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H. W. SPENCER ET AL

2,135,645

FURNACE AND THE OPERATION THEREOF FOR INDUSTRIAL PURPOSES

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3 Sheets-Sheet 1

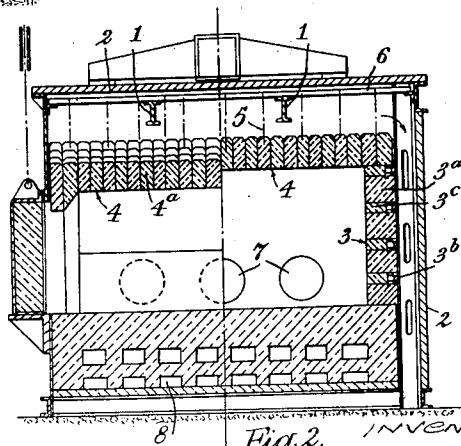
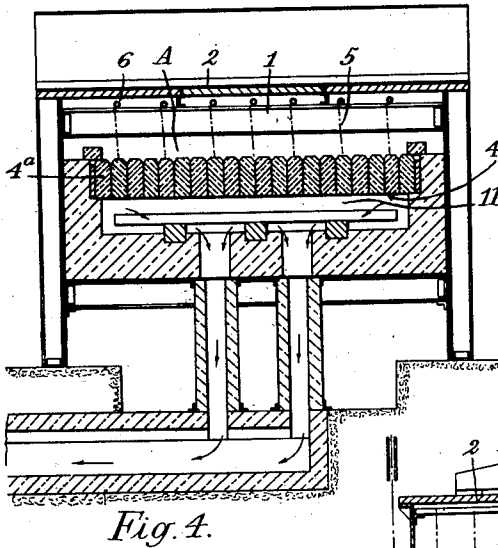
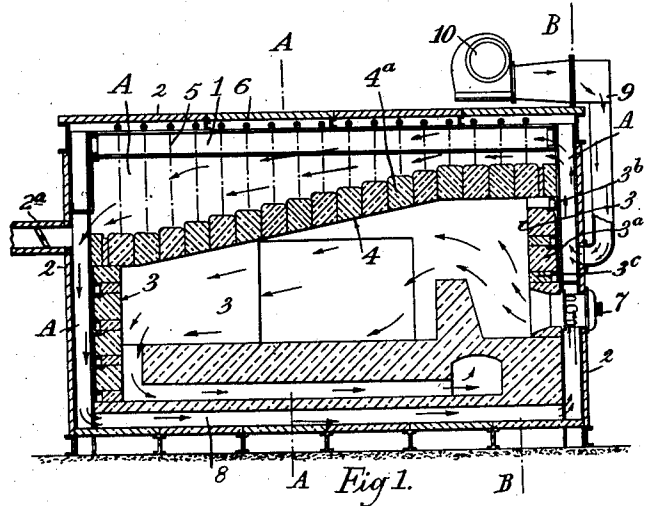


Fig 2 INVENTORS.

