March 18, 1930. J. P. DOVEL 1,751,136

APPARATUS FOR HEATING THE AIR BLAST FOR FURNACES AND THE LIKE

Filed Dec. 16, 1926 3 Sheets-Sheet 1

Fig. 1

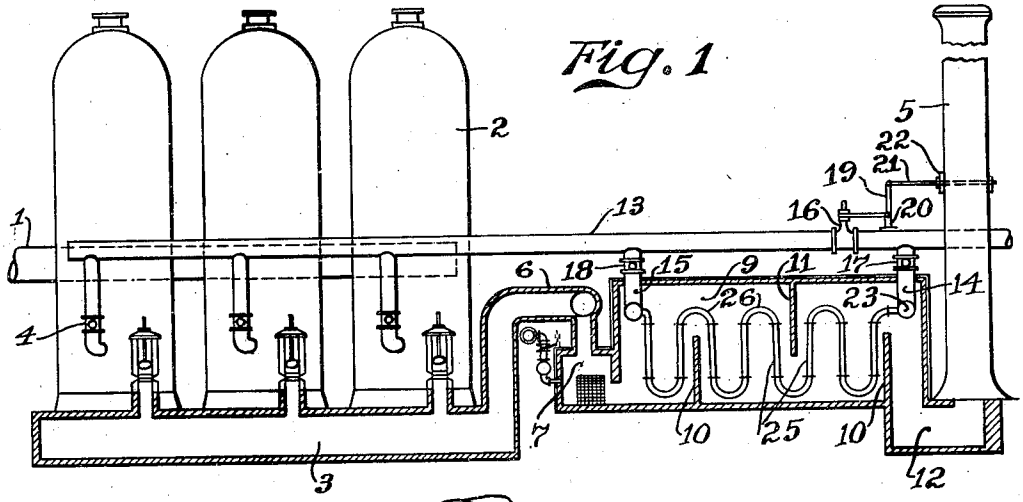
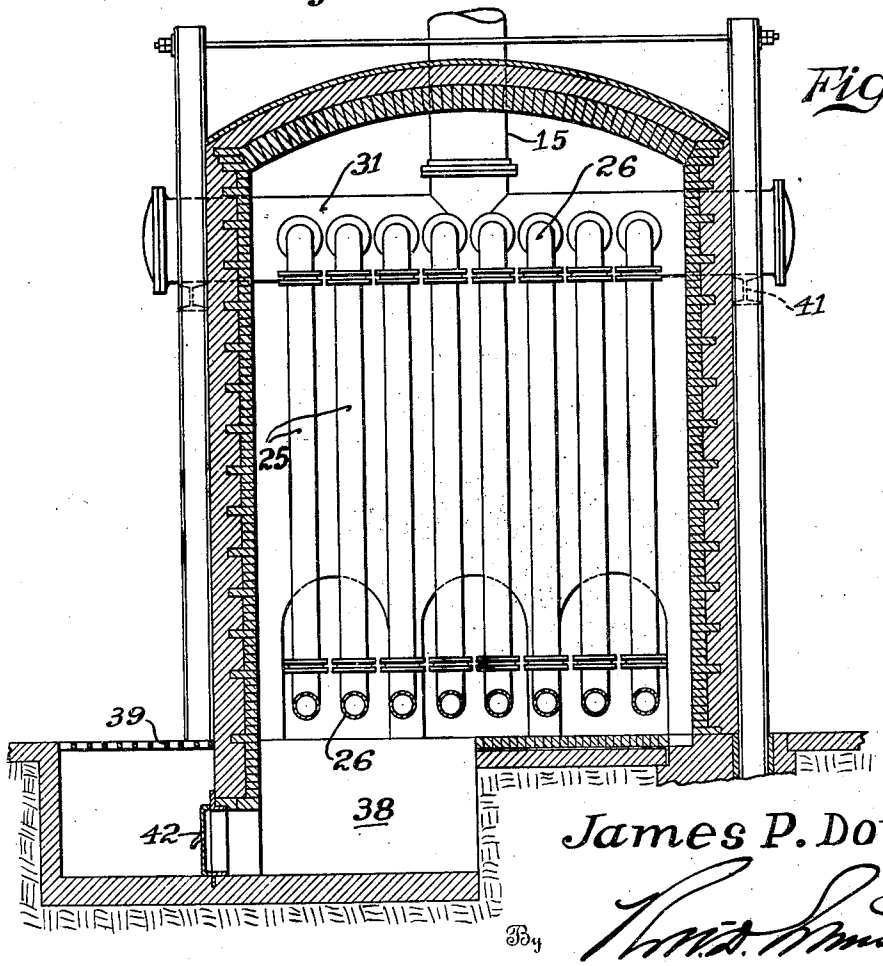


