July 26, 1932. A. E. GRAPP 1,868,824

OVEN CIRCULATING AIR TYPE

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Fig. 4

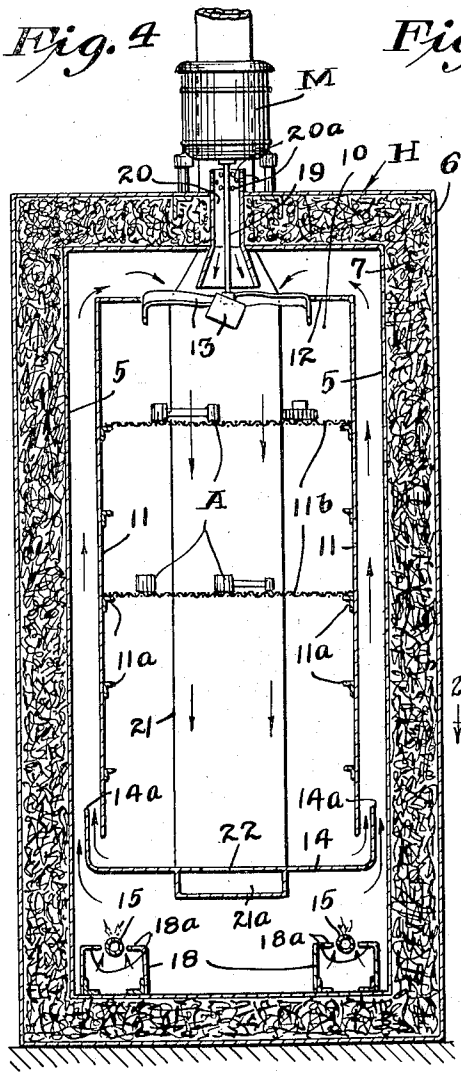
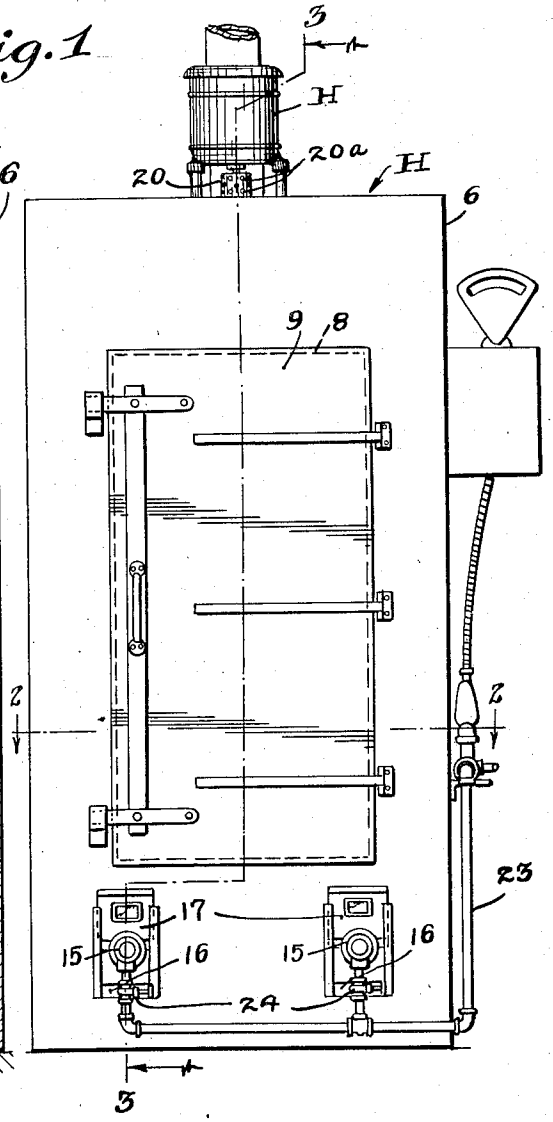