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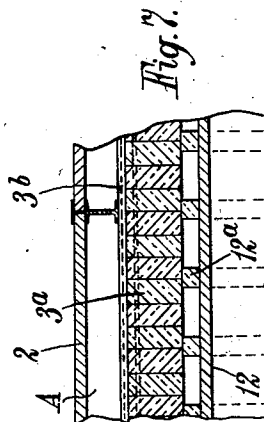
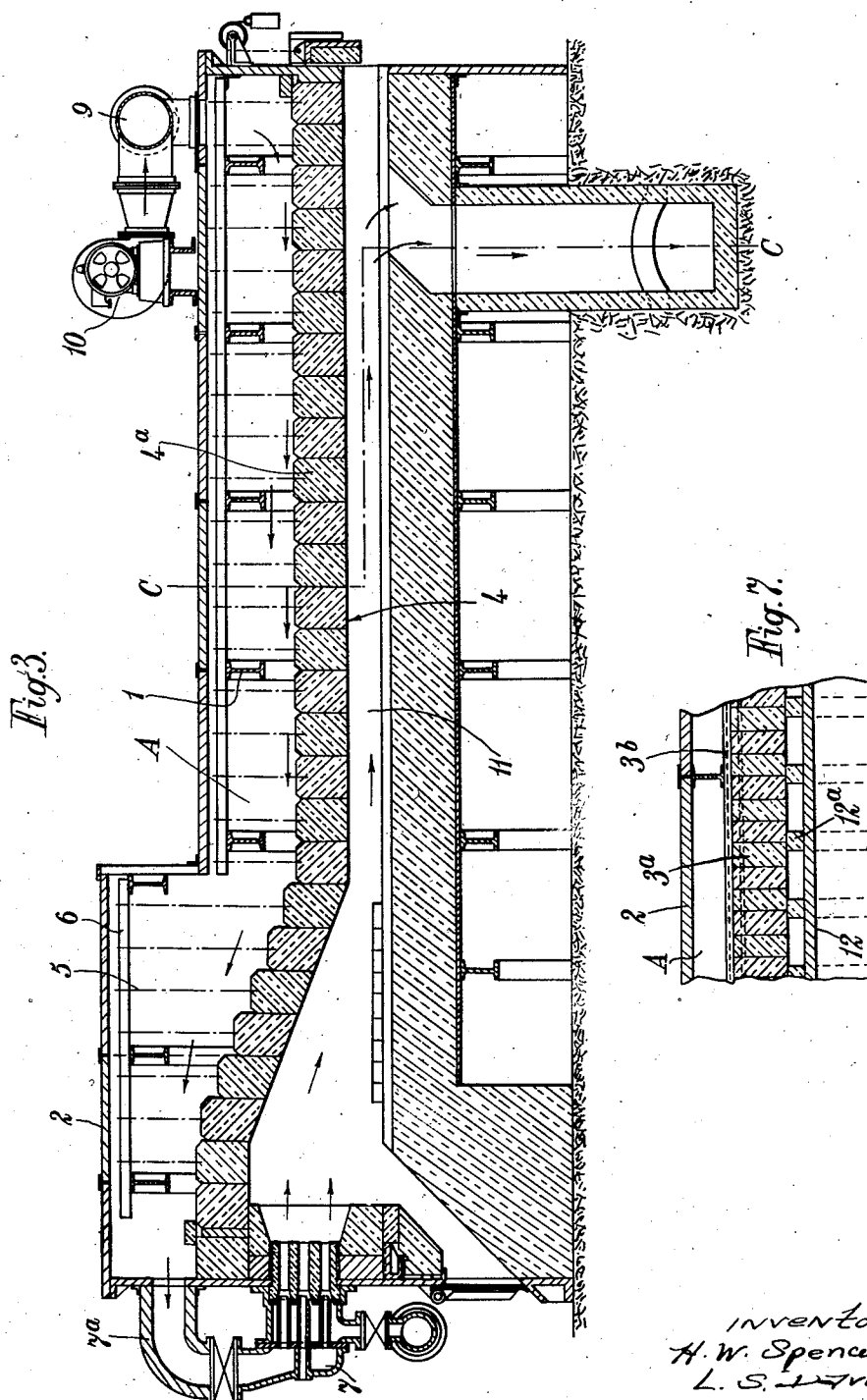
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3 Sheets-Sheet 2



