E. E. MARSHALL.

PREHEATING OF AIR FOR HOT BLAST STOVES OF BLAST FURNACES.

APPLICATION FILED APR. 4, 1916.

1,217,039.

Patented Feb. 20, 1917.

4 SHEETS—SHEET 1.

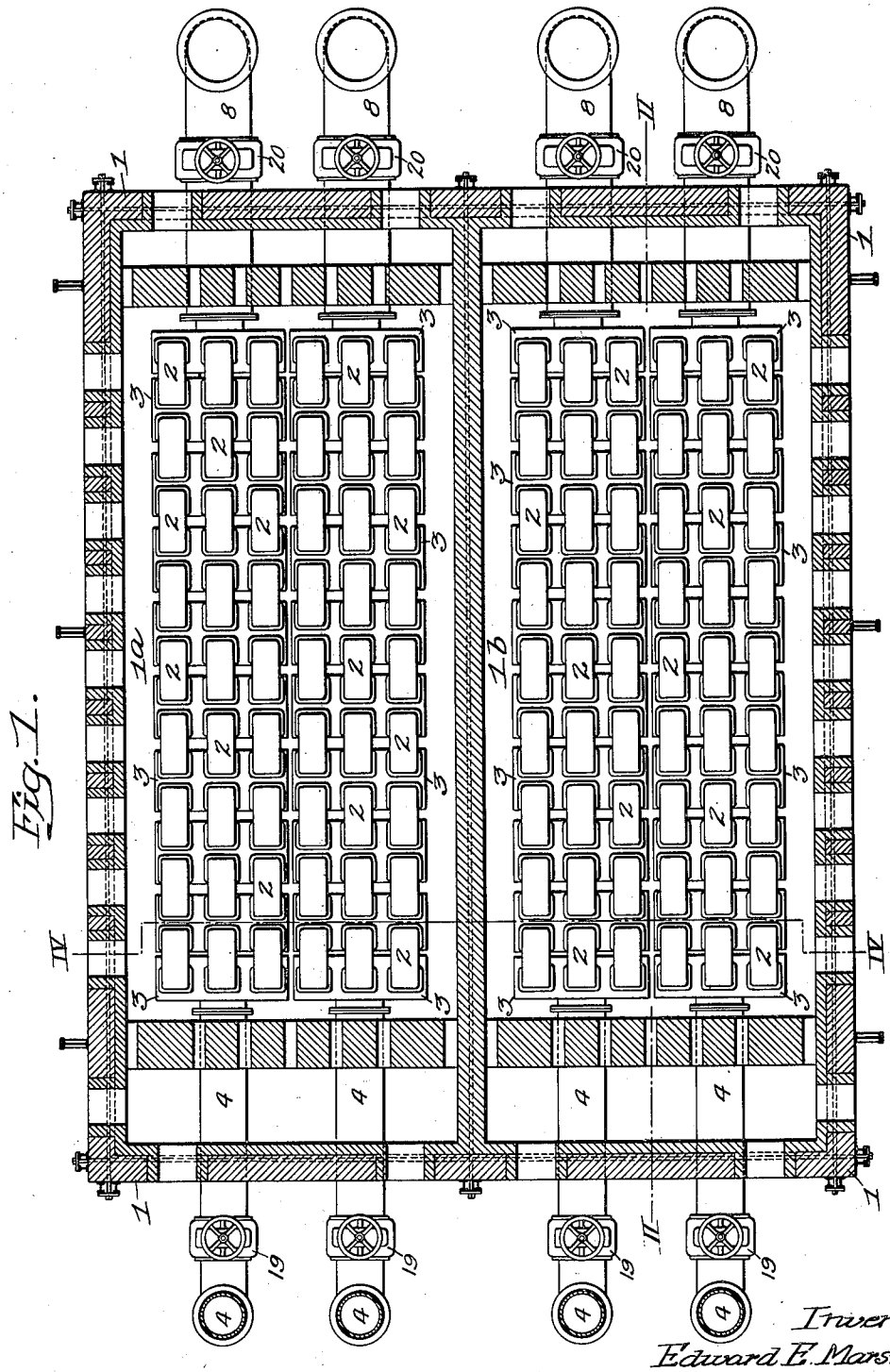


Fig. 1.