Fig. 2



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Filed Dec. 16, 1926 3 Sheets-Sheet 2

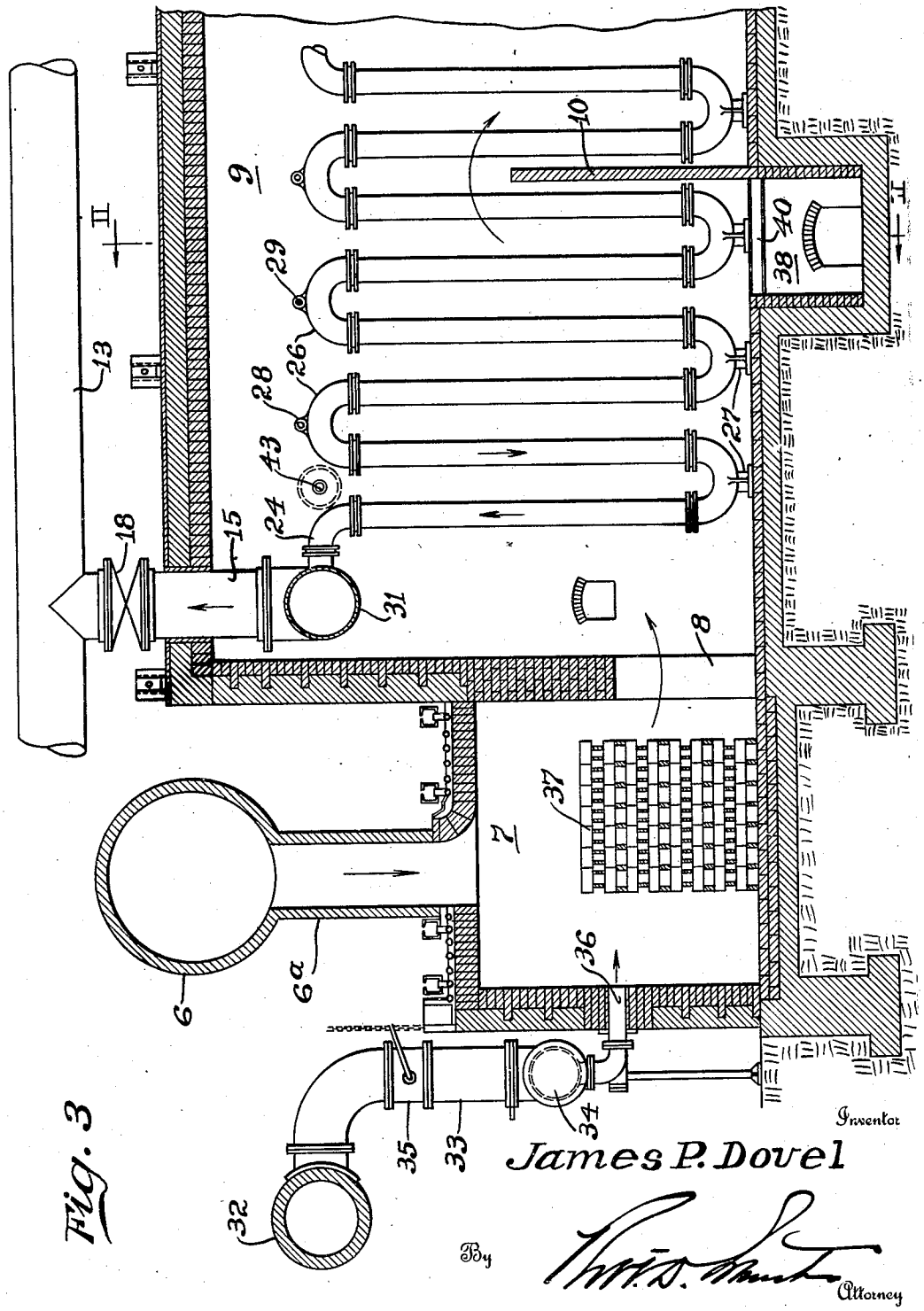


Fig. 3

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Filed Dec. 16, 1926 3 Sheets-Sheet 3

