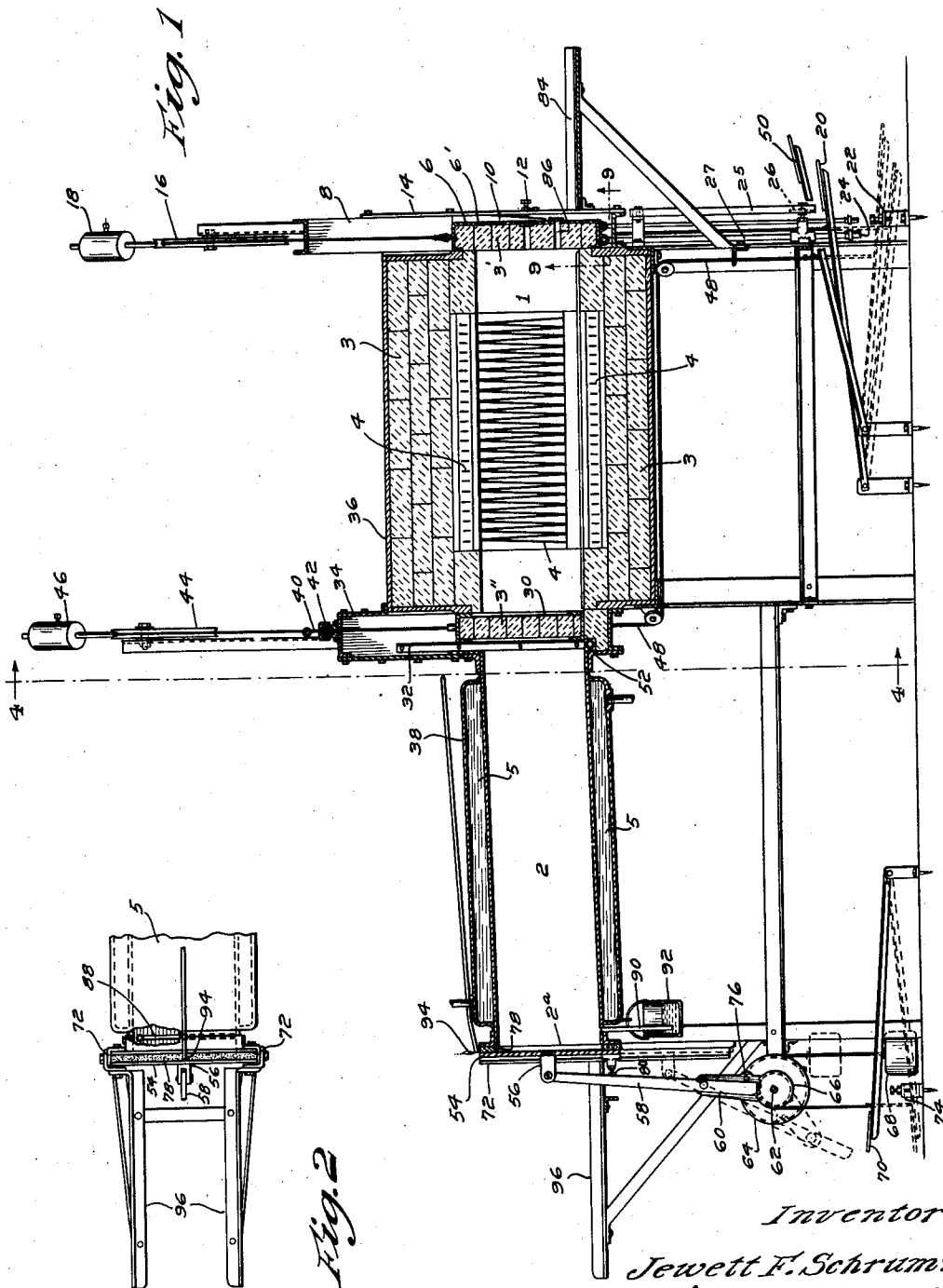
J. F. SCHRUMN

1,818,759

FURNACE

Filed May 8, 1930

3 Sheets-Sheet 1



Aug. 11, 1931.