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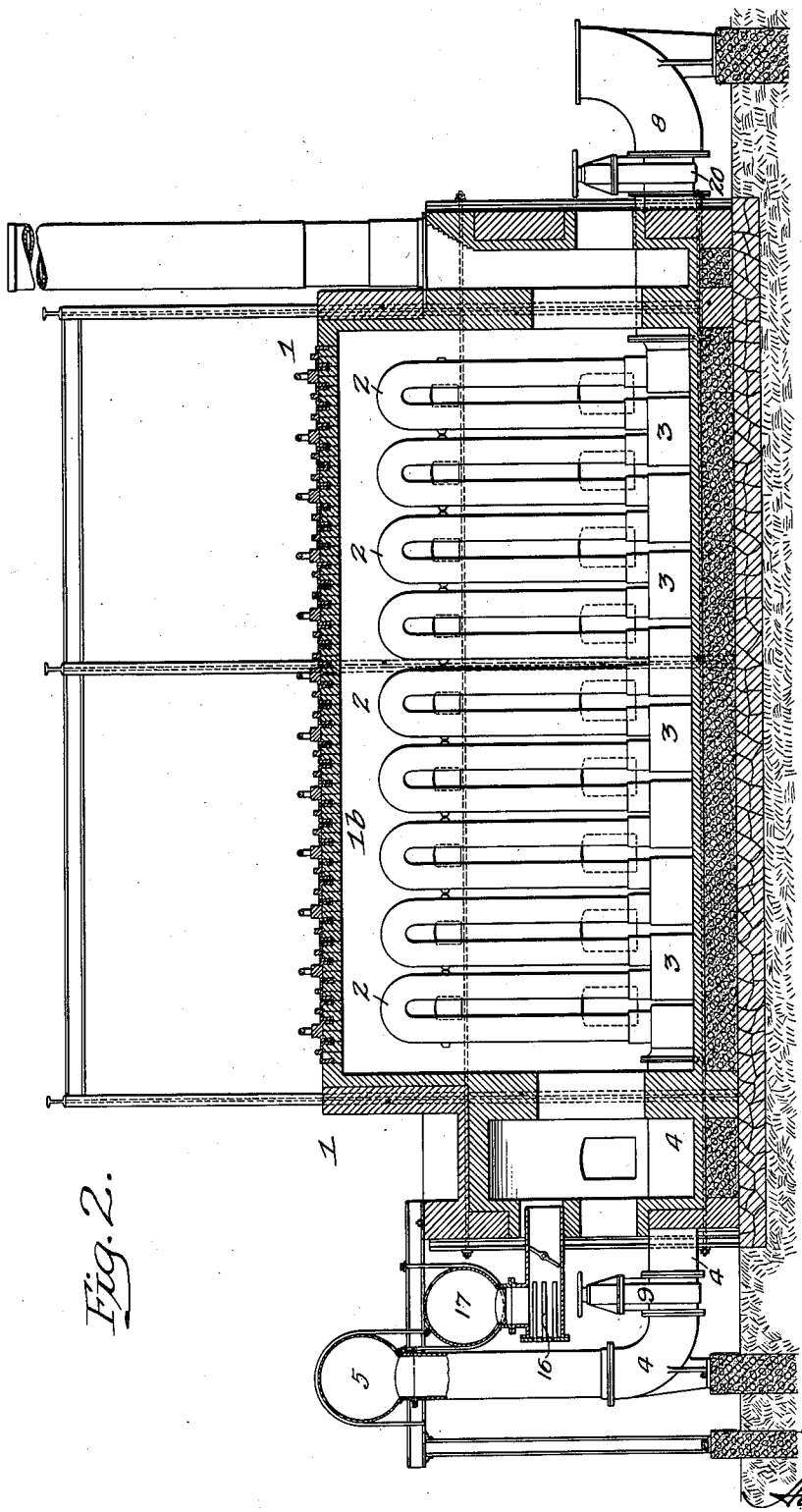


Fig. 2.

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4 SHEETS—SHEET 3.

Fig. 3.