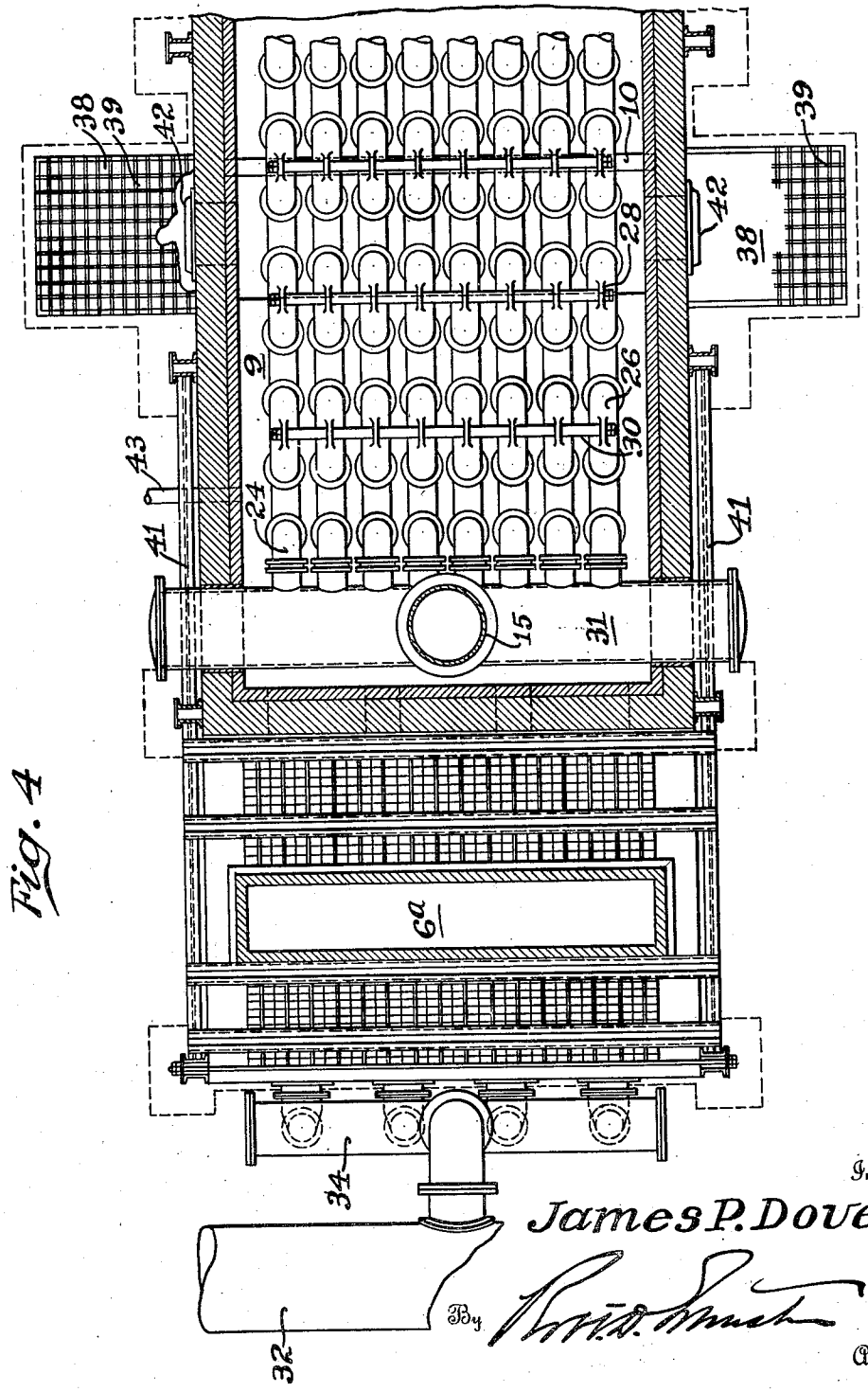


Fig. 4

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UNITED STATES PATENT OFFICE

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APPARATUS FOR HEATING THE AIR BLAST FOR FURNACES AND THE LIKE

Application filed December 16, 1926. Serial No. 155,277.

My invention relates to a new and improved process for the heating of the air blasts delivered to blast furnaces, cupolas, or wherever it is desired to heat the air blast, and to an apparatus for carrying my said process into effect.

While it is to be understood that my invention is applicable for service in heating any type of blast, I shall hereinafter describe it more particularly with reference to its application to blast furnaces, but without thereby intending to limit myself to such specific use.

In Letters Patent No. 1,316,086, issued to me on September 16th, 1919, I have shown and described an air heater connected in a by-pass across the cold air main and through this heater the waste gases from the stoves are passed in their flow to the stack. By controlling the volume of cold air delivered to the heat transfer apparatus it was possible to absorb from the waste gases all heat in excess of that required to maintain the necessary draft in the stack.

In the practical application of this process I have discovered that a more efficient and a materially less expensive means for heating the blast can be had by the simple enlargement or increase in capacity of my air heater and by supplementing the heat supplied thereto by the waste gases with burning gas or a like source of heat of active combustion controllable in amount and regulable so that the aggregate of heat units delivered from the waste gases and the burning gases will enable the heater to preheat the cold air blast to the desired temperature without robbing the stack of its necessary heat, unless the draft therein be maintained by a blower or fan.