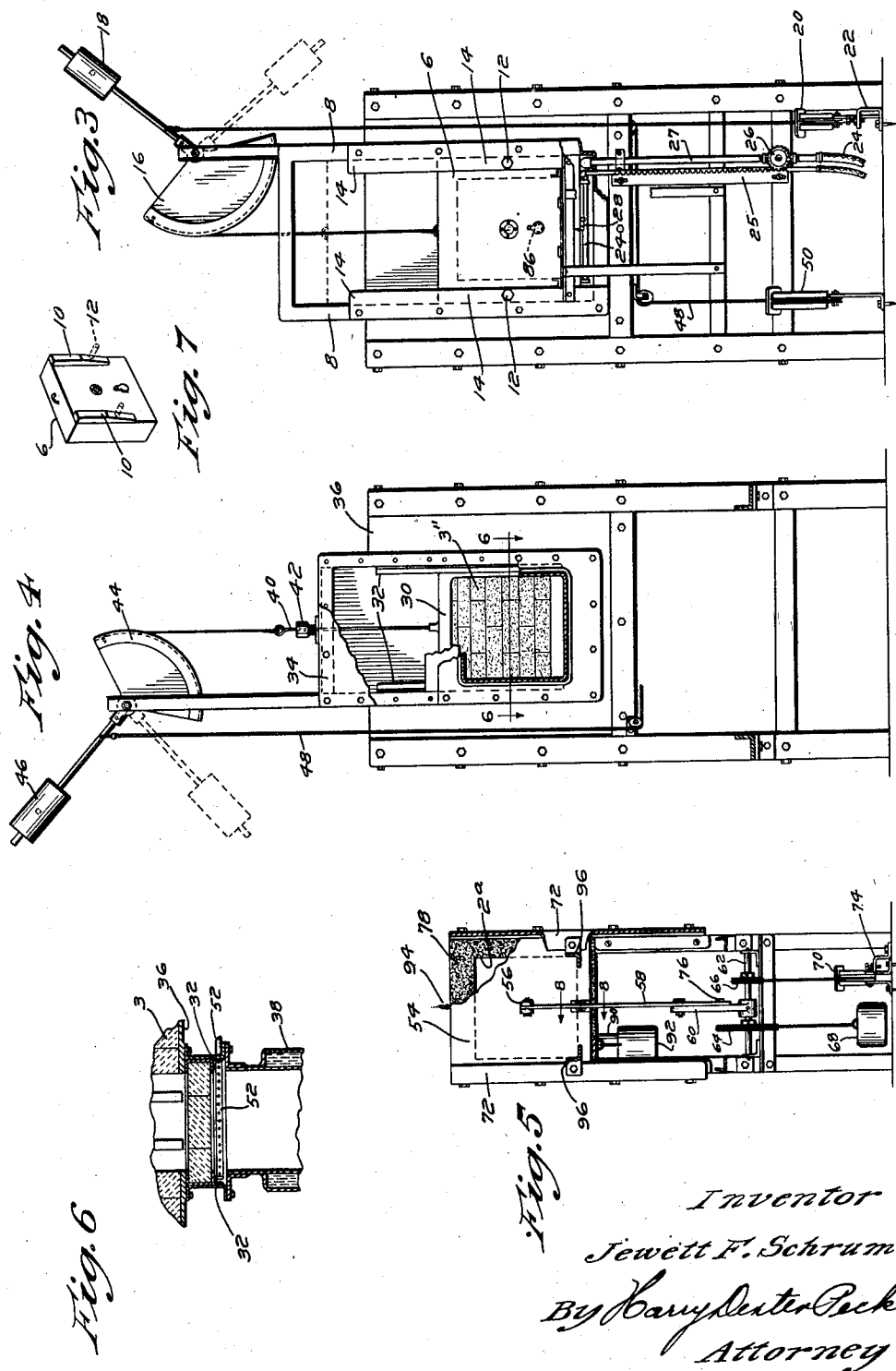
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3 Sheets-Sheet 2



