

Dec. 15, 1936.

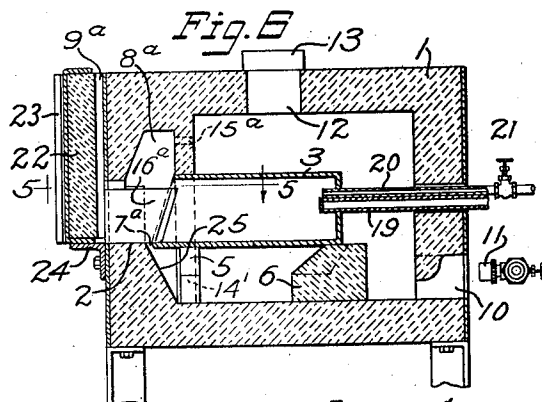
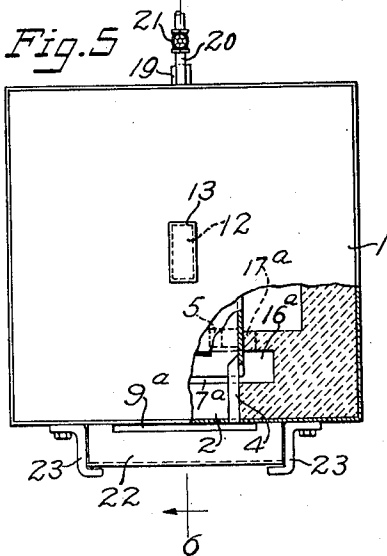
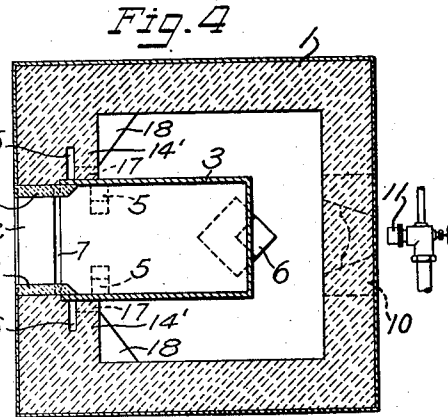
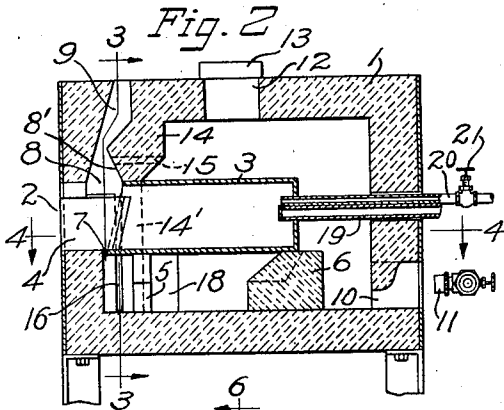
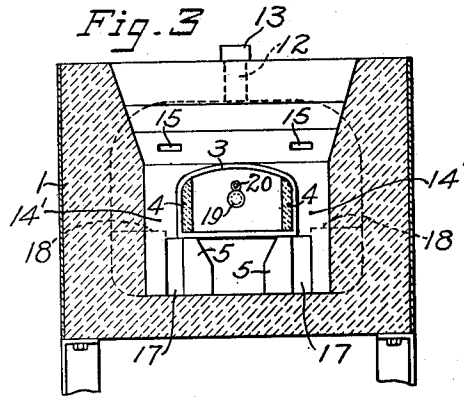
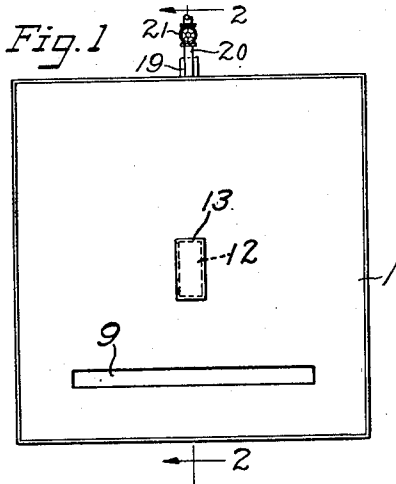
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2,064,532