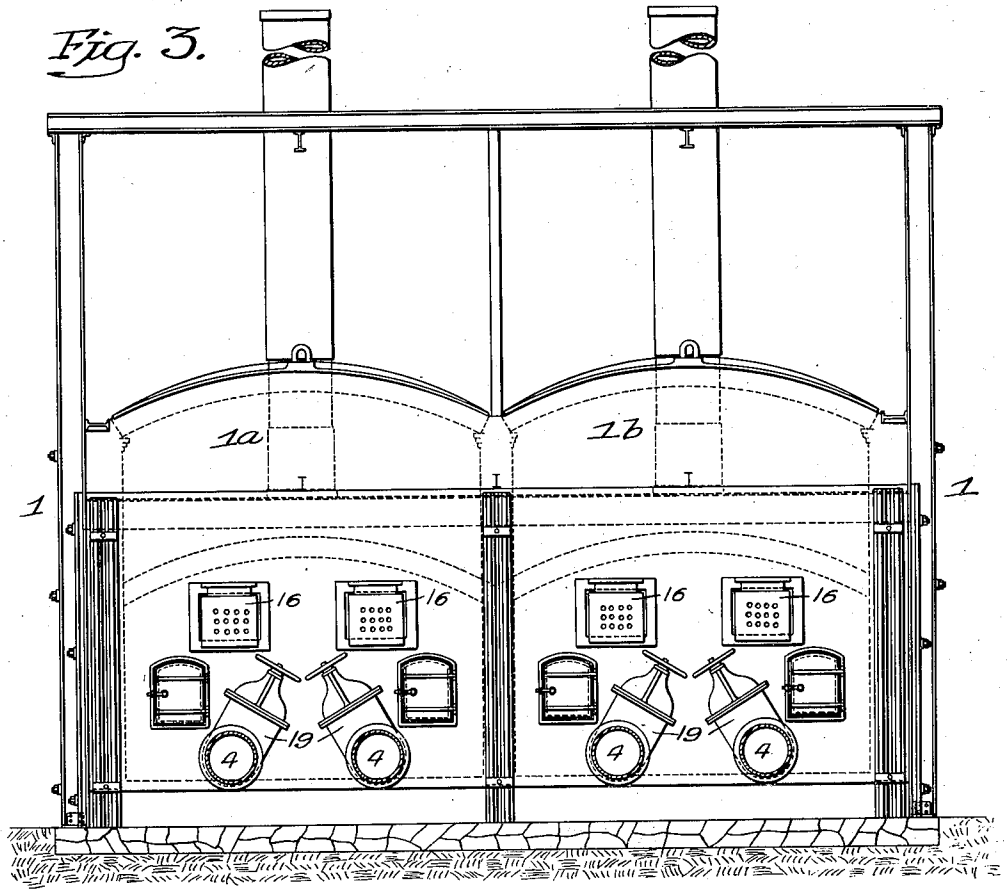
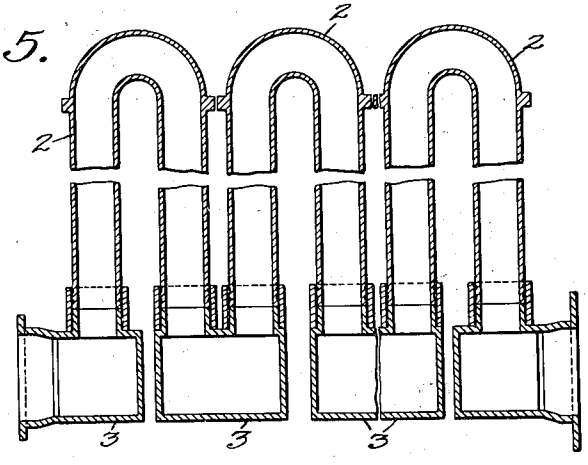


Fig. 5.



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Fig. 4.