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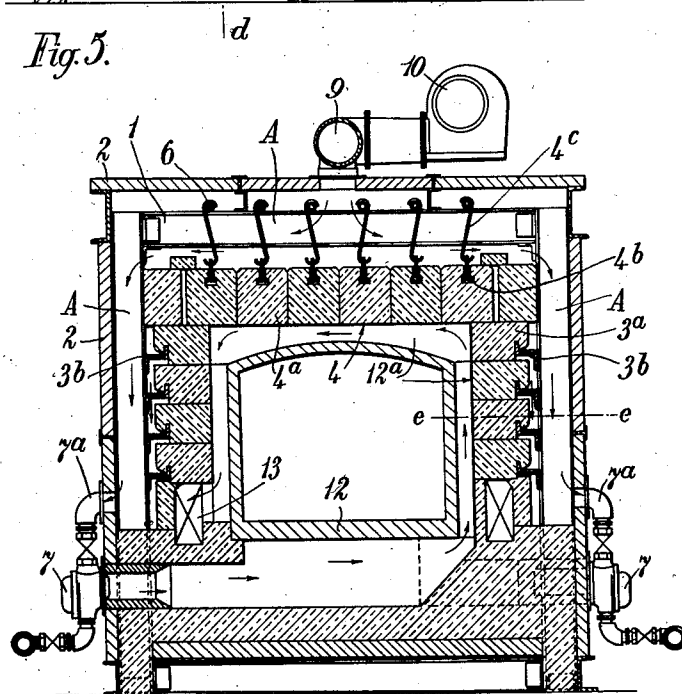
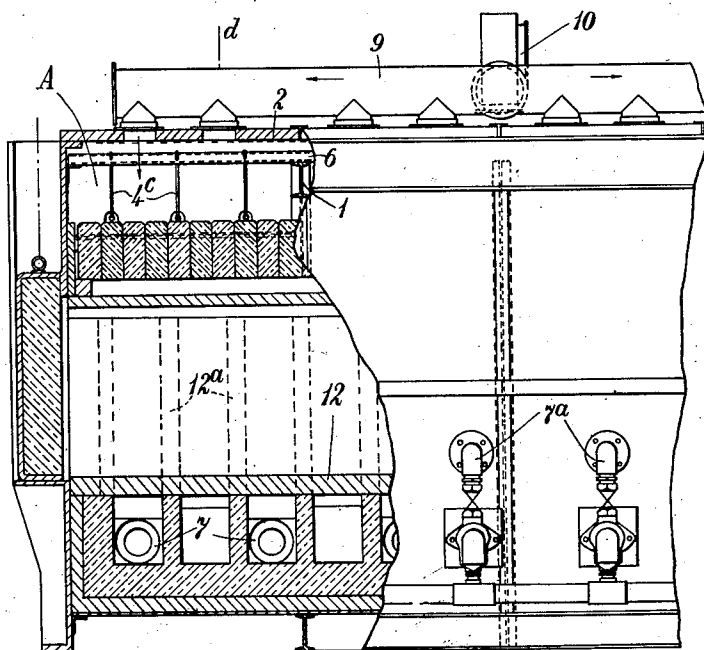
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3 Sheets-Sheet 3.



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UNITED STATES PATENT OFFICE

2,135,645

FURNACE AND THE OPERATION THEREOF
FOR INDUSTRIAL PURPOSES

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5 Claims. (Cl. 263—52)

This invention relates to furnaces for industrial purposes other than tunnel kilns for clay products and more particularly to furnaces for treating metals, such for example as reheating and annealing furnaces.

In industrial furnaces of the kind in question it has been customary to construct the arches and walls mechanically strong on the ordinary built-up and self-sustaining principle and, accordingly the roof and wall structure has been very thick and of great heat storage capacity. These necessarily massive structures are cumbersome, inflexible and suffer from defects arising from expansion and contraction under heating and cooling conditions, while they are costly in upkeep and wasteful in operation.

The inherent factors of this older type of construction impose certain characteristics on the furnace irrespective of the particular purpose or duty for which it is designed. For example, a furnace cannot readily be designed to suit a definite heating time or cooling time, or to afford a definite time to change from one temperature to another. Furthermore, the distribution of heat, or the rate of heating throughout the furnace, can only be controlled in a rough and ready manner. If a furnace be designed to keep its radiation losses to a minimum, then due to the heavy construction (if the furnace is not used continuously) its losses in the heat stored in its walls and arch are considerable. Conversely, if it be attempted to reduce the heat storage losses then radiation losses become proportionately greater. Due to the mechanical strain involved in the refractories of the construction and the high degree of soaking often obtained, the life of the refractories is reduced and when repairs and replacements are necessary they are difficult to effect.