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3 Sheets-Sheet 3

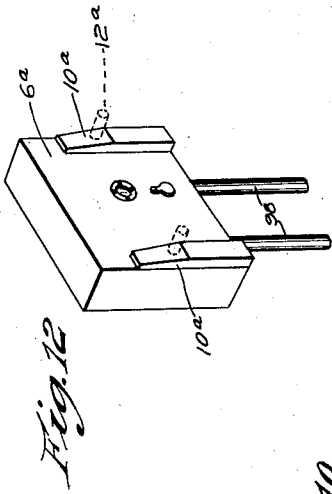
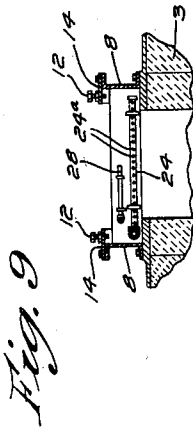
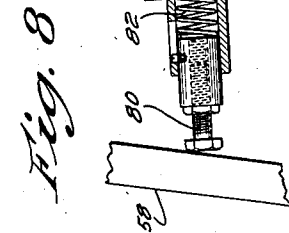


Fig. 10

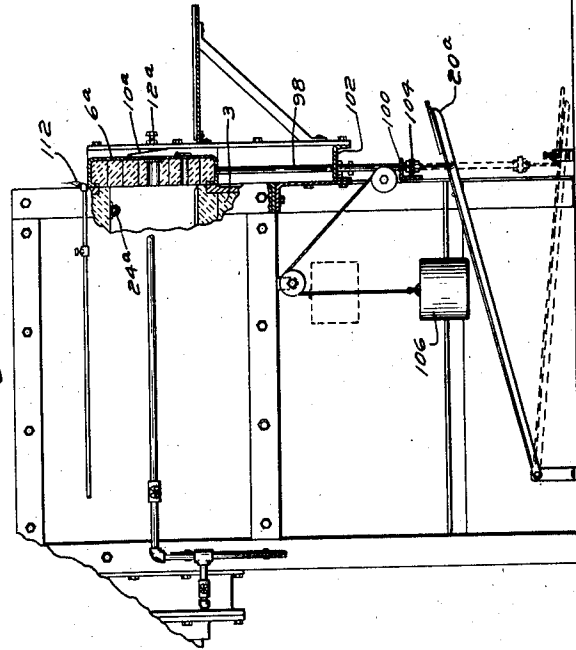
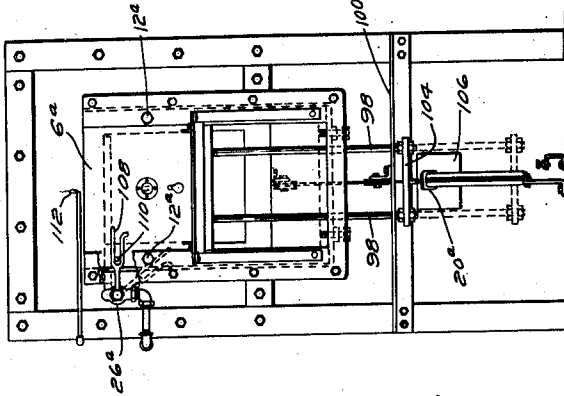


Fig. 11



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UNITED STATES PATENT OFFICE

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FURNACE

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This invention relates to improvements in furnaces. More especially it has to do with furnaces employing a special atmosphere and in particular to novel devices and means for making such furnaces economical in operation and safe from the dangers which may attend the use of such an atmosphere.

Heat treatment of materials has been practiced for many years, although it is only in comparatively recent times that such treatment has been carried out in special atmospheres. The desirability of using a particular gas, or a mixture of gases, or a vapor instead of air is now well recognized because if the material can be kept from contact with air while it is being heated and subsequently cooled, no oxidation will occur and no formation of scale or discoloration will take place. But the use of some special atmospheres in furnaces of the types heretofore available is attended with considerable danger of explosion and with almost prohibitive loss of the atmosphere either by absolute escape or by infiltration of air with consequent adulteration. Hydrogen gas, for example, can be desirably employed as a special atmosphere in the heat treatment of various materials. Like other special atmosphere gases it is somewhat expensive and because of the loss which has followed its employment heretofore, has only been used where expense of operation is not a primary consideration. Hydrogen particularly may become an exceedingly dangerous agent if air is permitted to mix with it in quantity sufficient to cause an explosion.