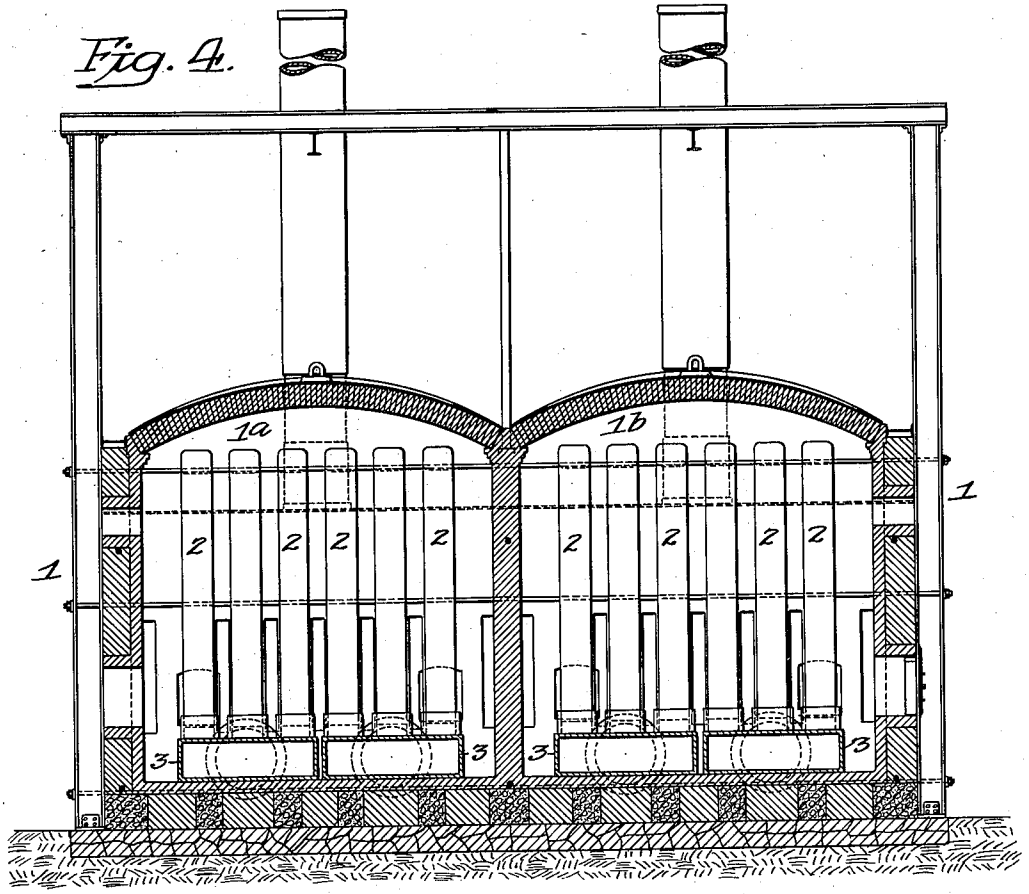
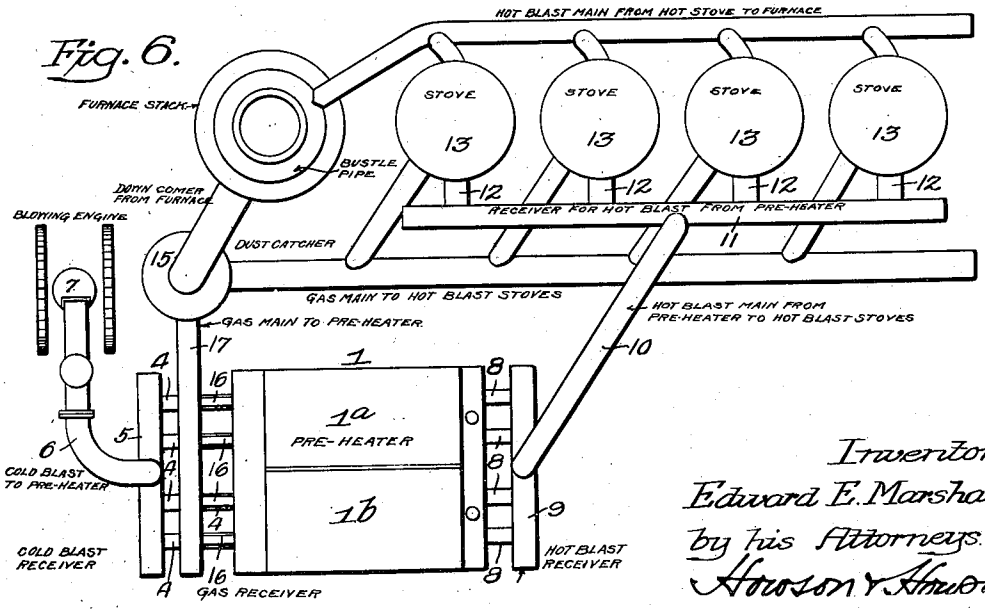


Fig. 6.



Inventor.-
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UNITED STATES PATENT OFFICE.

EDWARD E. MARSHALL, OF PHILADELPHIA, PENNSYLVANIA.