Accordingly an object of the present invention is to obviate these defects or to reduce them to a minimum by providing a construction of furnace which affords not only economy in avoidance of heat losses, and in time taken in heating up a furnace or in cooling after use, but enable the temperature conditions of the furnace to be controlled in such a way as to give flexibility of treatment whilst possessing the capacity to maintain any required constant temperature treatment as may be predetermined.

An aim of the invention is to secure the advantages of the suspended arch (with or without associated suspended wall construction) which has hitherto been employed for steam generator work, in the field of industrial furnaces as indicated,

and to adapt this character of construction to afford improved furnace operation and efficiency in addition to the advantages of replacement and repair inherent in this type of construction.

It is to be understood that by the term "suspended arch" is meant a roof or arch comprising a single or relatively thin (as compared with non-suspended structures) layer of refractory blocks hung from a super-structure by the aid of hooks or link members.

Similarly, by the phrase "suspended wall" is meant a wall the blocks (or main blocks, irrespective of filler blocks) of which are hung upon hooks or brackets carried by a rear framework so that the lower blocks do not sustain the cumulative weight of those above. The suspended roof type of construction is exemplified in British patent specifications Nos. 215,464 and 297,271 for steam generators, while the suspended wall is similarly exemplified in British patent specifications Nos. 310,305 and 385,717.

According to the invention an industrial furnace of the kind described is provided with a suspended refractory arch enclosed in an outer insulating housing between which and the arch variable quantities of air are mechanically circulated and utilized for furnace combustion purposes, in order to aid in controlling the temperature conditions or working of the furnace.

The invention also consists in an industrial furnace of the kind described comprising a suspended refractory arch, or a suspended arch and suspended refractory walls, enclosed in an insulating housing affording an air jacket, and regulatable mechanical means adapted to circulate air through the jacket over the arch (or arch and walls) to aid in controlling the temperature conditions of the furnace and having means for utilizing heated air from the jacket for combustion purposes in the furnace.

According to a further feature of the invention means is provided for diverting heated air to permit its utilization for other purposes when desired.

It is, of course, well known in the older types of furnaces above referred to, to allow air to circulate around the walls or roof or arch of such furnaces and to utilize such air for combustion purposes either directly or by passage to an air heater. In such cases, however, owing to the massive construction and great heat storage capacity, the heat absorbed by the air was relatively slight and any heat transfer between the air and walls was useless for influencing furnace conditions and

could not be employed as a controlling factor in the furnace operation.

It has also been proposed in tunnel kilns for clay ware to provide a suspended refractory arch and to circulate air mechanically through the space between the arch and an enclosing outer casing, the heated air being then introduced into the water smoking zone of the tunnel.

It has also been proposed in steam generator furnaces to provide ducts or passages between an inner suspended wall and an outer masonry wall through which air is drawn by the furnace draught for preventing the overheating of the refractories of the suspended wall and for combustion purposes.

A furnace arch construction has also been proposed comprising transverse bars or girders upon which the arch bricks are threaded, a small space being left between the underside of each girder and the bricks threaded thereon through which air may be passed for cooling the bars and then led to the furnace.

In the accompanying drawings:—

Figure 1 is a side sectional elevation illustrating the invention applied to a gas or oil fired furnace typical of many furnaces used for a variety of purposes such as billet, bar, or sheet heating or for annealing.

Figure 2 shows cross sections of the furnace seen in Figure 1, the left half being taken on the line A—A and the right half on the line B—B of the figure looking towards the burners.

Figure 3 is a side sectional elevation of an oil or gas fired billet heating furnace illustrating an application of the invention thereto.

Figure 4 is a cross sectional view taken on the line C—C of Figure 3.

Figure 5 is a fragmentary elevation partly in section illustrating the invention applied to a muffle furnace.

Figure 6 is a transverse section according to Figure 5 on the line d, d and

Figure 7 is a fragmentary sectional plan taken on the line e, e of Figure 6.