Another distinctive feature of my present process is the blending of the low and high temperature gases prior to their delivery to the transfer elements in the air heater, thereby to reduce the temperature of the gases entering the heater sufficiently to avoid injury to the heat transfer elements. It has been demonstrated that the transfer of heat directly through the transfer elements of my present type of heater to the air blast is a more efficient means of heating same than by the indirect methods of the stoves and in practical experience I have demonstrated that my improved air heater for the cold blast, representing an initial installation cost of less than half that of stoves and with practically negligible maintenance cost, has enabled me to dispense with one stove and still to maintain a suitable temperature in the hot blast with a marked economy in consumption. The desirability of blending the high and medium temperature gases delivered to the air heater arises from the fact that from the point of view of prime cost it is desirable to make the heater of standard cast iron pipe which can be obtained at low cost and can be assembled with the available help at the furnace and maintained with but slight expense. Such heat transfer elements would not stand the high temperatures of direct combustion, and to this end my present invention contemplates blending the flame of the burning gases with the waste gases from the stoves in a Dutch oven or equivalent apparatus connected with the air heater and provided with suitable refractory elements therein to insure an equalization of the different temperatures therein of the gases delivered to the heater. The refractory elements in the Dutch oven are of negligible cost and of easy replacement and thus do not represent, to any appreciable extent, an element of cost in the operation of the process.