PREHEATING OF AIR FOR HOT-BLAST STOVES OF BLAST-FURNACES.

1,217,039. Specification of Letters Patent. Patented Feb. 20, 1917.

Application filed April 4, 1916. Serial No. 88,855.

To all whom it may concern:

Be it known that I, EDWARD E. MARSHALL, a citizen of the United States, residing in Philadelphia, Pennsylvania, have invented certain Improvements in the Preheating of Air for Hot-Blast Stoves of Blast-Furnaces, of which the following is a specification.

My invention relates to the pre-heating of air for blast furnace use, and consists more particularly of improved means for supplying the hot blast stoves of blast furnaces with pre-heated air, which air after further heating in such hot blast stoves is delivered to the blast furnace in a highly heated state. For the best results, this air must be at a relatively high and substantially uniform temperature, and the usual practice heretofore has been to utilize the structures familiarly known as hot blast stoves, which stoves contain certain forms of heating devices whereby cold or relatively cold air introduced into the same can be highly heated, and heated to the temperature desired before being introduced into the blast furnace.

Various forms of hot blast stoves are employed in practice but, as may be readily understood, the introduction of relatively cold air or air at atmospheric temperature is highly destructive of the heating portions of such hot blast stoves; hence the necessity of constantly repairing portions destroyed by stresses or breaks occasioned by the great difference between the temperatures of the incoming and outgoing air. Moreover the use of hot blast stoves for supplying all of the heat necessary for the required amount of air passing therethrough to the blast furnace necessitates the employment of a large number of stoves to maintain the desired or required supply of heated air, which stoves, however, are unable to impart the really high heat desired to air entering at ordinary atmospheric temperature. When, however, as in my method of procedure the air entering the hot blast stove has been raised approximately to 600° F. the work of the hot blast stove is materially lessened, with a consequent reduction of energy necessary to raise it to the high heat desired, and by reason of supplying the blast furnace with the required amount of highly heated air, the amount of fuel required therein for smelting purposes is materially lessened.

The object of my invention is to provide a pre-heating device for the hot blast stoves whereby air at atmospheric temperature may be heated to a relatively high temperature before introduction into the hot blast stove, wherein the temperature of such air is raised to a much higher point, and in order that the difference in temperature at the inlet and outlet of the hot blast stove shall be materially lessened. A further object of my invention is to economize the amount of fuel required in the blast furnace for smelting purposes, and further to greatly reduce the time usually required to heat the air employed in the blast furnace in the hot blast stoves. While heating means for the pre-heater may be obtained from any suitable source, I preferably employ the waste gases direct from the blast furnace which are delivered to suitable burner structures at the inlet end of the pre-heater.

These and other features of my invention are more fully described hereinafter, reference being had to the accompanying drawings, in which:

Figure 1, is a sectional plan view of a pre-heater structure embodying my invention;

Fig. 2, is a longitudinal section of the same on the line II—II, Fig. 1;

Fig. 3, is a front elevation of the pre-heater structure;

Fig. 4, is a cross sectional view on the line IV—IV, Fig. 1;

Fig. 5, is an enlarged view of a portion of the tubular air-passages in the pre-heater in which the air is heated, and

Fig. 6, is a diagrammatic view illustrating the layout of blast furnace, hot blast stoves and pre-heater.

My improved pre-heater structure may comprise a substantially rectangular building 1 of suitable type, preferably of the usual furnace construction, with fire-brick lining &c., and the pre-heater proper preferably embodies a pair of units 1^a and 1^b, which may be worked alternately or simultaneously as may be necessary or desirable, for the requirements of the hot blast stove or stoves, or the blast furnace.

Within the chambers 1^a and 1^b of the pre-heater structure, I provide a plurality of conductors 2 for the heated air, which conductors are substantially of inverted U-shape in cross section, projecting vertically into the chambers and having their free ends connected to manifolds 3 so as to make continuous channels of a tortuous type providing for the heating of a large quan-

tity of air. Air at or about atmospheric temperature is delivered to these conductors 2 through pipes 4 from a manifold 5 which in turn receives such air from a blast pipe 6 leading from a suitable blowing engine 7, and from said conductors the heated air is led by suitable conduits 8 to a manifold 9 from which it passes to a pipe 10, thence to a manifold receiver 11, and from the latter it passes to the inlet ports 12 of the hot blast stove or stoves 13. The latter may receive heated air from the conductors 2 of both chambers 1^a and 1^b, or from either chamber alternately.