In carrying the invention into effect with reference to Figures 1 and 2, a metal framework comprising uprights and horizontal girders 1 which are enclosed by suitable insulation or lagging wall 2, is adapted to form the housing for the furnace proper. Within this housing suspended walls 3 for the sides and front and rear of the furnace are erected. These walls comprise refractory blocks 3a hung on metal brackets or angle bars 3b, intermediate filler bricks 3c being usually employed between the blocks after the known mode of the construction of suspended walls. The suspended arch 4 comprises a series of recessed blocks 4a the recesses of which receive transverse bars which are carried by hook members 5 indicated by the dotted lines which are in turn hung upon transverse rods 6 supported by the longitudinal girders 1. While examples of the hook members and fittings in the recesses of the arch blocks are shown in Figure 6 it will be understood that any suitable form of suspended block and suspension means may be employed and such may be varied to suit the character or design of furnace.

The suspended wall and arch construction is arranged to afford in conjunction with the spaced housing walls and roof 2, an air jacket A. Any suitable form of heat source or fire may be utilized. In the present instance oil or gas fired burners 7 are illustrated and the hearth may be of any desired construction according to the par-

ticular purpose for which the furnace is intended. The air jackets at the front and rear walls may be in communication with one another through passages 8 beneath the hearth and the roof jacket has free communication with the wall jackets. The oil or gas burners have air inlets in communication with the front jacket so that air may be supplied therefrom into the burners for combustion purposes. At the front of the furnace or in any other suitable position, a conduit 9 is provided for the introduction of air for circulation through the air jacket A. This conduit is connected to the delivery of a centrifugal or other blower or fan 10 driven by a variable speed prime mover, such as a variable speed electric motor, or through variable speed gearing so that the rate of circulation may be regulated.

A conduit 2a is provided for diverting air from the jacket when desired and may be provided with a damper or valve for controlling the quantity thus diverted. It will be understood that such control of the diverted air in conjunction with the variable speed fan enables the quantity of air admitted to the burners to be regulated.

Alternatively the quantity of air circulated may be regulated by dampers or valves arranged in the delivery conduit to the jacket or elsewhere.

In Figures 3 and 4 the invention is seen as applied to a continuous billet reheating furnace, the hearth and burners of which may be of any usual construction. The walls 11 may be of the usual built-up construction and are formed with recesses to receive the outermost row of blocks of the suspended arch 4, the blocks 4a of which are hung (after the manner described in reference to Figure 1) from rods supported by transverse girders 1 of a framework or housing enclosed by insulating slabs or lagging and affording an air jacket A over the roof or arch of the furnace. The burner 7 is supplied with combustion air through a conduit 7a from the roof air jacket A of the furnace. The air is circulated through the jacket from the fan 10 and conduit 9 as described in reference to Figure 1.

In applying the invention to a muffle furnace as illustrated in Figures 5, 6 and 7, the suspended walls and arch are constructed after the manner already described, the walls comprising blocks 3a carried on angle brackets 3b whilst the recesses of blocks 4 of the roof are engaged by longitudinal bars 4b slung on hooks 4c. The upper ends of the hook members 4c are hung upon longitudinal rods 6 supported upon transverse girders 1. The suspended arch and walls are enclosed by insulation slabs or lagging 2 and provide the air jacket A, the jacket being supplied with circulating air through the conduit 9 from the fan 10. The burners 7 of the muffle furnace receive air from the jacket through the branches 7a. The muffle of the furnace is indicated at 12 and may be of any suitable construction, being located in spaced relationship with the suspended walls 3 and suspended arch 4. The space between the muffle tiles and the walls is preferably provided with spacing or positioning ribs or partitions 12a. Bearers are provided in the base of the furnace on which the muffle chamber is supported. The products of combustion from the burners travel around the muffle to the outlet 13.

The air jacket of the arch and/or walls may be provided with baffles for directing the course of

the air currents for example transverse baffles extending alternately from each side of the arch jacket towards the other side may be provided to give the air a zigzag or serpentine course.