The practice of my process will be better understood by reference to the accompanying drawings, in which I have illustrated the preferred type of mechanism for carrying same into effect.

Fig. 1 is a view in side elevation of a conventional arrangement of stoves for a blast furnace with the stack flue and air heater shown in vertical cross-section.

Fig. 2 is a transverse detail sectional view of the Dutch oven and the adjacent end of the heater taken along the line II—II of Fig. 3;

Fig. 3 is a vertical longitudinal cross-section of the apparatus; and

Fig. 4 is a sectional plan view of the apparatus.

Similar reference numerals refer to similar parts throughout the drawings.

In the apparatus illustrated, 1 is the hot main from the stoves 2 to the blast furnace or other source of use (not shown), and 3 is the flue by means of which waste gases from the stoves are usually delivered, under control of valves 4 to the stack 5 or equivalent draft maintaining agencies. The flue 3 is adapted to discharge through a flue 6 and connection 6^a into the top of a Dutch oven 7 which has connection, through the ports 8 at its bottom, with an elongated air heater chamber 9 provided at intervals with alternately disposed top and bottom baffles 10 and 11 to cause a tortuous flow of the gases therethrough until discharged through a flue 12 to the stack or other discharge. The Dutch oven and the air heater may be built up in accordance with any standard practice and therefore need not be specifically described otherwise than to state that the construction is such as to withstand stove temperatures. The cold blast main 13 leads above the air heater and is provided with by-pass connections 14 and 15 to the ends of the air heater. I interpose a by-pass valve 16 beyond the connection 14 in the cold blast main, and also a valve 17 for the by-pass connection 14, and a similar valve 18 in the connection 15. The valve 16 is of any suitable type which is adapted to be opened and closed by means of a bell crank 19 pivotally mounted on a standard 20 on the main 13 and having its vertically disposed arm connected to a thermostatic bar 21 which projects into the stack and is slidable through a stuffing-box 22 suitably anchored in the stack. The bell crank is given an adjustable connection to the valve stem, as described in my Letters Patent aforesaid, to which reference is made for a more detailed description of the automatic thermostatic control of the volume of cold air by-passed through the air heater. The cold air entering the air heater by means of the connection 14 is delivered to a header 23 having a transverse series of elbow fittings 24 connected thereto and downturned to receive pipe coils 25 which form the heat transfer elements. These coils extend continuously the full length of the air heater and comprise vertical legs connected top and bottom by U-bends 26, the lower U-bends being seated on low cradles 27 on the floor of the air heater and the U-bends are provided overhead with perforated lugs 28 which receive connecting bars 29 having spacer sleeves 30 interposed so that the heat transfer elements are suitably connected and spaced overhead so as to prevent vibration. Each heating coil at its end delivers the heated air through an end elbow 24 to a header 31 from which the connection 15 leads back to the cold main.

Live gas through a main 32 and connection 33 is delivered to a header 34 under control of the valve 35, and from the header 34 lead suitable burners 36 which deliver through the outer end wall of the Dutch oven. I interpose suitable refractory material 37, preferably in checker-work design in this Dutch oven and I interpose same between the burner nozzles 36 and the ports 8 so that the flame from the burning gases, delivered from the burners 36, will impinge against this refractory mass and be broken up and diverted in all directions to the end that it will become properly and uniformly mixed with the waste gases entering through the connection 6^a, thus causing the gases delivered through ports 8 to enter the air heater at a safe temperature for the durable service of the heat transfer elements therein. As illustrative of what I have in mind, when I refer to equalizing the temperatures of the gases delivered to the air heater, it may be said, by way of illustration, that the burning gases will enter the Dutch oven with a temperature around 2200° F. and that the waste chimney gases will enter around 800° F. The amount of burning gases can be so proportioned that the equalized heat of the gases passing into the air heater will be about 1400° F., which is a safe temperature for the type of heat transfer elements used. Obviously if better heat resistant transfer elements were used in the air heater higher entering gas temperatures could be used therein and thus a greater percentage of burning gases used.