Fig. 1



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Fig. 2

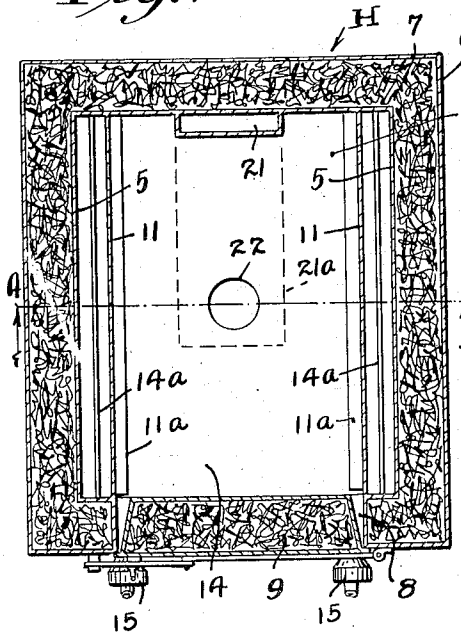
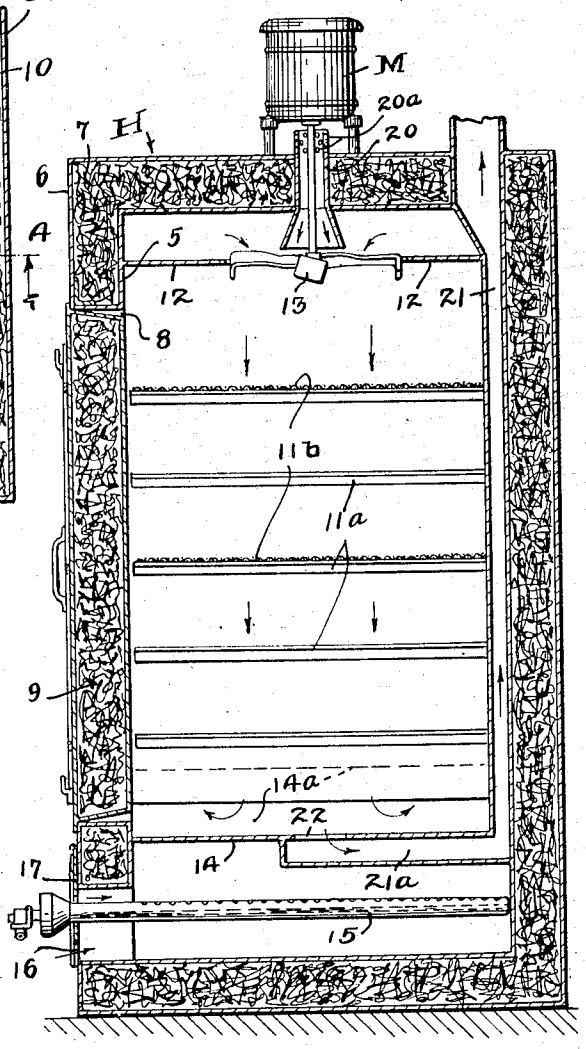


Fig. 3



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UNITED STATES PATENT OFFICE

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OVEN—CIRCULATING AIR TYPE

Application filed September 5, 1930. Serial No. 479,893.

This invention relates to ovens and furnaces adapted for various uses, such as, for example, heat treatment of steel, drying and baking coated surfaces, etc.

It is an object of my present invention to provide a highly efficient oven or furnace for producing substantially uniform distribution of heat throughout the heating chamber, operative with a high degree of economy and because of its structure, effective to bring the heating chamber and its contents rapidly up to the desired temperature.

More specifically it is an object to provide an oven or furnace wherein air and/or hot gases are continually circulated through the heating chamber, means being provided for removing a small portion of the air and other gases as the same are re-circulated and for supplying an equal and small amount of fresh air simultaneously.

Still another object is to provide an oven of the type described wherein the burners or heating elements are disposed in the lower portion of the oven, heating the air within the oven by radiation and convection through a conductive bottom and wherein a forced circulation of heated air is set up through the heating chamber, the air flowing through passages or venturi between the heating chamber and the oven housing and entering the end of the heating chamber opposite from the conductive bottom.

Another object is to provide in an oven of the type described having a fan and motor for driving the same, means for cooling the shaft and bearings of said motor by a suction of air adjacent the bearing and shaft due to the effect of the fan within the oven.

These and other objects and advantages of the invention will be fully set forth in the following description made in connection with the accompanying drawings, in which like reference characters refer to similar parts throughout the several views, and in which:—

Fig. 1 is a front elevation of an embodiment of my invention with the oven door closed;

Fig. 2 is a cross section taken on the line 2—2 of Fig. 1;

Fig. 3 is a vertical section taken on the line 3—3 of Fig. 1, and

Fig. 4 is a vertical section taken on the line 4—4 of Fig. 2.

In the embodiment of the invention illustrated in the drawings a relatively thick rectangular box-like housing H is provided which may comprise inner and outer metal jackets 5 and 6 respectively, between which is disposed a heavy layer of heat insulating or refractory material 7. The housing includes top, bottom and side walls and a doorway 8 is formed in the front wall having mounted therein a heavily insulated hinged door 9.

Within housing H is a rectangular heating chamber 10 spaced from the top, bottom and side walls of the housing and defined by a box-like preferably metal casing having vertical side walls 11 which are spaced from the innner side walls of the housing and extend from the rear wall to the front wall thereof. Heating chamber 10 is provided with a top 12 having a relatively large central aperture wherein a suitable fan 13 is disposed. A bottom for the heating chamber is provided as shown at substantially the lower end of the doorway by means of a conductive plate 14 having up-turned vertical side flanges 14*a* which are disposed medially between the vertical walls 11 of the heating chamber and the respective adjacent inner walls 5 of the housing, flanges 14*a* extending some distance above the lower edges of walls 11.