The inlet end of the pre-heater is provided with suitable burners 16 arranged to receive, via a conduit 17, the gas discharged direct from the blast furnace, which preferably passes through a dust catcher 15 before entering said burners 16, where it is burned for the purpose of heating the air to be subsequently delivered to the blast furnace; the flame from such burners being delivered to or discharged into the chambers 1^a and 1^b of the pre-heater structure around the conductors 2.

The quantity of the air to be heated which is introduced into the manifolds 3 of the conductors 2 from the pipes 4, is controlled by valves 19, and the conduits 8 are provided with valves 20 whereby delivery of the heated air to the several pipes for passage to the hot blast stove or stoves may be controlled or regulated.

The air passes through the conductors 2 under certain pressure, and as these conductors lie directly in the flame from the burners 16, it will be highly heated. As such conductors are of cast iron they will be able to stand variations in temperature much better than the checker brick of the hot blast stoves while the heating capacity of the hot blast stoves will be greatly increased by the reception of air at a high temperature.

By my improved arrangement and construction of pre-heating means, I am enabled to use the waste gases direct from the blast furnace to raise the temperature of the air in such pre-heater structure, which pre-heated air is delivered to the checker brick hot blast stoves. In this way air at a very high temperature is delivered to the hot blast stoves wherein it is heated to a much higher and desired temperature with the consequent result that as the incoming air is hot, it does not have to be raised from a low temperature to a high temperature in the hot blast stoves but being at a relatively high temperature upon entrance into the hot blast stoves it may be quickly raised therein to the desired temperature before passing to the blast furnace. This extra heating can be effected in a much shorter time than the entire heating usually performed by the hot blast stoves, and as the hot blast stoves are not subjected to objectionable cooling by the reception of air at atmospheric temperature, their life is greatly prolonged and their value as heating means is greatly increased.

Furthermore, I am enabled by my particular arrangement to impart a higher and more uniform degree of heat for a longer period, with the additional advantage of thereby reducing the consumption of fuel in the blast furnace. The greater the temperature of the air delivered to the blast furnace, coupled with uniformity of such high temperature in the continuing volume delivered, the less fuel will be required to overcome the variation in temperature necessary to raise the heat in such furnace to the smelting point. A further feature of economy is that the pre-heating of the air according to my arrangement enables me to cut down the capacity or number of the hot blast stoves, and inasmuch as the number of stoves (or hot blast stove capacity) can be reduced, the cost of plant equipment is proportionately reduced.

I claim:

1. The combination with a blast furnace and hot blast stoves employed therewith, of a pre-heating device for air, means for delivering heated air from said pre-heating device to said hot blast stoves, a connection between the furnace and the pre-heater for the passage of waste gas direct to said pre-heating device, burners for the latter discharging into said pre-heater, a conduit connecting the hot blast stoves with the blast furnace, and valves controlling the passage of air to and from said hot blast stoves.

2. The combination with a blast furnace and hot blast stoves employed therewith, of a pre-heating device for air, a blower for supplying air to the pre-heater and for delivering heated air from said pre-heating device to said hot blast stoves, a connection between the furnace and the pre-heater for the passage of waste gas direct to said pre-heating device, burners for the latter discharging into said pre-heater, a conduit connecting the hot blast stoves with the blast furnace, and valves controlling the passage of air to and from said hot blast stoves.

3. The combination with a blast furnace and hot blast stoves employed therewith, of an air pre-heater, a connection between the furnace and the pre-heater for the passage of waste gas direct to said pre-heater, connections between the furnace and the hot blast stoves for delivering waste gas thereto independently of such delivery to the pre-heater, burners mounted in the pre-heater for the combustion of the waste gas delivered thereto from the blast furnace; said burners discharging their flame into the chambers of the pre-heater, means for delivering heated air from said pre-heater to

the hot blast stoves including pressure means, a conduit connecting the hot blast stoves with the blast furnace, and valves controlling the passage of the heated air to and from said hot blast stoves.

4. The combination, with a smelting furnace and hot blast stoves therefor, of a pre-heater in which air is heated by the waste gases direct from the furnace, said pre-heater being located between the hot blast stoves and the furnace, a plurality of air conductors in said pre-heater, and valves controlling the inlet and discharge of air to and from said pre-heater.