HEAT TREATING FURNACE

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2 Sheets-Sheet 1



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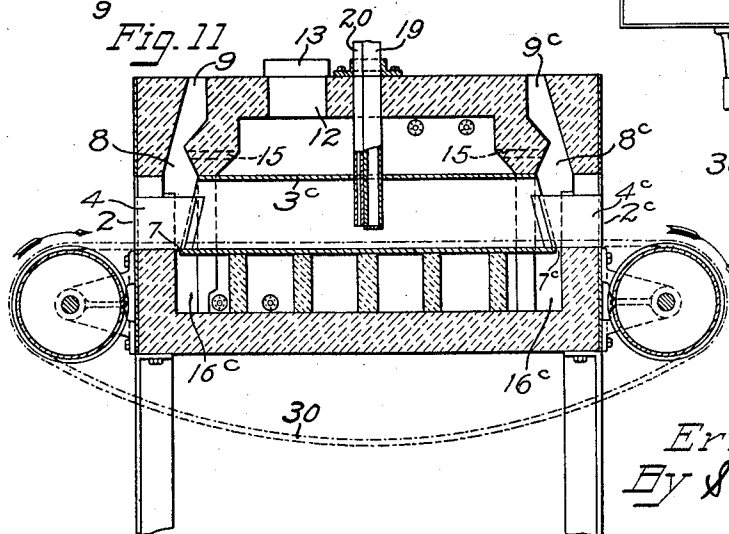
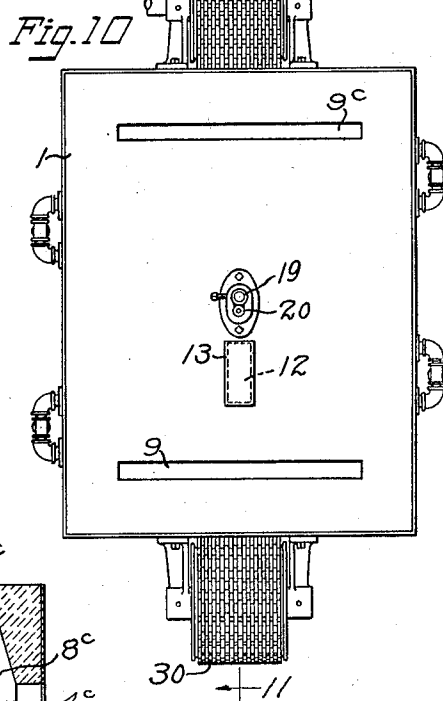
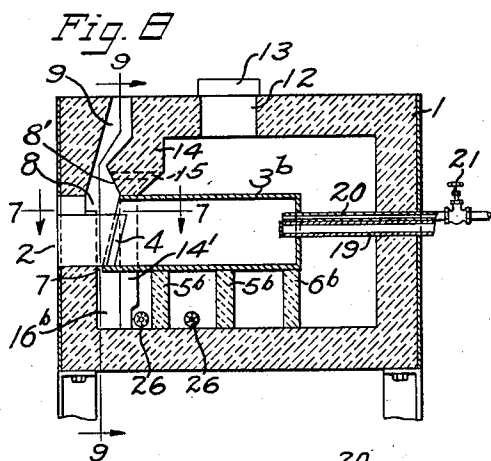
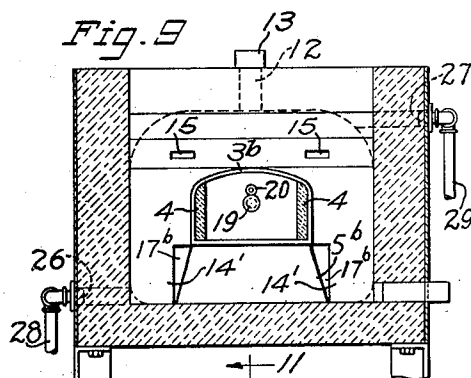
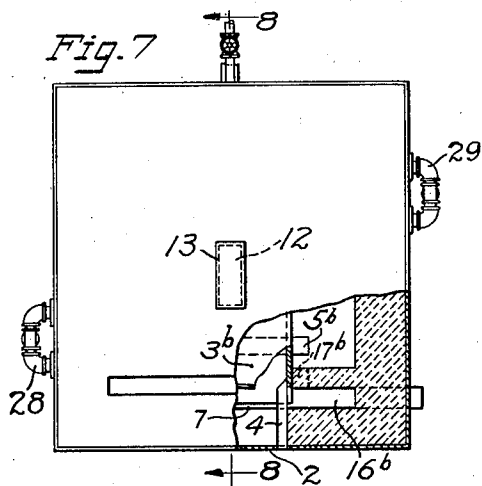
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HEAT TREATING FURNACE

Filed Dec. 24, 1931

2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE

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HEAT TREATING FURNACE

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Application December 24, 1931, Serial No. 582,997

22 Claims. (Cl. 263—42)

The general object of the invention is to eliminate or reduce to a minimum oxidation or other deleterious chemical effects upon the steel or other material being treated. This result is attained not only by controlling the chemical content of the atmosphere within the work containing or heating chamber of the furnace, but also by maintaining the said atmosphere in a substantially quiescent condition. The invention is applicable to various types of heat treating furnaces, but for reasons which will presently appear it is specially applicable to a fuel heated furnace.

