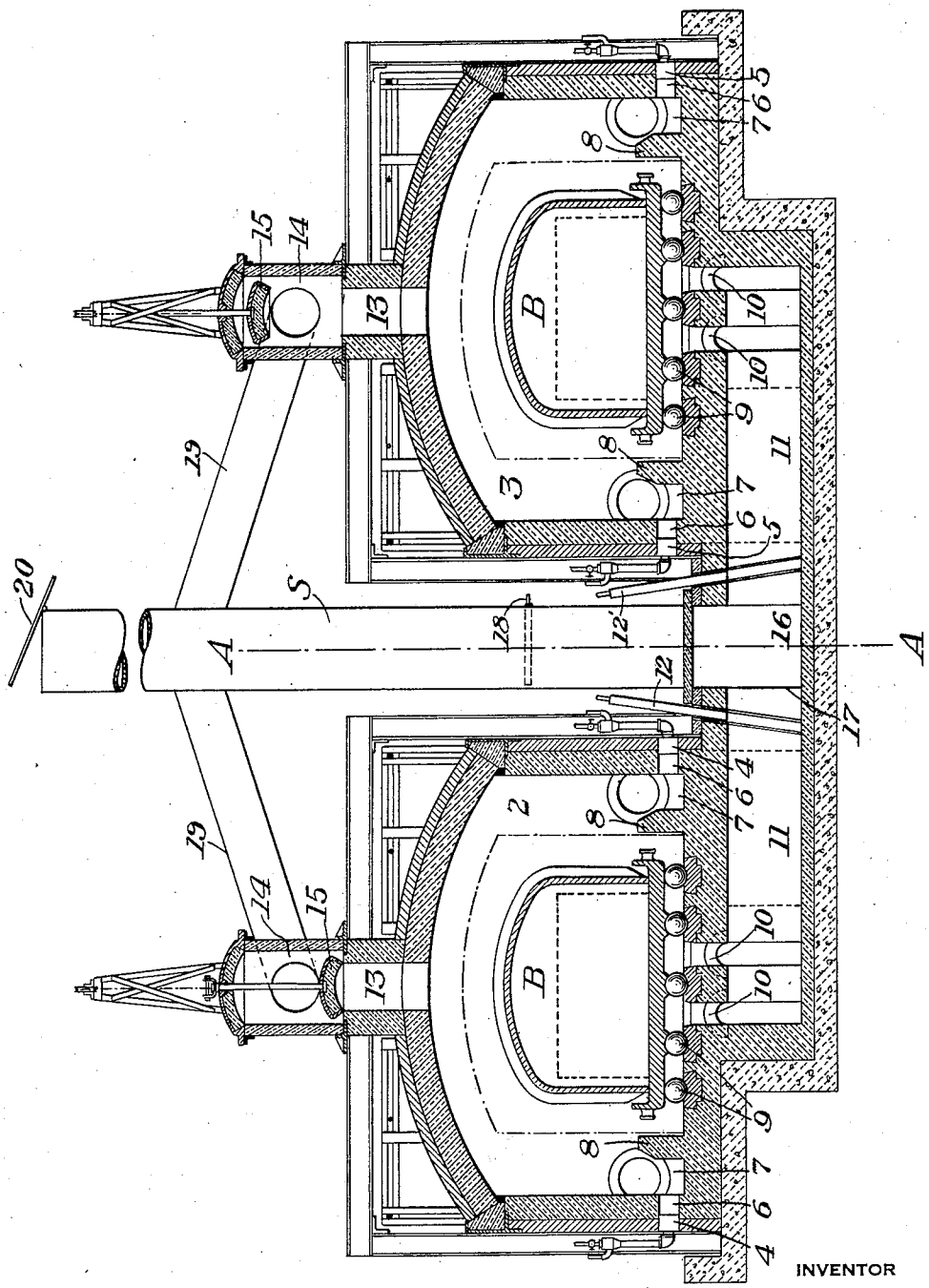
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FURNACE AND METHOD OF OPERATING THE SAME

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FURNACE AND METHOD OF OPERATING THE SAME

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The present invention relates broadly to the art of heat exchange, and in the embodiment herein illustrated, is directed toward a furnace adapted to heat metals and the like by substantially surrounding them by a gaseous envelope. In this respect it is particularly adapted to the annealing of sheets, plates and the like, and will hereinafter be described in such connection, although it will be understood that the utility of the invention is not limited to its particular use or application.