This is particularly so if the mixture is permitted to occur to any considerable extent in the chambers of a furnace, because these chambers are usually at such a high degree of temperature as to cause spontaneous combustion of the mixture with obviously damaging results. It is to the avoidance of such dangers, coupled with the saving of the special atmosphere and maintaining it free from undesirable additions that the present invention is directed.

It is among the objects of the present invention to provide in a furnace employing a special atmosphere certain novel features of

construction and arrangement of parts which make for the safe and economical operation of the furnace, and the maintenance of an undiluted special atmosphere. It is also an object to provide for the more efficient treatment of work of recessed shape, especially as regards the scavenging of the air from the recesses. Other objects and features of the invention will be apparent as the description develops.

A furnace embodying the features and advantages of this invention is disclosed in the accompanying drawings as illustrative of how the principles of the invention may be applied. This furnace is of the multiple chamber type with the chambers in horizontal alignment. At opposite ends of the furnace are the entrance and exit doors respectively.

The front door is arranged to move vertically across the entrance opening of the furnace, and suitable cams are provided to insure its being tightly seated when closed. If the door opens upward its lower edge is provided with a conduit having outlets arranged so as to project a sheet or curtain of gas downward across the entrance opening. If the door opens downward, a similar conduit is located close by the upper edge of the entrance opening for the same purpose.

This gaseous curtain serves two major purposes in that it forms a barrier between the gas in the furnace and the outside air and in that it acts with scavenging effect upon any material being introduced to the furnace. The exit or rear door of the furnace preferably moves downward in opening. Novel means are provided for tightly closing this door and for insuring its initial opening to occur primarily along its top edge. This latter provision allows the gas of the rear chamber to flow out from the top thereof first. Just above this door is a pilot flame which instantly ignites the escaping gas (assuming of course that this gas is burnable when mixed with air) and thereby starts the combustion which continues as the door is fully opened for the removal of the treated material. By thus providing for the ignition of the gas and air mixture promptly as

they come into contact, the burning proceeds more or less rapidly as the air moves into the chamber but without any such explosion of the mixture as has heretofore attended the opening of the door in such furnaces.

Between the chambers is an intermediate door adapted when closed to substantially separate the chambers, although as will later more particularly appear it is preferable to permit of some passage of the gas from one chamber to the other even when this intermediate door is shut. It is a feature of the invention that the casing of the furnace surrounding this door is tight against leakage so that whether this door is open or closed no gas from the furnace can escape nor can any foreign gas, such as air, enter the furnace.

It is intended that the patent shall cover by suitable expression in the appended claims whatever features of patentable novelty exist in the invention disclosed.

In the accompanying drawings:

Figure 1 is a side elevation in medial section through a furnace constructed in accordance with the principles of this invention;

Figure 2 is a plan of the rear or exit end of the furnace, with a portion of the casing cut away to disclose a detail of construction;

Figure 3 is a front elevation of the furnace of Figure 1;

Figure 4 is an elevation as on line 4—4 of Figure 1, with a portion of the casing cut away;

Figure 5 is a rear elevation with parts cut away for clearness;

Figure 6 is a plan in section as on the line 6—6 of Figure 4;

Figure 7 is a perspective of the front door of the furnace shown in Figures 1 and 3;

Figure 8 is a sectional view on line 8—8 of Figure 5 showing a detail;

Figure 9 is a section on line 9—9 of Figure 1 viewed as from the bottom looking upward;

Figure 10 is a side view of a furnace like that of Figure 1, but with parts in section to show an entrance door opening downward;

Figure 11 is a front view of the furnace of Figure 10; and

Figure 12 is a perspective of the entrance door of Figures 10 and 11.

Referring more particularly to the drawings, the furnace is preferably of that type having two chambers 1 and 2 in alignment so that material to be treated can be introduced at one end of the furnace, pass from one chamber to the other, and ultimately be removed at the other end of the furnace. The first chamber 1 has surrounding walls of heat insulating material 3 and is provided with suitable heating means such as the electric units 4. This chamber will be hereinafter referred to as the heated chamber. The other chamber 2 is surrounded by a water jacket 5,

through which a circulation of cooling water may be maintained. This chamber will be termed the cooled chamber.

