G. F. FULLER.

METHOD AND APPARATUS FOR CONTROLLING FURNACE TEMPERATURE.

APPLICATION FILED MAR. 26, 1919.

1,339,190. Patented May 4, 1920.

2 SHEETS—SHEET 1.

Fig. 1.

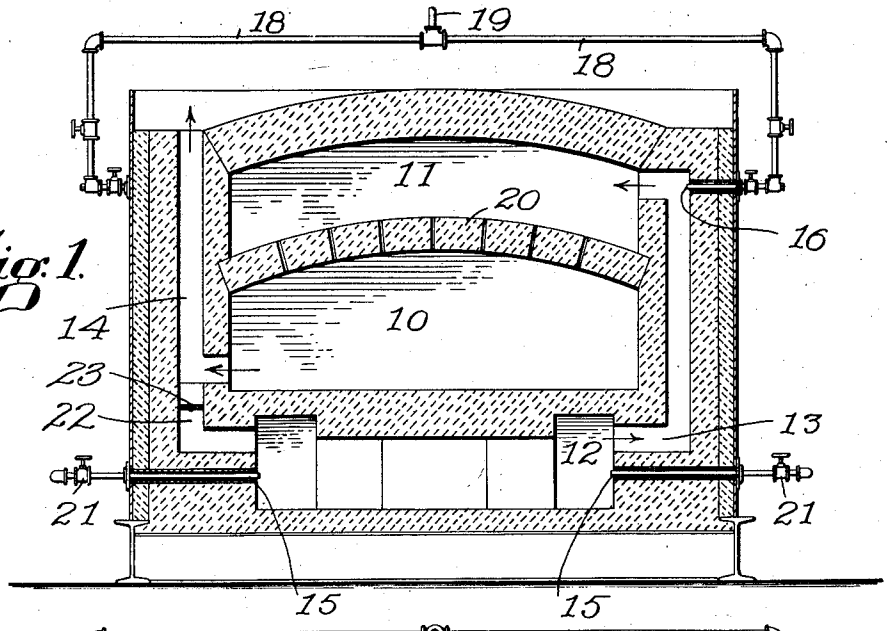

Fig. 2.

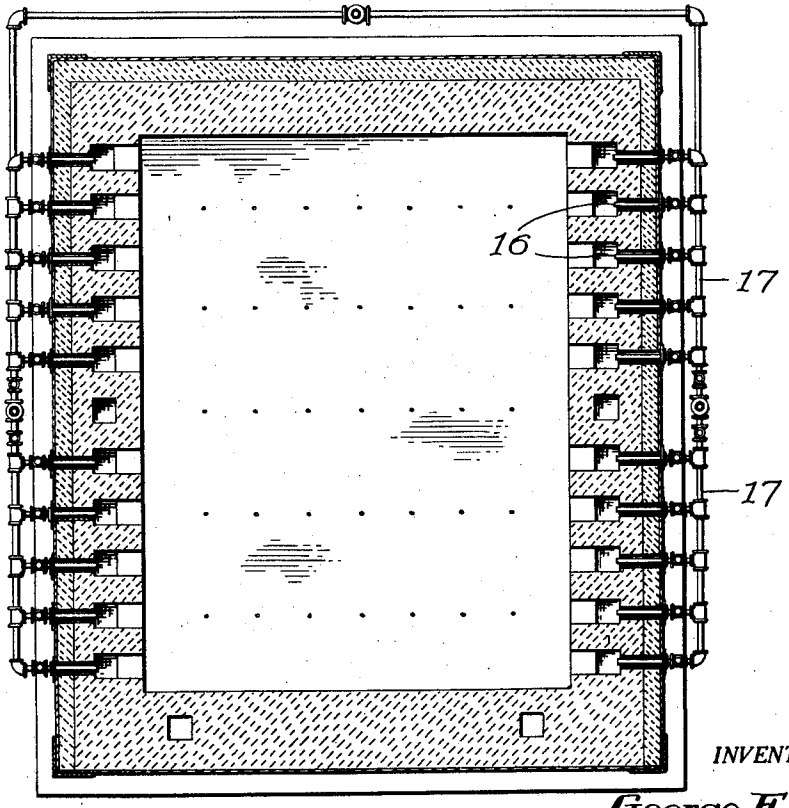

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Fig. 3.