In the heat treatment of metals it has long been recognized that atmospheric air should be excluded from the heating chamber; and it has heretofore been common practice to provide a furnace having a heating chamber which is open at the front for the introduction and removal of the work and which is otherwise closed so as to exclude the surrounding gases, and to provide a curtain of upward moving hot gases across the passageway at the front of the chamber to thus prevent, at least in part, the entry of atmospheric air into the chamber.

Even when the atmosphere in the heating chamber is substantially free from uncombined oxygen, chemical reactions may take place between the ambient gases and the steel or other material being heated. This fact is well exemplified by the common practice of introducing into the heating chamber sufficient proportion of carburizing gases to prevent decarburization, and by the practice of introducing neutral gases for the purpose of preventing or at least minimizing chemical reaction between the chamber atmosphere and the material being heated. Only limited success has attended these attempts to adjust or control the atmospheric content of the heating chamber in such a way as to prevent chemical action. This lack of success has been due in part to the variations in chemical activity resulting from changes in temperature, and has also been due in part to the difficulty of accurately controlling the composition of the chamber atmosphere, particularly when the said atmosphere in accord with common practice comprises burning gases and the end products of combustion.

While it has been recognized that air or other gases containing free oxygen should be excluded from the heating chamber, and while it has been recognized that the atmospheric content of the chamber may be otherwise controlled to minimize chemical activity, little or no consideration has been given to the fact that the atmosphere in

the chamber regardless of its composition should be maintained in a substantially tranquil or quiescent state. Observation of steels at elevated temperatures has disclosed the fact that little or no chemical activity takes place when the ambient atmosphere is substantially quiescent, even though the said atmosphere may contain chemically active constituents such as oxygen, hydrogen, sulphur compounds and the like. This is believed to be due to a protective gaseous envelope which surrounds the work and which is either exuded from the steel or is formed by chemical reaction between the steel and the gaseous atmosphere. This protective envelope is effective only when the ambient atmosphere is quiescent and it is disturbed and made ineffective by even a slight degree of motion or turbulence.

Heretofore, in heat treating furnaces utilizing atmospheric control, the neutral gases or the more or less controlled gases of combustion have been freely and continuously introduced into the heating chamber in large quantities, thus causing and maintaining a high degree of turbulence with resulting extensive chemical activity, which activity was particularly great when there was any considerable departure from a condition of chemical equilibrium. This sustained turbulence has prevented the functioning of the protective gaseous envelope heretofore described, and has made necessary an accuracy of atmospheric control which has been impossible of attainment.

In accordance with the present invention I very completely exclude atmospheric air from the heating chamber of the furnace, and I accomplish this result in such a way that the atmosphere within the furnace is disturbed to a minimum extent and is allowed to remain in a substantially tranquil quiescent condition, thus permitting the protection of the metal by the inherent auto-protective action already described.

For the purpose of controlling the atmospheric content of the working chamber it has been heretofore proposed, particularly in conjunction with electrically heated furnaces, to provide a fuel burner of one type or another at or near the front opening to the working chamber so as to deliver a curtain of moving burning or burned gases, which curtain extends across the opening and, to a greater or less extent, prevents the entry of atmospheric air into the chamber, but introduces other gases.

In accordance with prior practice a large portion of the gases constituting the protective curtain has been guided directly into the heating chamber, thus causing a continuous and sus-

tained turbulence therein; but in accordance with the present invention the gases of the gaseous curtain are so guided and controlled that they are prevented from entering the heating chamber to any considerable extent, thus leaving the atmosphere in the chamber substantially quiescent, with the resultant advantages already pointed out.

It is generally recognized that electrically heated furnaces have certain important advantages, but that such furnaces are nevertheless subject to the rather serious disadvantage that the initial cost and the cost of operation and maintenance are considerably greater than for fuel heated furnaces of equal capacity. The present invention may be advantageously incorporated in a furnace of the less expensive and more economical fuel heated type, and in accordance with one phase of the invention the products of combustion from the fuel are directed, guided and controlled so as to serve in and of themselves as the means for preventing the entry of deleterious gases into the working chamber, and so as to otherwise serve to reliably and efficiently control the atmospheric condition within the said chamber. In accordance with my invention I not only attain the advantages that are inherent in a fuel heated furnace, but I am enabled to also provide without additional expense of operation a means of atmospheric control which is much more effective and reliable than is any means heretofore provided for this purpose.