Heating elements may be mounted in the bottom of housing H below the conductive plate 14 and while it will be understood that any suitable type of heating element may be employed, in the form illustrated I disclose a pair of gas burners 15 having orifices directed upwardly towards conductive bottom or plate 14. Burners 15 may extend horizontally and inwardly from the front wall of the housing and openings 16 in said front wall are provided for supplying adequate oxygen to the burners, the size of said openings if desired being controllable by vertically sliding doors 17 mounted in suitable guides. Burners 15 are mounted at the top of burner boxes 18 which as shown have inturned horizontal flanges 18*a* spaced

a slight distance from the pipe or burner proper 15 to permit a supply of oxygen for aiding combustion.

The fan 13 at the upper end of the heating chamber may be fixed to a depending shaft 19 which as shown constitutes the projection of the armature shaft of an electrical motor M. Motor M is mounted centrally above the top of housing H with its lower end spaced therefrom to permit free access of air beneath the motor and around shaft 19. A central vertical passage or opening is formed through the top of housing H and an inverted funnel-shaped tube 20 is fixed in said opening concentrically surrounding shaft 19 and with its open upper end disposed just below the motor M and having therein a series of apertures 20*a* to permit lateral passage of air into said tube. The lower or flared end of tube 20 is open and terminates just above the central portion of fan 13. The plates of fan 13 are so skewed or turned that their inner ends at the center of the fan produce a displacement of air causing a strong suction through the tube 20.

At the rear of the heating chamber 10 a contiguous vertical duct 21 is provided having an elbow 21*a* communicating with its lower end and which under-lies the bottom of the heating chamber formed by conductive plate 14. A relatively small air discharge passage 22 is formed through the bottom plate 14 communicating with the elbow 21*a*.

If desired, two series of oppositely disposed ledges 11*a* may be provided on the walls 11 of the heating chamber adapted to support reticulated shelves 12 on which articles to be heated may be placed. Several articles A, such as metal castings are illustrated in Fig. 4 of the drawings, which may be placed in the oven for heat treatment, such as for example, tempering or case-hardening.

A gas supply pipe 23 is shown on the exterior of the housing H communicating through valves 24 with the burner conduits 15.

A suitable thermostatically operated heat regulator may be provided for my oven including an electro-magnetically operated valve for controlling the gas supply to pipe 23, which mechanism, however, forms no part of my present invention and therefore is not illustrated or described in detail.

Operation

In operation a hot flame is generated by each of the burners 15, the particular structure of the burner with reference to the burner boxes 18 setting up a nice draft of air around the burner conduits. The rapid rotation of fan 13 sets up a circulation of air throughout the oven as clearly indicated by the arrows in the drawings. The hot products of combustion which are of relatively small volume pass upwardly between flanges 14*a* of the conductive bottom and the inner side walls 5 of the housing and air is drawn from the heating chamber 10 downwardly, most of said air passing outwardly and then upwardly between the flanges 14*a* and the side walls 11 of the heating chamber. The re-circulated air and hot products of combustion pass upwardly in the venturi or passages between the heating chamber and side walls of the oven and enter the top of the heating chamber through fan 13.

In the circulation of the hot air a small amount is exhausted through the discharge aperture 22 in the center of bottom plate 14, this discharged air passing through elbow 21*a* and duct 21.

The inner ends of the fan blades 13 are so skewed that the central portion of the fan will displace or draw a small amount of air through the funnel tube 20 into the top of the heating chamber. This downwardly directed suction draft of air is taken from adjacent the lower bearing of motor M and through the lateral ports 20*a* in the upper and projected end of tube 20. The incoming air cools the said motor bearing and shaft 19 which, being constructed of conductive material, absorbs heat rapidly from the motor bearing. The conductive bottom plate 14 constitutes an efficient heat transmitting member and the temperature of the interior of the oven is very quickly raised to the desired point by transmission, convection and radiation of heat.

From the foregoing description it will be seen that a very uniform temperature will be maintained throughout the entire heating chamber. The provision of a conductive bottom for the heating chamber which is subjected to the intense heat of the burner flames in combination with the circulating fan at the upper or opposite end of the heating chamber is responsible for the highly successful results in securing a uniform distribution of heat. The entire heating chamber is preferably constructed of heat conductive material, such as metal, and is quickly brought up to a high temperature by the impingement of the hot circulating air and the hot products of combustion against the walls 11 thereof. These walls and the inner jacket 5 of the oven housing attain and transmit heat by radiation and convection and the circulating air is quickly raised to the desired temperature. The disposition of the fan and the location of the air outlets at the bottom and adjacent the side walls 11 of the heating chamber causes a substantially uniform downward draft of the hot air over articles contained in the heating chamber as contrasted with other types of circulating air ovens where a draft of air is passed laterally across the heating chamber.