At the entrance end of the heated chamber is a door 6 having a casing 6' with a lining of insulating material 3'. This door moves vertically between the side members 8 and has cam strips 10 at its edges to engage adjustable set screws 12 provided on the plates 14 attached to the members 8. As the door moves downward, its cam strips ride on these screws 12 and by their coaction force the door tightly against the furnace wall. A sector 16 and counterweight 18 with suitable connections with the treadle 20 enable the door to be operated easily by the foot of the attendant, a latch 22 being provided to engage treadle 20 and hold the door open when desired.

Along the bottom of this front door is a perforated conduit 24 having its perforations 24a (see Figure 9) opening generally downward so that when a suitable gas is discharged therefrom a curtain or sheet of gas will be projected downward across the door opening. Preferably the gas supplied to this conduit 24 is an inert gas which will not mix or combine chemically with the gas in the chamber. If the work or material to be introduced to the furnace is flat, or does not stand very high, the door need be raised but a short distance and in such a case the gas curtain projected from conduit 24 need only be sufficient to project across the small opening. If, however, the work is of greater height, or has recesses or hollows, the door can be raised higher and the extent of the gas curtain increased, to insure that it will not only extend across the whole opening but what is more important will force itself into the recesses or hollows of the work and act with scavenging effect upon the air therein.

The gas flow for this curtain can be manually controlled or may be automatically controlled in accordance with the door movement by providing an adjustable rack 25 on the frame in position to be engaged by a gear 26 mounted on the stem of a gas supply valve. As the door moves upward carrying with it the conduit 24 and supply pipe 27, the gear 26 is turned to open the valve, and as the door descends the gear is rotated in the closing direction.

The presence of this gas curtain prevents the escape of the special atmosphere gas from the heated chamber and the entrance of outside air thereinto. When this chamber contains a gas which forms a combustible mixture with air, it is desirable to use a burnable gas in conduit 24 and ignite it, upon the turning of gear 26, by a steadily burning pilot 28. This burning curtain takes care of any mixture of the special atmosphere gas and air that may occur and thereby prevents

the infiltration of the air to the chamber. As a result no explosive mixture can form in the chamber and no dilution of its special atmosphere can occur.

At the rear end of the heated chamber, and at the front end of the cooled chamber, is an intermediate door 30 composed largely of heat insulating material 3". This door also moves upward to open being guided by the angle plates 32. The casing 34 surrounding this door forms a tight connection between the casing 36 of the heated chamber 1 and the casing 38 of the cooled chamber 2. The door 30 is preferably attached to a rod 40 which extends through a suitable packing box 42 at the top of the intermediate casing and has cable connection with the sector 44. A counterweight 46 and cable connection 48 to treadle 50 also enables this intermediate door to be operated from the front of the furnace.

Whether this intermediate door is open or closed, no air can get into the chambers and no gas escape therefrom through the door casing 34. While thus tight against the transfer of any air to or gas from the chambers, the casing is not entirely tight with respect to the door when closed, thus enabling a slight leakage of gas from one chamber to the other to take place, this being desirable because as here arranged the special atmosphere is supplied to the cooled chamber through a conduit 52, which extends across the chamber, just rearward of the intermediate door, in a suitable recess or groove in the floor. By not making the intermediate door too tight when closed, the supply of special atmosphere gas is always available for the heated chamber.

At the rear of the furnace the exit door 54 is mounted so as to move vertically downward when opening. This door is a plate provided with a yoke arm 56 pivotably connected to one end of a lever link 58. This link is also pivotably connected near its lower end to a crank 60 attached to a shaft 62. Fast to the latter are two grooved pulleys 64 and 66, one of which has a cable secured thereto which carries the weight 68 and the other of which has a cable connection with a foot treadle 70. As the latter is depressed, the crank 60 is turned counter-clockwise as seen in Figure 1 and pulls the lever link 58 generally downward, thus causing the door to slide vertically downward within its guides 72. It may be retained in its lower or open position by the latch 74 provided for treadle 70.