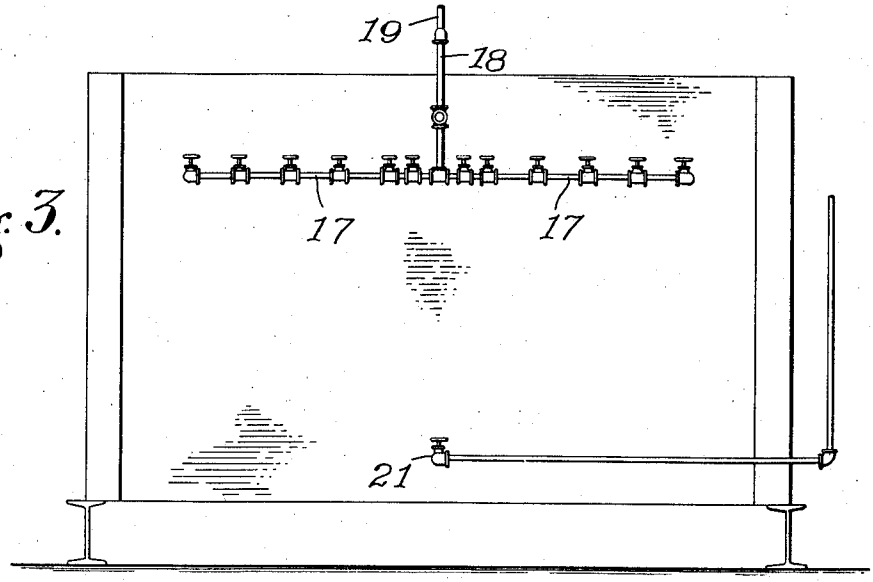
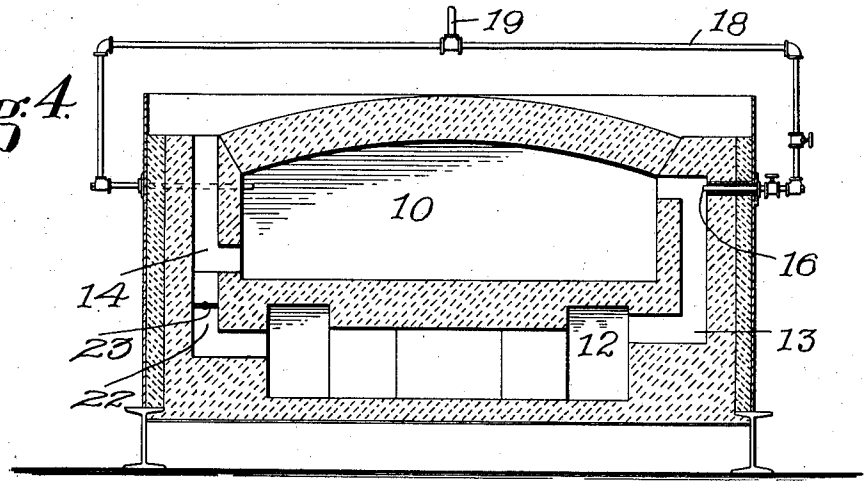


Fig. 4.



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UNITED STATES PATENT OFFICE.

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METHOD AND APPARATUS FOR CONTROLLING FURNACE-TEMPERATURE.

1,339,190. Specification of Letters Patent. Patented May 4, 1920.

Application filed March 26, 1919. Serial No. 285,343.

To all whom it may concern:

Be it known that I, GEORGE F. FULLER, a citizen of the United States, residing at Worcester, in the county of Worcester and State of Massachusetts, have invented a new and useful Method and Apparatus for Controlling Furnace-Temperature, of which the following is a specification.

In the heat treatment of high-grade special steels, the matter of temperature control has become of great importance, as a variation of a few degrees in the furnace temperature is found to produce a radical change in the characteristics of the metal under treatment.

In the lower temperature ranges, such as those between 800 and 1100° F., it has heretofore been extremely difficult to accurately control the furnace temperature. Furnaces for heat treatment of metals are usually heated by combustion gases from oil or fuel gas burners, and the combustion temperature of these gases is much above these relatively low furnace temperatures. It is found impossible to satisfactorily control the furnace temperature by varying the volume of hot gases admitted to the furnace, as any material reduction in volume of gas admitted leaves the furnace insufficiently supplied with gas. The furnace immediately becomes unevenly heated, with cool spots and air pockets in different parts of the furnace. On the other hand, a continued admission of gas in volume sufficient to fill the furnace with gas and to provide an even temperature, causes the furnace to be overheated.