It will further be noted that the heat from the small volume of vapor and steam as well

as carbon dioxide and other products of combustion is not wasted by passage into a stack or flue, but is admixed with the re-circulated air in the venturi between walls 1 and the inner side walls of the housing.

The total area of the air passages or discharges at the lower end of the heating chamber, including the upwardly directed passages formed between walls 11 and upturned flanges 14*a* and also discharge aperture 22 is less than the area of the centrally disposed relatively large air intake passage at the top of the heating chamber wherein the fan 13 is mounted, as will be apparent from the drawings. This causes some pressure to be built up in the heating chamber due to the forced circulation of air, and in the embodiment disclosed this pressure is approximately +1. The building up of this relatively small pressure materially aids the even distribution of temperature and heated air throughout the entire heating chamber and with the heating effect produced by the direct heat of the conductive bottom 14 of the chamber, careful tests have shown that throughout the entire heating chamber a uniform temperature is obtained.

From the foregoing description it will be seen that I have invented a comparatively simple, compact and highly efficient oven producing a substantially uniform distribution of heat throughout the heating chamber and operative with a high degree of economy due to the recirculation principle and consumption of heat from the products of combustion of the burners.

It will, of course, be understood that various changes may be made in the form, details, proportions and arrangement of the parts, without departing from the scope of applicant's invention, which, generally stated, consists in a device capable of carrying out the objects above set forth and in the novel parts and combinations of parts disclosed and defined in the appended claims.

What is claimed is:—

1. An oven comprising a heat insulated housing, a heating chamber disposed in said housing and spaced from one end thereof, air passages extending longitudinally and externally of said heating chamber and communicating with the two ends of said chamber, a fan mounted in an opening in one end of said heating chamber, a fan motor mounted externally upon the adjacent end of said housing with an extension of its armature shaft projected into said housing and carrying said fan and a relatively small air intake passage through said end of said housing and surrounding the extension of said shaft whereby fresh air will be drawn about the inner end and bearing of said motor impinging against said shaft.

2. The structure set forth in claim 1 wherein said air intake passage constitutes an inverted funnel-shaped tube, the outer open end of which is provided with lateral air intake ports adjacent the bearing of the motor and the inner and flaring end of which terminates adjacent the center of said fan.

3. An oven comprising, a heat insulated housing, a heating chamber constructed of heat conductive material disposed in said housing and spaced from at least two of the vertical inner walls thereof as well as from the top and bottom of said housing, said space between said chamber and said housing forming passages for the circulation of air, a fan mounted in an opening in the upper end of said heating chamber and adapted to project the heated air downwardly through said chamber, air outlet passages through the lower end of said heating chamber and communicating with the air passages between the vertical walls of said housing and said chamber, said chamber having a conductive bottom plate, burners mounted beneath said bottom plate having orifices directed against said plate, horizontal burner boxes communicating at their ends with the outside air and having inturned longitudinal flanges extending parallel with and in close spaced relation to the sides of said burners.

4. In an oven, a vertical housing, a vertical heating chamber mounted in said housing and spaced from at least two of the vertical walls of said housing as well as from the top of said housing to form passages for the circulation of air, a relatively large air intake passage in the top of said heating chamber, a fan mounted in said passage for forcing air downwardly through said chamber, air outlet passages at the bottom and adjacent the sides of said chamber communicating with the passages defined by the spaced vertical walls of said chamber and said housing, heating means and said outlet passages being of less aggregate area than said air intake passage of the chamber whereby a pressure will be built up in said heating chamber as the air is forced therethrough.

5. In an oven, a vertical heat insulated housing, a vertical heating chamber mounted in said housing and spaced from at least two of the vertical walls of said housing as well as from the top of said housing to form a passage for the circulation of air, said heating chamber having a heat conductive bottom, heating elements disposed below said bottom for directly heating the same and for heating by conduction and radiation the air in the bottom of said heating chamber, said heating chamber having an air intake passage in the upper end thereof and air outlet passages in the bottom thereof, said outlet passages communicating with the passages defined by the spaced vertical walls of said chamber and said housing, a fan for setting up a forced circulation of air downwardly through said heating chamber and upwardly

through said passages defined by the vertical walls of said chamber and said housing, the aggregate area of said outlet passages being less than the area of said intake passage of said heating chamber whereby a pressure will be built up in the heating chamber as the air is forced through.

In testimony whereof I affix my signature.

ALBERT E. GRAPP.