The air heater is provided at suitable intervals, preferably adjacent to its baffles, with transverse bottom openings 38 which extend to each side of the air heater and are there provided with removable gratings 39 by which access may be had for clean out purposes. The cradles 27 falling opposite these openings are supported on cross beams 40 and the ends of the headers 23 and 31, which project through the casing, are supported by cross members 41 of its metallic frame. The clean out space under the gratings 39 is normally shut off from the bottom openings 38 by manhole doors 42. It is of advantage to note that heat transfer coils while suitably supported and braced together, are all free to expand and contract in the air heater and are readily accessible for replacement and repair at any point. In order to keep these heat transfers clear of dust or soot, I provide at intervals soot or dust blowers 43 of the usual type of blowing soot or dust from boiler tubes and the like. By the intermittent use of these blowers I can maintain the heat transfer efficiency of the coils.

In operation, with the apparatus set up and connected substantially in the manner above described, the thermostatic valve 16 will control the volume of cold air by-passed from the cold air main through the air heater, maintaining this volume as large as will leave

the desired amount of heat in the exhaust gases in the stack or like point of discharge, and thus recoverable heat from the waste gases of the stoves is transferred to the cold blast. In order to raise this cold blast to a sufficiently high temperature to enable a part of the stove capacity for the furnace to be dispensed with, I deliver through the burners in the Dutch oven sufficient live gas, which burning in the oven and mingling with the entering waste gases will raise the temperature of such gases as high as may be desired within the limits contemplated for the heat transfer elements of the air heater. To illustrate, if sufficient live gas is burned to raise the temperature of the waste gases entering the air heater to 1400° F., I have found it possible to raise the temperature of the air blast sufficiently to reduce the duty on the stoves enough to enable a part of them to be discontinued and I accomplish this highly desirable end with an outlay as to cost much less than that of the discontinued stove capacity. Moreover, I obtain a much more efficient and more uniform and more accurately controlled transfer of heat to the air blast than where the indirect methods of transferring heat, as by stoves, is employed, and I am able to bring the heat transfer apparatus up to full service very rapidly, which is obviously impossible with stoves. The provision of the refractory mass in the Dutch oven is optional, as any arrangement of design may be provided which will effect a mingling of the gases entering the Dutch oven and an averaging of their temperatures before they enter the air heater.

The feature to which my present invention is broadly directed, consists in a combined live and waste heat means controllable so as to deliver to a heat transfer for the cold blast the requisite volume of blended hot gases to preheat the cold blast to the stoves to the desired extent without at the same time interfering with the necessary draft, for conducting the furnace gases through the stoves and heat transfer to the desired point of utilization or discharge, and without subjecting the heat transfer to excessive temperatures.

Though I have described my invention more particularly as applied to blast furnaces where such term is used, it is inclusive of any type of furnace or heating unit wherein waste gases are present and the preheating of air delivered to the furnace or heater would be desirable.

Though I have described with great particularity the details of the embodiment of the invention herein shown, it is not to be construed that I am limited thereto, as changes in arrangement and substitution of equivalents may be made by those skilled in the art without departing from the invention as defined in the appended claim.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent, is:—

In combination, stoves having a main for the discharge of waste gases therefrom and a main for the supply of cold air thereto, a heat recuperating means having a combustion chamber provided with means to produce therein high temperatures by active combustion, means to commingle said waste gases with the high temperature gases of active combustion and pass the commingled gases through said combustion chamber and heat recuperating means, refractory elements in said combustion chamber interposed in the path of the waste gases and the gases of active combustion to more effectively mix the same before they pass into the heat recuperating means, and means to pass air through said heat recuperating means into said cold air main.

In testimony whereof I affix my signature.

JAMES P. DOVEL.