5 In operation, it will be appreciated that in all furnaces according to the invention the air circulated by the fan travels in heat transference relationship with the backs of the suspended blocks and is available for combustion purposes. 10 The suspended arches are relatively thin as compared with non-suspended structures and have relatively small heat storage capacity, and because of this the circulation of the air is capable of influencing the temperature conditions 15 and the temperature in the furnace, within certain ranges, will rise and fall according to the rate of circulation of the air. As the rate of circulation of the air is controllable the temperature conditions in the furnace can correspondingly 20 be controlled. Owing to the nature of the suspended arch useful heat transference is effected such that on the one hand the backs of the blocks may be maintained at a suitably low temperature while on the other hand the air takes up practically all the heat lost thereby, such heat units 25 being used regeneratively in the furnace, for example through the medium of the burners. In addition to providing means for utilizing the heated air from the jackets for combustion purposes, arrangements are also made for diverting 30 air from the jackets and the amount of air thus diverted may be controlled in any convenient way. It will thus be seen that the invention provides means for controlling the amount of air 35 circulated through the jackets and the amount admitted to the furnace for combustion purposes, and by suitable regulation of these quantities the temperature conditions within the furnace may be controlled within the desired limits. Air which 40 is diverted and not used for combustion purposes in the furnace may be utilized for some other purpose where heat is required as for example in connection with another furnace either for combustion purposes or for heating up.

15 Also when a furnace is to be stopped or put out of commission the circulation of air is effective for rapidly cooling the furnace while the heated air derived during this period may be utilized in another furnace, either for combustion purposes or for heating up or other uses, for 50 example for drying fuel where pulverized fuel is employed.

It is to be understood that the invention is not limited in any way to the particular examples of 15 furnaces described and illustrated herein and that the design and arrangement of the suspended arch or arch and walls and the housing may be varied to provide air jacketing means as may be required to suit the particular conditions and 20 uses of the furnace or its association with another furnace or battery of furnaces. Furthermore, although the invention has been illustrated with reference to oil or gas burners, other fuels

may be employed in firing with the necessary modification in hearth construction or design.

Having now described our invention, what we claim as new and desire to secure by Letters Patent is:—

1. The method of controlling the temperature conditions or working of an industrial furnace of the kind described, which consists in mechanically circulating a variable quantity of air between a suspended refractory arch of the furnace treatment chamber and an enclosing insulating housing, utilizing air thus circulated for combustion purposes in the furnace and separately controlling the quantity of air circulated and the quantity of heated air admitted to the furnace for combustion purposes. 15

2. The method of controlling the temperature conditions or working of an industrial furnace of the kind described which consists in mechanically circulating air between a suspended refractory arch of the furnace treatment chamber and an enclosing housing in quantity sufficient to obtain the desired control by withdrawal of heat from the arch, and admitting part of the air thus circulated to the furnace for combustion purposes. 25

3. In an industrial furnace of the kind described a suspended refractory arch and a suspended refractory wall for the treatment chamber, an enclosing housing forming an air jacket for the arch and wall, regulatable mechanical means for circulating air through the jacket of the arch and wall in quantity sufficient to control the temperature conditions in said chamber, and means for admitting a proportion of air from the jacket for combustion purposes in the furnace. 35

4. In an industrial furnace of the kind described a suspended refractory arch and a suspended refractory wall for the treatment chamber, an enclosing housing forming an air jacket for the arch and wall, regulatable mechanical means for circulating air through the jacket of the arch and wall in quantity sufficient to control the temperature conditions in said chamber, means for utilizing heated air from the jacket for combustion purposes in the furnace, and 45 means for diverting heated air from the jacket.

5. In an industrial furnace of the kind described a suspended refractory arch and a suspended refractory wall for the treatment chamber, an enclosing housing forming an air jacket for the arch and wall, regulatable mechanical means for circulating air through the jacket of the arch and wall in quantity sufficient to control the temperature conditions in said chamber, means for admitting heated air from the jacket to the furnace for combustion purposes, means for diverting air from the jacket and means for regulating the quantity of air diverted whereby the temperature or working conditions of the furnace may be controlled. 50 55 60

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