When it is desired to close the door, the downward pressure on the treadle is released. The weight 68 then causes the crank 60 to turn clockwise and force the link and door upward. As the latter reaches its closing position the lower end of the link engages a pin 76 secured to the crank 60 below its pivotal connection with the link.

This engagement in effect makes the crank and link an integral member transmitting to the door the turning effect of the weight 68. Because of the relation of the moment arms, this transmitted force seats the door tightly against the gasket 78 surrounding the exit opening 2a, and holds it tight there-against.

As will more particularly hereinafter appear, it is desirable to have the rear door open initially along its top edge, and to insure its doing so, a spring actuated pin 80 is provided on the door near its bottom edge in position to be engaged by the lever link 58, as the door is being closed and forced toward the door against the resistance of its spring 82. As the crank begins its counter-clockwise movement and relieves the closing pressure exerted on the door by the link, the door continues momentarily to remain tightly closed along its bottom edge due to the force exerted by this spring 82 on pin 80 which is still engaged by the link 58. Moreover, the effect of this spring pressure on the door is to cause it to turn slightly about its bottom edge as a fulcrum, thus insuring that its top edge moves away from the gasket 78 and opens initially along this top edge.

In preparing the furnace for operation, the front door is initially closed and the other doors left open. If hydrogen is to be used as the special atmosphere, a torch (not shown) is introduced through the rear door so as to overlie the gas inlet pipe 52 which extends across a channel in the bottom of the cooled chamber nearby the intermediate door. As the hydrogen leaves the perforations of this inlet pipe and mixes with the air in the chambers the mixture is ignited by the flame of the torch and continues to burn until all the air in the chambers is used up. As soon as this burning starts, the torch is removed and the rear door moved upward and tightly closed. Very promptly the burning in the chambers comes to an end due to lack of air, and the chambers are then completely filled with the special atmosphere gas. The intermediate door is then closed.

The heated chamber may be prematurely heated or heated after being filled with the special atmosphere gas. When its desired temperature is attained the door 6 is opened and a suitable gas discharge from conduit 24 so that it will escape downward from the perforations thereof.

The front door is thus raised, the escaping gas from the conduit 24 forming an effective barrier or curtain across the door opening, and the work is then passed along the tracks 84 through this gas curtain into the heated chamber, being thoroughly bathed by the gas curtain and scavenged of any air that may be present in its recesses or hollows. The front door is then closed tightly and the work submitted to the desired heat treatment. Up-

on the completion of this treatment in the heated chamber, the intermediate door is raised, a rod is inserted through a small hole 86 in the front door, and the work is pushed into the cooled chamber, after which the push rod is removed and the intermediate door again closed. Another charge of material can now be placed in the heated chamber as heretofore described.

The work in the cooled chamber is cooled down at any desired rate, the speed of cooling being controlled by the flow of cooling water through the jacket 5 surrounding this chamber. If any condensation occurs in this chamber it runs along the floor to the end groove 88 and passes thence through drain pipe 90 to the waste pail 92. The end of this pipe is normally covered by the liquid in the pail and thus is sealed against escape of the chamber gas. When the cooling of the work is finished, the attendant begins to press downward on treadle 70. As heretofore explained, this results in an initial tipping of the door about its bottom edge, the top edge swinging outward slightly and permitting the chamber gas to escape through the crack between the top edge and the gasket 78. If this gas is combustible, as would be hydrogen when mixed with air, it is ignited by a pilot flame 94 just over the top of the door crack, and when this occurs the rear door can then be safely opened wide. This is so because the flame follows along into the cooled chamber as the entering air continues to mix with the special atmosphere, with just a normal burning in the chamber. This burning of the mixture is also beneficial in that during the burning the oxygen of the air is consumed, thus getting rid of this element before it can react with the work and effect oxidization thereof. By thus igniting the mixture as it first forms and allowing the flame to travel into the cooled chamber as the entering air continues to make contact with the special atmosphere gas, all danger of explosion is eliminated and the safe opening of the cooled chamber is realized.