A further object of the invention is to provide in combination with the means for excluding atmospheric air and other deleterious gases, a means for introducing into the muffle suitable selected gases adapted to chemically combine with or effect a neutral reaction upon the work being heated and treated.

Still another object of the invention is to provide a furnace of the type referred to having openings at opposite ends of the muffle or working chamber so that the work to be treated can be introduced at one end and removed at the other end. This construction makes it possible for a conveyor to be extended through the muffle so that the work can be moved continuously therethrough.

Other objects of the invention will be apparent from the following specification and claims.

In the accompanying drawings I have shown alternative constructions adapted for attaining the foregoing and other objects. The drawings show furnaces of the fuel heated type, but as to its broader phases the invention is not so limited. It will be understood that the drawings are intended for illustrative purposes only and are not to be construed as defining or limiting the scope of the invention, the claims forming a part of this specification being relied upon for that purpose.

Of the drawings:

Fig. 1 is a plan view of a furnace embodying the invention.

Fig. 2 is a vertical longitudinal sectional view taken along the line 2—2 of Fig. 1.

Fig. 3 is a vertical transverse sectional view taken along the line 3—3 of Fig. 2.

Fig. 4 is a horizontal sectional view taken along the line 4—4 of Fig. 2.

Fig. 5 is a combined plan and sectional view showing an alternate embodiment of the invention, the section being taken along the line 5—5 of Fig. 6.

Fig. 6 is a vertical longitudinal sectional view taken along the line 6—6 of Fig. 5.

Fig. 7 is a combined plan and sectional view showing a second alternate embodiment of the invention, the section being taken along the line 7—7 of Fig. 8.

Fig. 8 is a vertical longitudinal sectional view taken along the line 8—8 of Fig. 7.

Fig. 9 is a vertical transverse sectional view taken along the line 9—9 of Fig. 8.

Fig. 10 is a plan view of a furnace embodying the invention and having openings therein at opposite ends.

Fig. 11 is a vertical longitudinal sectional view taken along the line 11—11 of Fig. 10.

Referring first to Figs. 1 to 4 of the drawings, 1 represents as an entirety the external casing of the furnace, which casing is lined with fire brick or other heat resisting and insulating material. The front wall of the furnace is provided with an opening or passageway 2 through which work to be heated is put in place and removed. Mounted within the furnace is a muffle or heating chamber 3, the front end of which is open and is in register with the passageway 2 in the front wall. It will be observed that, except for the front, the heating chamber 3 is substantially completely closed so as to exclude surrounding gases from the interior thereof. Preferably cheek pieces 4, 4 are provided at the sides of the passageway 2, these cheek pieces constituting inward extensions of the passageway and engaging the side walls of the muffle. The muffle is supported on pedestals 5, 5 and 6 which project upward from the floor of the furnace.

In accordance with the invention there is provided a source of hot gases, which gases are ordinarily gases of combustion. Communicating with the said source of hot gases is a duct which terminates in a narrow transverse slot in one wall of the passageway and thus causes a curtain of the said hot gases to continuously move across the passageway 2 at the front of the heating chamber. Ordinarily the slot extends across the bottom of the passageway as indicated at 7 and the gases move upward; but as to this I do not limit myself. As shown the muffle or heating chamber 3 is mounted in spaced relation with the front wall of the furnace, the said slot 7 being formed between the muffle and the said wall. The hot gases directed through the slot 7 move upward as aforesaid and thus form a gaseous curtain at the front of the heating chamber. This curtain, particularly when it consists of gases of combustion, serves to prevent oxygen or other gases from the external air from entering the heating chamber.

In order to definitely regulate and control the gases delivered through the slot 7 I provide means associated with the wall of the passageway opposite the said slot 7 for substantially preventing the movement of the curtain gases into the heating chamber. Preferably and as shown the said means comprises a recess 8 in the wall of the passageway opposite the slot 7, and when the said slot is at the bottom as shown the recess 8 is at the top of the passageway. This recess 8 is so positioned and so formed as to be adapted for receiving the upward moving hot gases, and it prevents the said gases, or any substantial portion of them, from being deflected or diverted inward into the heating chamber. Preferably the width of the recess 8 is considerably greater than the width of the slot 7, thus permitting the gases to freely enter notwith-

standing expansion that may have taken place as the gases travelled across the passageway. It will be observed that the inner wall 8' of the recess 8 constitutes a transverse baffle facing outward away from the chamber and that this baffle serves to engage the gases and prevent their movement horizontally into the chamber. In this way the inherent turbulence of the gases constituting the curtain is substantially confined to the outside of the heating chamber, thus assuring approximate tranquility and quiescence within the said chamber.