It is the object of my invention to provide a method and apparatus by which the furnace temperature may be conveniently and accurately controlled, and by which an even furnace temperature may be secured and maintained.

With this general object in view, my invention contemplates the provision of a supply of heated gases for the furnace, and the further provision of a supply of preferably inert gas at a lower temperature, together with means for varying the admission of one or both of these gases to the furnace.

Having made such provision, my improved method of temperature control consists in raising the furnace temperature by admitting heated gases thereto and in limiting the rise in temperature by cooling the heated gases in said furnace in any desired ratio by mixing a cooler inert gas therewith. I have found that steam under pressure forms a satisfactory cooling gas, but any gas which will not support combustion may be used.

Or if desired, the inert material may be admitted to the furnace in non-gaseous form, to be immediately converted to an inert gas by the heated gases already in the furnace.

Further features of my invention are hereinafter described and will be more particularly pointed out in the appended claims.

In the drawings,

Figure 1 shows a vertical section of a simple form of heat-treating furnace in which my invention may be practised;

Fig. 2 is a sectional plan view thereof;

Fig. 3 is a side elevation showing the controlling valves, and

Fig. 4 is a sectional elevation of a modified type of furnace.

Referring to the drawings, I have shown a furnace comprising a heating chamber 10, a mixing chamber 11, a combustion chamber 12, a passage 13 connecting the chambers 11 and 12, and an exit flue 14 opening out of the chamber 10. I have also indicated conventional oil or gas burners 15 in the chamber 12, and a plurality of nozzles 16 extending through the side walls of the furnace into the upper portion of the passage 13.

The nozzles 16 are connected by pipes 17 and 18 to a supply pipe 19, these pipes being provided with valves, as shown, through which the nozzles may be controlled separately or in groups. The pipe 19 is connected to any suitable supply of inert gas under pressure, steam being more commonly used.

The chambers 10 and 11 are separated by a perforated arch 20 through which the gases pass readily to the chamber 10, the flow of gases being clearly indicated by arrows in Fig. 1. Valves 21 are provided for controlling the burners 15.

I will now describe the process of temperature control by which this apparatus may be successfully used for heat treatment of metals.

Starting with the furnace and charge cold, the burners 15 are lighted, producing gases of relatively high temperature which pass upward through the connection 13 to the mixing chamber 11 and thence through

the perforated arch 20 to the heating chamber or oven 10. As the gases cool and sink to the bottom of the chamber 10, they pass out through the exit flue 14. As the temperature of these gases is materially above the desired temperature for heat treatment, the temperature of the furnace is readily raised to the desired temperature. It is then necessary to prevent further rise in temperature.

As previously explained, this cannot be done by shutting off the hot gases from the chamber 12 without causing very irregular and uneven operation of the furnace on account of the insufficient amount of gas admitted to the chamber 10. I therefore control the temperature by admitting an additional amount of gas of lower temperature rather than by shutting off the high temperature gases.

In the preferred form of my invention, this is accomplished by blowing steam through the nozzles 16 into the mixing chamber 11. The steam thus admitted passes through the upper end of the passage 13 and acts to some extent as an injector carrying with it the hot gases from the combustion chamber 12. The temperature of these latter gases may be further reduced by temporarily shutting off the burners 21, but this is not essential as satisfactory regulation can be secured by the admission of steam even if the burners continue fully active.

The temperature of the furnace may be determined at several different points by the use of the usual fire-ends or pyrometers, and the admission of steam to any particular part of the mixing chamber may be adjusted in accordance with the readings of these instruments. When once adjusted, however, further separate regulation is commonly unnecessary and the temperature is readily controlled by opening the main valves and admitting steam to the whole series of nozzles. The opening and closing of these valves may be accomplished manually or automatically as preferred, the particular means of operating the valves forming no part of my present invention.

It is found that suitable manipulation of the steam valves enables the operator to hold any furnace temperature practically constant for any desired length of time, a result never before attainable in a furnace of this type to the best of my knowledge.

I call particular attention to the fact that I control the temperature without reducing the volume of gases admitted to the heating chamber. As I am able to maintain the heating chamber at all times completely filled with gas, a uniform temperature throughout the chamber can be maintained.