After the work has been pulled from the cooled chamber, onto the track 96 the rear door is moved upward and tightly closed. Very promptly thereafter the air left in this chamber is consumed by the burning therein, and then the flame goes out leaving the cooled chamber again full of the special atmosphere gas which is being steadily supplied through the conduit 52. The described cycle of operation can now be repeated and continued indefinitely with perfect safety. The prevention of air entering the heated chamber and the initial ignition of the escaping gas from the cooled chamber successfully prevents any explosions. Moreover, the means provided for keeping the end doors tightly closed, together with the gas-tight casing about the intermediate door avoids any un-

necessary loss of the special gas and any adulteration thereof. This enables the furnace to be operated with maximum economy.

In Figures 10-12 is illustrated an entrance door 6a which moves downward in opening. It is mounted on rods 98 adapted to slide in the guides 100 and 102. A treadle 20a is attached to the bar 104 joining the lower ends of these rods and a weight 106 is arranged to act as a counterbalance. This door is provided with cam strips 10a which act in conjunction with the adjustable screws 12a to insure tight closure of the door. In order that the desired scavenging effect of a gaseous curtain may be had with a door opening downward, the conduit 24a is located on the top edge of the entrance opening as seen in Figure 10. As here shown the flow of gas to this conduit is also automatically controlled by the door movement. The gas valve 26a is provided with a lever 108 whose forked end is adapted to engage a pin 110 on the door. As the latter moves downward the lever is turned to open valve 26a. When the lever reaches the dotted position seen in Figure 11, the pin 110 can leave the slot of the forked end and continue downward with the door. When the latter rises the pin again enters the slot of the lever and causes the latter to swing so as to close the valve 26a. If a combustible gas is used for the curtain, a pilot flame 112 is kept burning near the top edge of the door. When the latter starts to open the combustible gas is ignited and thereafter acts as a barrier and with scavenging effect while the door is open.

I claim:

1. A furnace having, in combination, a heated chamber and a cooled chamber in alignment, with an entrance door at one end of the heated chamber and an exit door at one end of the cooled chamber and an intermediate door at the adjacent ends of both chambers; the said entrance door being mounted to open vertically upward and being provided at its lower edge with a gas conduit having openings therein arranged to direct a gaseous curtain downward across the door opening as the door is raised.

2. A special atmosphere furnace having, in combination, a heated chamber and a cooled chamber arranged in alignment; a conduit having openings within said cooled chamber for admission of the special atmosphere gas; an exit door at the end of the cooled chamber arranged to open downward; and means providing a flame at the top edge of said exit door whereby upon the door being opened, the initial mixture of the special atmosphere gas and air is ignited, and can thereafter burn without explosion as the said door is further opened.

3. A special atmosphere furnace having, in combination, two chambers in alignment; means associated with one of said chambers to heat it and means associated with the other

of said chambers to cool it; a conduit having openings within one of said chambers for admission of the special atmosphere gas; a door at the entrance of the heated chamber
 5 arranged to open vertically upward and having a perforated gas conduit along its bottom edge whereby a gaseous curtain can be projected downward across the opening of said doorway upon the door being raised and
 10 thereby prevent the escape of said special atmosphere gas and the ingress of air to said heated chamber.

4. A special atmosphere furnace having, in combination, a heated chamber and a cooled
 15 chamber in alignment; means for introducing special atmosphere gas to said chambers; a door at the entrance end of said furnace arranged to open vertically upward and having means at its bottom edge to provide a gaseous
 20 curtain across the door opening and thereby prevent escape of the special atmosphere gas therethrough; a gas tight casing connecting the adjacent ends of said chambers; an intermediate door mounted in said casing and
 25 adapted to be moved therein and having connection with means outside said casing whereby its movements can be effected; a door at the exit end of said furnace arranged to move vertically downward in opening; and means
 30 at the upper edge of the last mentioned door for effecting ignition of the initial gas and air mixture consequent upon the first opening of this door, whereby the subsequently formed mixture of said gas and air will burn
 35 without explosion as the said exit door is further opened.

5. A furnace having a chamber adapted to receive material for heat treatment, a door at the entrance of said chamber arranged to
 40 move vertically upward in opening; and a gas conduit at the lower edge of said door with outlets disposed to project a gaseous curtain downward across the said entrance when the door is opened.