5. The combination, with a smelting furnace and hot blast stoves therefor, of a pre-heater in which air is heated by the waste gases from the furnace, said pre-heater being located between the hot blast stoves and the furnace, a plurality of air conductors in said pre-heater, valves controlling the inlet and discharge of air to and from said pre-heater, and a blower for delivering air to the pre-heater and continuously discharging the air heated therein to the hot blast stoves.

6. In a pre-heater for hot blast stoves disposed between the latter and a blast furnace, the combination of a chamber, a plurality of heating tubes projecting vertically into said chamber, manifolds for the lower ends of said tubes, a valved conduit for leading air to said tubes, a valved conduit for leading heated air from said tubes, burners for discharging flame into said heating chambers, and means for delivering waste gas direct from the blast furnace to said burners.

7. In a pre-heater for hot blast stoves disposed between the latter and a blast furnace, the combination of a chamber, a plurality of heating tubes projecting vertically into said chamber, manifolds for the lower ends of said tubes, a valved conduit for leading air to said tubes, a valved conduit for leading heated air from said tubes, a blower for forcing air through said conduits and the tubes and manifolds of the pre-heater, burners for discharging flame into said heating chambers, and means for delivering waste gas from the blast furnace to said burners.

8. In a system for heating air for blast furnaces and passing the same thereto via hot blast stoves employed therewith, the combination of a pre-heating device for air, means for delivering air under pressure to said pre-heating device, a connection between the furnace and the pre-heating device for the passage of waste gas to the latter, burners for the combustion of the waste gas delivered to the pre-heating device from the blast furnace; said burners discharging their flame directly into said pre-heating device and the heated air from said pre-heating device being delivered to the hot blast stoves by the same pressure means which previously introduced it to the pre-heater, means affording communication between the hot blast stoves and the blast furnace, and means for controlling the passage of the heated air to and from said hot blast stoves.

9. In a system for heating air for blast furnaces and passing the same thereto via hot blast stoves employed therewith, the combination of a pre-heating device for air, means for delivering air under pressure to said pre-heating device, a connection between the furnace and the pre-heating device for the passage of waste gas direct to the latter, connections between the furnace and the hot blast stoves for delivering waste gas thereto independently of the delivery of such waste gas to the pre-heating device, burners for the combustion of the waste gas delivered to the pre-heating device from the blast furnace; said burners discharging their flame directly into said pre-heating device and the heated air from said pre-heating device being delivered to the hot blast stoves by the same pressure means which previously introduced it to the pre-heater, means affording communication between the hot blast stoves and the blast furnace, and means for controlling the passage of the heated air to and from said hot blast stoves.

10. The method of heating air for the blast of a smelting or other furnace, which consists in delivering air under pressure to a conduit disposed within a combustion chamber coincident with the delivery to said chamber of waste gas direct from said blast furnace, utilizing a portion of the oxygen of the air in said combustion chamber in supporting the combustion of the waste gas whereby the air in the conduit within said combustion chamber is highly heated, delivering such heated air to a hot blast stove, raising the temperature of such heated air in the hot blast stove, and finally delivering said twice heated air to the smelting furnace.

11. The method of heating air for blast furnaces and passing the same thereto via hot blast stoves employed therewith, which comprises the delivery of air under pressure to a heating element, delivering waste gas direct from the furnace to said heating element, burning the waste gas delivered to the heating element whereby the flame from such combustion may discharge into the interior thereof; the air so heated being delivered to the hot blast stoves by the same pressure which previously introduced it to the heating element, providing communication between the hot blast stoves and the blast furnace, and controlling the passage of the heated air to and from the hot blast stoves.

12. The method of heating air for blast

furnaces and passing the same thereto via hot blast stoves employed therewith, which comprises the delivery of air under pressure to a heating element, delivering waste gas direct from the furnace to said heating element independently of the delivery of waste gas to the hot blast stoves, burning the waste gas delivered to the heating element whereby the flame from such combustion may discharge into the interior thereof; the so heated air being delivered to the hot blast stoves by the same pressure which previously introduced it to the heating chamber, providing communication between the hot blast stoves and the blast furnace, and controlling the passage of the heated air from the heating element to the hot blast stoves and from the latter to the blast furnace.

EDWARD E. MARSHALL.