Preferably in addition to the recess 8 I provide an exhaust outlet 9 for carrying the hot gases away from the passageway 2. As shown in Figs. 1 to 4 the exhaust outlet 9 communicates directly with the recess 8 and extends upward therefrom. The exhaust outlet may, however, be otherwise located as will be presently explained.

When the exhaust outlet 9 communicates directly with the recess 8 as shown in Figs. 1 to 4 the initial duct terminating in the said slot 7, the said recess 8 and the said exhaust outlet 9, may be considered collectively as constituting an interrupted flue having portions thereof oppositely positioned with respect to the passageway 2 and serving to conduct hot gases across the passageway in front of the heating chamber. As already stated the recess 8 is of considerably greater width than the slot 7, thus permitting the gases of the curtain to expand. This free expansion of the gases relieves any pressure which might otherwise be formed in front of the heating chamber. Preferably and as shown the walls of the recess 8 converge, thus giving increased velocity to the upward moving gases, and the walls of the outlet 9 immediately above the recess diverge, thus giving decreased velocity to the said gases. The gases are thus given a relatively high velocity and a reduced pressure at the zone between the recess 8 and the outlet 9.

The gaseous curtain not only serves to prevent the admission of deleterious external gases, but it probably also serves to form a slight vacuum in the heating chamber.

Preferably and as already stated the furnace is heated by the direct combustion of fuel therein. To this end the rear wall of the furnace is provided with an opening 10 at which is located a burner 11 through which liquid or gaseous fuel may be projected into the interior of the furnace. Preferably there is provided at the top of the furnace an opening 12 which may be used for ignition purposes when a gaseous fuel is used. If liquid fuel is used it may be ignited directly at the burner 11. Ordinarily the opening 12 is closed by a removable cap 13. It will be observed that the main walls of the furnace constitute a combustion chamber which is separate from the heating chamber but which is so positioned that the heat of combustion is transmitted to the heating chamber. As shown the combustion chamber substantially surrounds the heating chamber except at the front thereof.

The main combustion chamber of the furnace preferably constitutes the source of the hot gases which are delivered in such a way as to form a gaseous curtain at the front as already described. Preferably the gases are delivered at the bottom through a slot such as that at 7. To this end the combustion chamber is formed with a portion which extends forward under the heating chamber and which may be regarded as a duct terminating in the before-mentioned slot 7. A wall 14

separates the recess 8 and the outlet 9 from the combustion chamber, this wall extending downward at the sides as indicated at 14', 14'. I have already pointed out that the gas passages at the front may be regarded as collectively constituting an interrupted flue, and thus takes the place of the conventional exhaust flue. It will be apparent that this flue at the front communicates with the combustion chamber and serves to conduct the hot exhaust gases from the combustion chamber across the passageway 2 in front of the heating chamber 3, thus forming a curtain of moving hot gases.

When the hot gases of combustion are supplied through the slot 7 at a rate less than normal they may fail to sufficiently protect the interior of the heating chamber from the entry of external gases. This may happen when the fuel burner is adjusted to provide only a very low heat. Under these circumstances it is preferable to provide a supplemental supply of gas at the side of the passageway 2 opposite the slot 7, that is, in the present instance, at the top of the passageway. The gases so supplied at opposite sides of the passageway will cooperate with each other to provide a body of moving protective gases at the front of the heating chamber. As a result of the additional protection provided by the gases supplied at the top it is possible to reduce the temperature within the heating chamber without any infiltration of external gases.

When the gases are drawn from the main combustion chamber as is preferred I supply the said gases to the top of the passageway 2 by means of secondary ducts 15, 15 which extend substantially horizontally through the wall 14 and which terminate at the front in the recess 8. When the furnace is operating in a normal manner the secondary ducts 15, 15 are less important.

Ordinarily it is unnecessary, and in fact impracticable, to cause all of the gases of combustion to flow through the narrow slot 7. Some of the remaining gases may pass through the secondary ducts 15, 15; but I preferably also provide auxiliary ducts 16, 16 which are located adjacent the respective sides of the passageway 2. These auxiliary ducts 16, 16 communicate with the lower portion of the combustion chamber by means of slots 17, 17 and they extend to and merge with the recess 8. The gases are guided into the slots 17, 17 by triangular deflectors 18, 18.