6. A furnace having a chamber adapted to receive material for heat treatment; a door at the exit end of said chamber arranged to move vertically downward in opening; and means for moving said door comprising a link
 50 pivotally connected to said door, a crank pivotally connected to said link, and a weight acting upon said crank tending to rotate it, and means causing said link and crank to assume an integral relation as they are moved
 55 to close said door, whereby the tendency of said crank to rotate is transmitted to said door so as to press it against its seat.

7. A furnace having a chamber adapted to receive material for heat treatment; a door
 60 at the exit end of said chamber arranged to move vertically across said exit in opening and in closing; and means for so moving said door comprising a weight and interconnected linkage whereby the force of said weight
 65 after acting to move said door to closed posi-

tion thereafter acts to press said door tightly against its seat.

8. A furnace having a chamber adapted to receive material for heat treatment; a door at the exit end of said chamber arranged to
 70 move vertically across said exit in opening and in closing; means holding said door tightly to its seat comprising a yieldable member near one edge thereof; said member being adapted upon the release of said hold-
 75 ing means to cause said edge to remain tight and the opposite edge of said door to open initially.

9. A furnace having a chamber adapted to receive material for heat treatment and hav-
 80 ing an opening; a door arranged to move vertically across said opening under the force of gravity; and cam means associated with the door and adapted to apply the force tendency to move said door across said opening
 85 as a force holding said door tightly against the edge of said opening.

10. A furnace having a chamber adapted to receive material for heat treatment, a door at the entrance of said chamber arranged to move vertically upward in open-
 90 ing; a gas conduit at the lower edge of said door with outlets disposed to project a gaseous curtain downward across the said entrance when the door is opened; and means controlled in accordance with the movement
 95 of said door and governing the flow through said conduit.

11. A special atmosphere furnace having in combination, a chamber; means for the
 100 admission of special atmosphere gas to said chamber; an exit door at one end of said chamber arranged to open downward; and means providing a flame at the top edge of said exit door whereby upon the door being
 105 opened the initial mixture of the special atmosphere gas and air is ignited, and can thereafter burn without explosion as the said door is further opened.

12. A furnace having, in combination, a
 110 heated chamber and a cooled chamber in alignment; means for introducing special atmosphere gas to said chambers; an entrance door at one end of the heated chamber; an exit door at one end of the cooled
 115 chamber; the said doors being arranged to move vertically downward when opening; and means providing a flame at the top edge of one of said doors whereby upon the door being opened, the initial mixture of the
 120 special atmosphere gas and air is ignited and can thereafter burn without explosion as the said door is further opened.

13. A special atmosphere furnace having a chamber adapted to receive material for
 125 heat treatment; a conduit arranged to introduce a combustible gas within said chamber; an opening at one end of said chamber; a door for closing said opening arranged to move vertically downward thereacross in
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opening; and means providing a flame near the top edge of said opening whereby upon the door being opened the mixture of said combustible gas and air is ignited and can thereafter burn without explosion as the said door is further opened.

14. A furnace having a chamber adapted to receive material for heat treatment; a door at the entrance of said chamber arranged to move vertically downward across said entrance in opening; and a gas conduit extending across the entrance at its upper edge having outlets disposed to project a gaseous curtain downward across the said entrance when the door is opened.

15. A furnace having a chamber adapted to receive material for heat treatment; a door at the entrance of said chamber arranged to move vertically downward across said entrance in opening; a gas conduit at the upper edge of said entrance having outlets disposed to project a gaseous curtain downward across said entrance when the door is opened; a valve controlling the flow of gas in said conduit; and control means actuated by the movement of said door for opening and closing said valve.

16. A furnace having a chamber adapted to receive material for heat treatment; a door at the entrance of said chamber arranged to move vertically downward in opening; a gas conduit at the upper edge of said entrance having outlets disposed to project a gaseous curtain downward across said entrance when the door is opened; means over-balancing the weight of said door and adapted to held the door closed; means whereby the force of the last said means may be overcome and the door locked in open position.

Signed at Attleboro, Massachusetts, this 17th day of April 1930.

JEWETT F. SCHRUM.

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