In the art of annealing, several serious problems present themselves. In the first place, it is necessary to accurately control the maximum temperature if any uniformity of characteristics in successive batches of metal being annealed is to be obtained. It is also necessary to effect the heating in such manner that one portion of the metal being annealed is not brought to its full temperature too much in advance of the remaining portions, inasmuch as this results in holding the portion first heated at a soaking temperature while the remainder of the charge is being brought up to temperature. This results in articles each of which has different characteristics and qualities in different portions.

The present invention provides an improved furnace structure and method of operating the same, whereby not only is heating effected with a material saving in fuel, but with much greater uniformity. This results in an improved product at a less cost.

The figure of the drawing shows somewhat diagrammatically one embodiment of my invention particularly adapted for the heating of annealing boxes. In the drawing there is shown a structure such as to be substantially symmetrical on opposite sides of a vertical transverse plane including the line A—A. This construction provides heating chambers 2 and 3 of similar construction.

The heating chambers are provided with burners 4 and 5, respectively, which are preferably of the natural gas burning type, although other types of fuel may be utilized. The burners are conveniently arranged on opposite sides of the heating chambers, and discharge thereinto through ports 6. All of the ports on a given side of a furnace communicate with a common mixing and combustion chamber 7 defined on one side by the furnace wall, on the bottom by the furnace bottom, and on the opposite side by a bridge wall 8, effective for distributing the flames and products of combustion and initially deflecting them upwardy into the upper portions of the respective heating chambers.

Each of the heating chambers is herein illustrated as having its bottom shaped to receive rolling supports 9 for an annealing box B within which is placed the charge to be annealed.

Extending through the furnace bottoms are flues 10 communicating with a conduit 11, common to the two heating chambers. This conduit is provided with controlling valves 12 and 12′ adapted to be closed to cut off communication between the two chambers, or opened to establish such communication.

Each heating chamber is also provided with an off-take flue 13 delivering into a passage 14 in turn communicating with a stack S. These offtake flues are controlled by valves 15.

In accordance with the present invention, it may be assumed that an annealing box is in position in both of the heating chambers. At this time, the burners 4 for the chamber 2 may be fired for directly heating the box and charge in the chamber 2, the hot products of combustion initially contacting with the top and sides of the annealing box. Assuming the valve 15 for the chamber 2 is closed, the corresponding valve for the chamber 3 open, and the controlling valves 12 and 12′ open these hot gases will pass downwardly around the annealing box in chamber 2, and into its flues 10 and conduit 11. After passing through this conduit, they pass upwardly through the flues 10 of chamber 3 and into such chamber, initially contacting with the bottom of the annealing box therein. They then flow upwardly around the sides of such box, then over the top, and finally escape through the offtake flue 13 and passage 14 of chamber 3 into the stack.

By reason of the construction and operation described, it will be apparent that the

heat of waste gases which have accomplished their heating duty and which are ordinarily discharged into the stack, is recovered by passing these gases into a second chamber and abstracting heat therefrom in such chamber. It is further to be noted that in one chamber the hottest gases contact with the top of an annealing box, while in the other chamber, during what may be termed the preheating period, the hottest gases contact with the bottom of the annealing box therein.

After the charge in the chamber 2 has been brought to the desired temperature and held at such temperature for the necessary length of time, which may be termed the soaking period, the burners 4 may be cut off, and the burners 5 fired. They are effective for delivering the hottest gases to the top of the annealing box in chamber 3, which box has previously been subjected to the greatest heating throughout its bottom portion. I have found that this accomplishes a very effective method of heating for three reasons:

First: It cuts down the total time required for bringing a charge to the desired temperature.

Second: It obviates the necessity of first bringing some one part to the required maximum temperature and thereafter holding such part at that temperature while the necessary heating of the remainder of the charge is being accomplished. This has previously been the necessary result of the normal operation of annealing furnaces, and has meant holding one part of a charge at a soaking heat for an unnecessarily long period of time, to the detriment of such part.

Third: It insures not only greater uniformity of heating, but also correspondingly greater uniformity of characteristics throughout an entire charge.

To those skilled in the art it will be apparent that I accomplish what may in effect be termed a reversing operation, the reversal taking place after an initial preheating, and being effective for delivering the hottest gases to that part of the charge previously subjected to the coldest gases, and vice versa.

While the first charge does not obtain the benefit of this reversal, with both preheating and final heating, it is as effectively heated as has heretofore been possible, and more effectively and uniformly heated than would be the case if the heating gases were discharged directly into the stack, and not forced to substantially completely envelope the charge. After the initial operation, however, all of the subsequent charges obtain the benefit of this reversal.

In case of necessity, such as represented by the need of repair to one of the furnaces, the gases may be directly discharged from one chamber into the stack independently of the other chamber. Experience has shown, however, that the life of the furnace is considerably lengthened due to the reversal operation referred to which gives a greater average uniformity of temperature to all parts of the heating chambers, just as it does to the charge.