At 19 I have shown a tube extending through the rear wall of the furnace and also through the rear wall of the muffle or heating chamber 3. This tube may be used for the introduction of a thermocouple of any usual or preferred construction.

In addition to the tube 19 referred to I may also provide a pipe 20 which also extends through the rear wall of the furnace and through the rear wall of the muffle or heating chamber 3. The pipe 20 is provided with a valve 21 and the pipe may be connected with any suitable source of gas. By means of the pipe 20 any selected gas of predetermined character may be admitted to the interior of the heating chamber, the rate of admission being controlled by the valve 21 or other suitable controlling device. The gas so admitted will contact the material in the furnace, the type of reaction being dependent upon the gas used, upon the material being treated and upon the temperature involved. The introduction of a selected gas in the manner described becomes practicable by reason of the fact that the entry of deleterious gases at the front

may be substantially prevented by properly regulating the gaseous curtain in the manner already described. The maintenance of a slight vacuum within the heating chamber facilitates the flow of the selected gas thereinto and also causes the gradual withdrawal of the selected gas at the front, thereby insuring an undiluted atmosphere of the said gas.

With a gaseous protective curtain formed as herein described it is ordinarily unnecessary to provide a door for closing the front end of the passageway to the heating chamber. If desired however a door may be provided, and in Figs. 5 and 6 I have shown an alternative construction which includes a door. The construction of the furnace is, in the main, similar to that shown in Figs. 1 to 4, and a complete detailed description is unnecessary. At the front of the furnace there is provided a door 22 which is vertically movable in guideways 23, 23. In its lowermost position the door rests upon a shelf 24. In the construction as shown in Figs. 5 and 6 there is provided a recess 8^a which is similar to the recess 8 but which is entirely closed at the top except for auxiliary ducts 15^a leading from the main combustion chamber. The exhaust outlet 9^a, instead of extending directly from the top of the recess 8^a, is located in front of the said recess communicating directly with the passageway 2 at the front of the recess. Preferably and as shown the outlet 9^a is formed as a depression in the rear face of the door 22, the passageway thus being positioned between the said door and the main front wall of the furnace.

Gases are guided to the slot 7^a by means of a beveled deflector 25. Gases are also permitted to rise at the sides of the front passageway through auxiliary ducts 16^a, 16^a. Slots 17^a, 17^a are provided to facilitate the entry of gases into these auxiliary ducts.

The operation of the furnace shown in Figs. 5 and 6 is substantially the same as already described, with the single exception that the gases instead of flowing directly upward from the recess 8^a circulate through the said recess and then forward along the top wall of the passageway 2 to the exhaust outlet 9^a.

In Figs. 7 to 9 I have shown a construction which is similar to that shown in Figs. 1 to 4 and which differs therefrom primarily in the arrangement of the fuel burners. This construction is intended primarily for the use of gaseous fuel and instead of a single burner 11 at the rear there are provided multiple burners located at the sides. As shown there are two burners 26, 26 located at the left side of the furnace near the bottom. Similar burners 27, 27 are located at the right side near the top. Gas is supplied to these burners through piping indicated at 28 and 29. The gases of combustion from the said burners 26 and 27 tend to circulate circumferentially around the muffle 3^b and in order to permit such free circulation the muffle is supported upon narrow slabs 5^b, 5^b and 6^b. The flue construction at the front for the passage of gases is similar to that already described and repetition of the description is unnecessary. It will be observed that the auxiliary ducts 16^b, 16^b at the sides are considerably larger than the ducts 16, 16 before described.

In Figs. 10 and 11 I have shown a construction similar to that shown in Figs. 1 to 4, with the exception that the muffle 3^c is open at both ends, similar passageways 2 and 2^c being provided in communication with the said open ends. The flue constructions at both ends of the furnace may

be the same as already described, and a repetition of the detailed description is therefore unnecessary.

With a furnace construction as shown in Figs. 10 and 11 it is possible for the articles to be treated to be moved longitudinally through the muffle, being inserted through one passageway, as for instance the passageway 2, and being discharged through the opposite passageway, as for instance the passageway 2^c. The gaseous curtains such as already described prevent the admission of deleterious gases at either end of the muffle.