While I have described my invention as involving the use of an inert gas, it is not always necessary that the inert material shall be in gaseous form when admitted to the mixing chamber. As a matter of fact, the steam commonly used is rarely dry steam, but usually contains more or less water of condensation and many of the advantages of my invention may be secured by the admission of water or other liquid instead of steam through the nozzles 16. Water thus admitted is preferably in a spray or mist-like form which is, of course, almost instantly converted to dry steam upon entering the furnace and which may even under some conditions be disassociated into its component gases, all of which transformations involve the absorption of relatively large amounts of heat, with increased cooling action on the combustion gases.

The results above described may also be accomplished, although perhaps to less advantage, by admitting a constant supply of low temperature gas through the nozzles 16 and by varying the supply of high temperature gas in any convenient manner as by opening and closing the burners 21, or by the use of a by-pass 22 and damper 23 (Figs. 1 and 4). When the by-pass 22 is opened a part of the heated gases will pass directly to the flue 14 and a reduced amount will pass through the chambers 11 and 10. The proportion passing in each direction is determined by the position of the damper 23.

In Fig. 4 I have shown a furnace construction in which the mixing chamber 11 is omitted, the heated gases and the steam entering the heating chamber itself. I have also indicated in this figure certain of the nozzles projecting directly into the heating chamber rather than opening into the connecting passage as in Fig. 1. The method of operating these modified structures is exactly the same as in the preferred form.

Having thus described certain forms of apparatus together with my improved process of operating the same, it will be evident that other changes and modifications can be made therein by those skilled in the art without departing from the spirit and scope of my invention as set forth in the claims, and I do not wish to be otherwise limited to the details herein disclosed, but what I claim is—

1. The method of controlling furnace temperature which consists in providing two gases of higher and lower temperature respectively than the desired furnace temperature, and in admitting said gases in varying quantities to the heating chamber of said furnace.

2. The method of controlling furnace temperature which consists in raising the furnace temperature by the admission of heated gases, and in thereafter maintaining substantially constant furnace temperature by variably admitting cooler inert gases with the heated gases.

3. The method of controlling furnace temperature which consists in supplying heated gases to raise the temperature, and in thereafter reducing the temperature of the entering gases by the addition of a quantity of inert gas of lower temperature to prevent further rise in furnace temperature.

4. The method of controlling furnace temperature which consists in admitting heated gases to the heating chamber of said furnace to raise the temperature of said chamber, and in limiting the temperature rise of said chamber by thereafter admitting additional gas at lower temperature to said chamber.

5. The method of controlling furnace temperature which consists in supplying a substantially inert variable mixture of relatively high and relatively low temperature gases to the heating chamber of said furnace.

6. The method of controlling furnace temperature which consists in raising the temperature by the admission of heated gases to the furnace, and in preventing undue rise in temperature without loss in gas volume by adding to the heated gases a gas of lower temperature.

7. The method of controlling furnace temperature which consists in constantly admitting heated gases thereto, and in intermittently adding gases of lower temperature to said heated gases.

8. The method of controlling furnace temperature which consists in providing a supply of heated gases to the heating chamber of said furnace, and in controlling the temperature of said gases by the admission of steam at a lower temperature to said heating chamber.

9. Furnace heating mechanism having, in combination, a heating chamber, a source of high temperature gas, a source of low temperature gas, and means to control the mixture of such gases in said chamber.

10. Furnace heating mechanism having, in combination, a source of high temperature gas, a source of low temperature gas, a mixing chamber, a heating chamber, a connection between said chambers, and means to vary the relative amount of low temperature gases admitted to said mixing chamber.

11. Furnace heating mechanism having, in combination, a combustion chamber, a mixing chamber, a heating chamber, a connection between said combustion and mixing chambers, a connection between said mixing and heating chambers, a source of steam supply, and means controlling the admission of steam to said mixing chamber.

12. The method of controlling furnace temperature which consists in supplying heated gases to raise the temperature, and in thereafter mixing a variable quantity of inert gas of lower temperature therewith to prevent further rise of temperature.

13. The method of controlling furnace temperature which consists in forming a mixture of relatively high and relatively low temperature gases in the heating chamber, and in varying the relative proportions of the high and low temperature gases to regulate the heating effect of the mixture.

In testimony whereof I have hereunto affixed my signature.

GEORGE FREEMAN FULLER.