It will also be apparent that the construction provided enables the furnaces to be operated individually, independently of the offtake flues 13 and passages 14. This may be accomplished, for example, by closing the valves 15 and opening the valves 12 and 12′, thereby causing the two chambers to discharge their products into the space 16 intermediate the valves 12 and 12′, which space in turn is in communication with the flue 17 communicating with a stack S, and suitably controlled by a valve 18. During such periods, the valve 18 will be open to permit the free discharge of gases directly into and through the stack. During such periods, however, as the waste gases are passing from one chamber to the other for effecting preheating of the character referred to, the valve 18 will be closed, thereby compelling the gases to follow the desired path.

The stack S may either be an independent stack, or may be the stack to which the passages 14 discharge through suitable conduits 19. This stack may be provided with any usual type of draft control 20, as customary in the art.

While I have herein described the illustrated furnace as being operated in such manner as to effect a heating of a charge in sequence, first by waste gases from the other chamber, and thereafter by direct firing, the construction is such as to enable these two heating operations to occur simultaneously. It may be assumed, for example, that waste gases are passing from the chamber 2 into the chamber 3, wherein they are initially effective on the bottom of the charge therein.

During this same time, the burners 5 may be operated for simultaneously subjecting the sides and top of such charge to substantially the same temperature conditions. In this manner, the entire outside surface of a given charge or charge container may be simultaneously subjected to such temperature conditions as to insure absolute uniformity of heating. This is true for the reason that the waste gases are initially effective on one portion while the products of combustion from the burners delivering to such chamber are initially effective on the remaining portions. In this manner, a charge can be completely enveloped with heating gases at temperatures such that the desired heating may be obtained. This being true, it is apparent that the heating need not occur in sequence in the manner previously referred to.

The present furnaces, therefore, possess the advantage of being operable either as a series of individual furnaces, or as a series

of furnaces effective in tandem, or with the tandem effect in combination with direct firing. This flexibility of operation has not, to my knowledge, been heretofore obtainable with any furnaces heretofore provided.

I am aware that what may be called tandem, series, or double furnaces have been proposed heretofore for heating, reheating, and crucible furnaces, but in cases with which I am familiar, the operation while it may have contemplated what may be termed alternate firing, has not been effective for accomplishing not only a reversal of the direction of flow of gases, but a reversal also of the heating effect on a furnace charge.

In other words, with structures with which I am familiar, the heating has always, in effect, been in the same direction, regardless of which furnace was actually being fired.

Furthermore, I am not aware that this broad principle of operation has been applied in any case to the annealing of articles en masse as represented by an annealing operation in boxes. For the reasons pointed out, the invention is particularly useful and desirable when applied to such operation. This is true not only because of the tremendous saving in fuel, but also on account of the ability to secure the desired temperature conditions throughout an entire charge without detrimental heating of a part thereof.

While I have herein illustrated a preferred embodiment of my invention, it will be apparent that changes in the particular construction and operation referred to may be made without departing either from the spirit of my invention or the scope of my claims.

I claim:—

1. An annealing furnace comprising a pair of heating chambers, means for supporting an annealing box in each of said chambers for independent removal therefrom, means for firing one chamber for initially heating a given portion of a charge therein, and means for passing spent gases from such chamber into the other chamber, said last mentioned means being effective for initially heating a different given portion of a charge in the second chamber, said second chamber also having means for firing the same to effect a reversal of the operating cycle.

2. A furnace comprising a pair of heating chambers, means for initially heating the upper and top portion of a charge in one chamber and the lower and bottom portion of a charge in the other chamber, and means for accomplishing a reversal of the heating operation.

3. In a furnace, a pair of heating chambers, means for firing either of said chambers at will, and passages extending downwardly through the bottom of one chamber and then upwardly through the bottom of the other chamber.

4. In a furnace, a pair of heating chambers, means for firing either of said chambers at will, and passages extending downwardly through the bottom of one chamber below a charge therein and then upwardly through the bottom of the other chamber below a charge therein.

5. An annealing furnace comprising a pair of heating chambers, means for supporting an annealing box in each of said chambers for independent removal therefrom, means for firing one chamber for initially heating a given portion of a charge therein, means for passing spent gases from such chamber into the other chamber, said last mentioned means being effective for initially heating a different given portion of a charge in the second chamber, said second chamber also having means for firing the same to effect a reversal of the operating cycle, and means for cutting off communication between the chambers.

In testimony whereof I have hereunto set my hand.

EDWARD M. FREELAND.