When the furnace is constructed with two open ends as shown it may be provided with a conveyor having an endless link belt such as 30 extending through the muffle. This belt can be connected with any suitable source of power so as to be moved at the desired rate in the direction indicated. The articles to be treated can be placed on the belt at the entrance end and will then be carried through the heating chamber and finally removed or discharged at the opposite end.

What I claim is:

1. In a heat treating furnace having a heating chamber and a passageway at the front communicating with the heating chamber, the combination of a duct adapted for supplying hot gases and terminating in a narrow transverse slot extending across the bottom of the passageway so as to form a curtain of upward moving gases at the front of the heating chamber, and means additional to the said duct and slot for supplying hot gases at the top of the passage above the slot.

2. In a heat treating furnace having a heating chamber and a passageway at the front communicating with the heating chamber, the combination of a duct adapted for supplying hot gases and terminating in a narrow transverse slot extending across the bottom of the passageway so as to form a curtain of upward moving gases at the front of the heating chamber, a recess provided at the top of the passageway above the duct adapted for receiving the said upward moving hot gases and having a width greater than the width of the slot, and means additional to the said duct and slot for supplying hot gases to the said recess.

3. In a heat treating furnace having a heating chamber and a passageway at the front communicating with the heating chamber, the combination of a duct adapted for supplying hot gases of combustion and terminating in a narrow transverse slot extending across the bottom of the passageway so as to form a curtain of upward moving gases at the front of the heating chamber, a recess being provided at the top of the passageway above the duct adapted for receiving the said upward moving gases, and an upward extending exhaust outlet separate from the recess and communicating with the passageway at the front of the said recess.

4. A heat treating furnace as set forth in claim 3, wherein there is a movable door at the front end of the passageway, and wherein the said exhaust outlet is formed between the door and the front wall of the furnace.

5. A heat treating furnace comprising in combination, a heating chamber, a passageway at the front communicating with the heating chamber, and an interrupted flue for conducting hot gases of combustion, which flue includes a supply duct terminating in a narrow transverse slot extending across the bottom of the passageway and also includes a recess at the top of the passageway which is of considerably greater width than the

said slot so as to permit the said gases to expand therein.

6. A furnace as set forth in claim 5, wherein the walls of the recess converge thus giving increased velocity to the upward moving gases, and wherein the walls of the flue above the recess diverge thus giving decreased velocity to the said gases.

7. A furnace as set forth in claim 5, wherein there is a second duct for supplying additional hot gases of combustion to the said recess.

8. A heat treating furnace comprising in combination, a heating chamber, a passageway at the front communicating with the heating chamber, a combustion chamber separate from the heating chamber but positioned so that the heat of combustion is transmitted to the said heating chamber, a duct communicating with the combustion chamber and terminating in a narrow transverse slot extending entirely across the said passageway, the said duct serving to conduct the hot gases of combustion from the combustion chamber to the passageway so as to form a moving gaseous curtain at the front of the heating chamber, and means for supplying additional hot gases from the combustion chamber to the passage at a position opposite the slot.

9. A heat treating furnace comprising in combination, a heating chamber, a passageway at the front communicating with the heating chamber, a combustion chamber substantially surrounding the heating chamber except at the front, a duct communicating with the combustion chamber and terminating in a narrow transverse slot extending entirely across the bottom of the said duct serving to conduct the hot gases of combustion to the passageway so as to form an upward moving gaseous curtain at the front of the heating chamber, and auxiliary ducts communicating with the lower portion of the combustion chamber and extending upward adjacent the respective sides of the passageway.

10. The combination in a heat treating furnace, of a heating chamber, a passageway at the front communicating with the heating chamber, a combustion chamber separate from the heating chamber but positioned so that the heat of combustion is transmitted to the said heating chamber, a duct communicating with the combustion chamber and terminating in a narrow transverse slot extending across the bottom of the passageway so as to form a curtain of upward moving gases at the front of the heating chamber, a recess being formed at the top of the passageway above the duct for receiving the said upward moving gases, and a second duct communicating with the combustion chamber and terminating directly in the recess.

11. The combination in a heat treating furnace, of a heating chamber, a passageway at the front communicating with the heating chamber, a combustion chamber substantially surrounding the heating chamber except at the front, and an interrupted flue communicating with the combustion chamber and including a supply duct terminating in a narrow transverse slot extending across the bottom of the passageway, the said flue also including a recess at the top of the passageway which is of considerably greater width than the said slot thereby permitting the said gases to expand therein.

12. A furnace as set forth in claim 11, wherein there is a second duct communicating with the combustion chamber and terminating directly in the recess.

13. A furnace as set forth in claim 11, wherein there are auxiliary ducts communicating with the lower portion of the combustion chamber, the said auxiliary ducts extending upward adjacent the respective sides of the passageway and terminating in the said recess.

14. In a heat treating furnace having a heating chamber and a passageway at the front communicating with the heating chamber, the combination of an interrupted flue having separated portions positioned with the passageway between them so as to serve to conduct a curtain of hot gases of combustion across the passageway in front of the heating chamber, which curtain excludes deleterious gases from the external atmosphere, and means for supplying directly to the interior of the heating chamber a gas of predetermined character adapted to contact the articles being treated.

15. In a heat treating furnace having a heating chamber and a passageway at the front communicating with the heating chamber, the combination of a combustion chamber separate from the heating chamber but positioned so that the heat of combustion is transmitted to the said heating chamber, an interrupted flue communicating with the combustion chamber and having portions below and above the passageway, the said flue serving to conduct a curtain of hot exhaust gases from the combustion chamber across the passageway in front of the heating chamber, which curtain excludes deleterious gases from the external atmosphere, and means for supplying directly to the interior of the heating chamber a gas of predetermined character adapted to contact the articles being treated.

16. A heat treating furnace comprising in combination, a heating chamber, two similar passageways communicating with the heating chamber at opposite ends thereof, two ducts adapted for supplying hot gases of combustion and terminating in narrow transverse slots extending across the respective passageways so as to form curtains of moving gases, two recesses being formed in the walls of the respective passageways opposite the ducts for receiving the said upward moving gases, and two exhaust outlets adapted to receive the gases discharged from the respective recesses.

17. A heat treating furnace comprising in combination, a heating chamber, two passageways communicating with the heating chamber at opposite ends thereof, a combustion chamber separate from the heating chamber but positioned so that the heat of combustion is transmitted to the said heating chamber, and two ducts communicating with the combustion chamber and terminating in narrow transverse slots extending entirely across the respective passageways, the said ducts serving to conduct the hot gases of combustion from the combustion chambers to the passageways so as to form moving gaseous curtains positioned across the passageways.

18. A heat treating furnace comprising in combination, a heating chamber, two passageways communicating with the heating chamber at opposite ends thereof, a combustion chamber separate from the heating chamber but positioned so that the heat of combustion is transmitted to the said heating chamber, and two interrupted flues communicating with the combustion chamber and having portions below and above the respective passageways, each flue serving to conduct a curtain of hot exhaust gases

from the combustion chamber across the corresponding passageway.

19. In a heat treating furnace having a front passageway communicating with a heating chamber which is otherwise substantially completely closed to exclude surrounding gases from the interior thereof, the combination of a transverse baffle associated with one wall of the passageway and having a surface facing outward away from the chamber, and means extending across the opposite wall of the passageway for projecting a curtain of moving hot combustion gases transversely of the passageway and along the said outward facing surface of the baffle.

20. In a heat treating furnace, the combination of a heating chamber which is open at the front and which is otherwise substantially completely closed to exclude surrounding gases from the interior thereof, and walls forming a passageway communicating with the open front of the heating chamber, the bottom of the passageway having a slot therein extending from side to side for projecting upward across the passageway a transverse curtain of moving hot combustion gases to thereby exclude atmospheric air from the chamber and the top of the passageway having a recess therein extending from side to side for receiving the said gases and substantially preventing movement thereof into the chamber.

21. In a heat treating furnace, the combination of a heating chamber which is open at the front and which is otherwise substantially com-

pletely closed to exclude surrounding gases from the interior thereof, and walls forming a passageway communicating with the open front of the heating chamber, the bottom of the passageway having a slot therein extending from side to side for projecting upward across the passageway a transverse curtain of moving hot combustion gases to thereby exclude atmospheric air from the chamber and the top of the passageway having a gas-receiving recess therein opposite the slot and extending from side to side and having a width considerably greater than that of the slot.

22. In a heat treating furnace, the combination of a muffle which is open at the front and which is otherwise substantially completely closed to exclude surrounding gases from the work containing chamber thereof, the front edges of the muffle being inclined upward and rearward, and walls forming a passageway communicating with the open front of the muffle, a transverse slot being formed between the bottom walls of the passageway and muffle for projecting upward across the passageway a transverse curtain of moving hot combustion gases to thereby exclude atmospheric air from the chamber and there being a transverse recess in the top of the passageway immediately adjacent the top wall of the muffle and wider than the said slot which recess is adapted for receiving the said gases and substantially preventing movement thereof into the chamber.

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