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AIR HEATING

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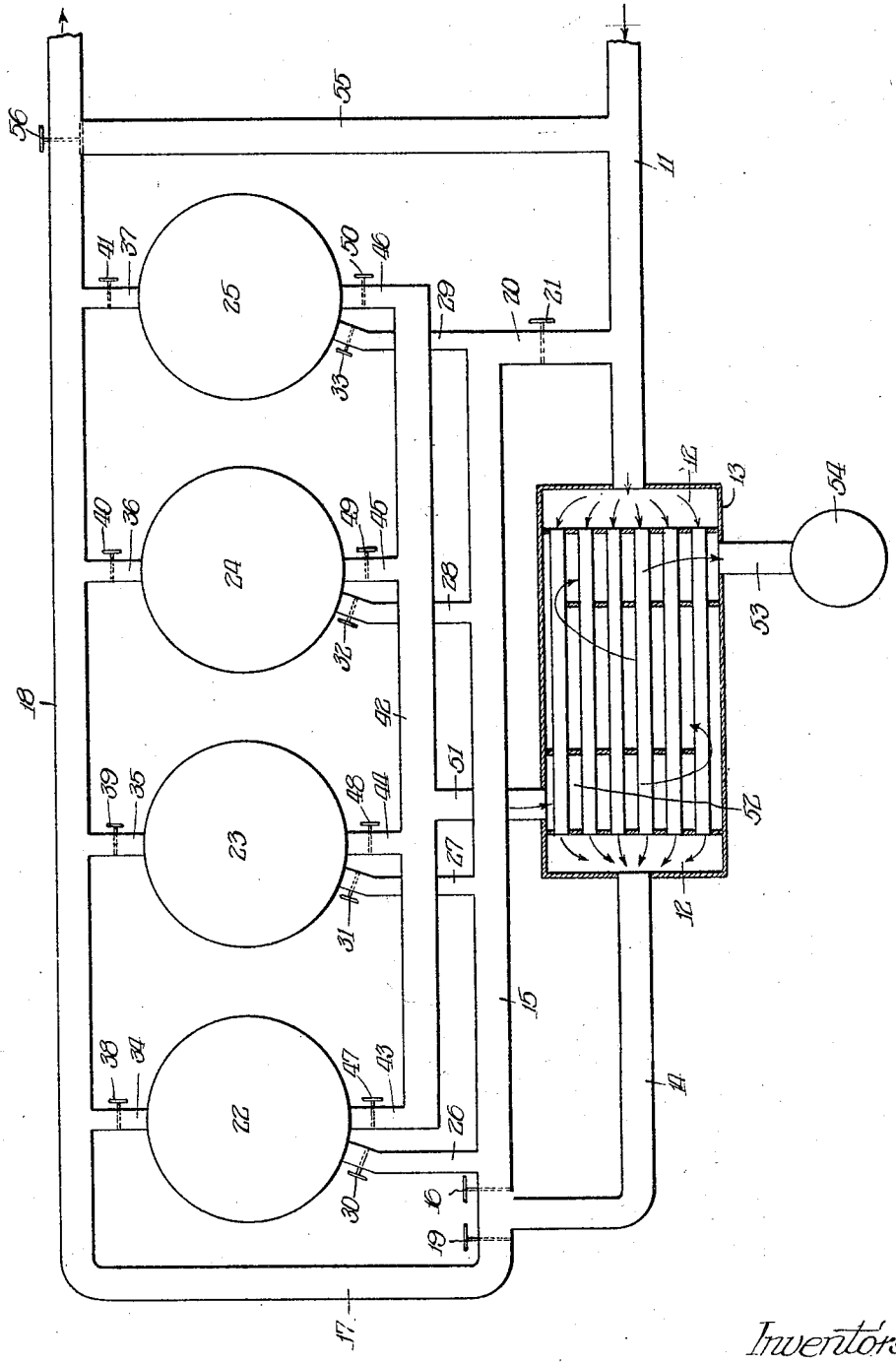

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AIR HEATING

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This invention relates to a new and improved method of heating air, and more particularly of heating the blast air for blast furnaces.

At the present time a blast furnace is usually equipped with either three or four air heating stoves, usually the latter. Three of these stoves are normally being heated by gas, and the fourth is in turn heating the incoming cold air. A by-pass connection from the cold main to the hot main, controlled by what is known as a mixing valve, is in general use in order that the temperature of the air going to the furnace may be maintained fairly uniform. This is necessary as the stove when first put on air is very hot and gradually cools down as the cold air absorbs heat from it. Likewise when the stove is being heated by burning gas, the temperature of the outgoing products of combustion gradually rises until at the end of the heating period the temperature may be around 1000° or 1200°, whereas on the start it is often as low as 400° to 500°. The stack temperature where two or three stoves are being heated, remains practically constant at around 600° to 700° and often reaches 800° where high heats are being carried on the furnace.

According to the method of our invention a recuperator is interposed between the stoves and stack and a portion of the heat going to the stack is recovered by air going to the stoves, or to the blast furnace. Where such a recuperator is used, it will become possible to permit the products of combustion to leave the stoves at a higher temperature than in usual practice, since a considerable portion of the remaining heat may be recovered in the recuperator.

It is well known that the amount of heat which can be put into the blasting air by a stove is in direct proportion to he heat in the brickwork of the stove. By our invention the temperature of the stove and consequently the heat therein, may be increased, without increased loss of heat to the stack, as would be the case in ordinary methods of operation with usual stoves. The heat head in the stove is thus increased and such portion as desired of the incoming air may be preheated in the recuperator. By this method of operation smaller stoves may be used or higher blast air temperatures may be reached with existing stoves. This latter feature is highly important as the present tendencies are toward higher heats in blast furnace operations and in many cases the stoves now in use are not of sufficient size to give higher temperatures without undue loss of efficiency due to high stack temperatures.

There have been various recent developments in gas cleaning apparatus, including the introduction of the vortex types of dry cleaners for removing dust from the blast furnace gas to be used in heating stoves or for other purposes. It is important in the use of our invention that the gas be cleaned so as not to deposit dirt in the stoves or more particularly in the recuperator. The particular methods or apparatus used for cleaning the gas form no part of the present invention, but for efficient operation of our method, it is desirable that the gas be cleaned so as to contain not more than .05 grains per cubic foot. With dirty gas there will be such deposits in the recuperator as to adversely affect the efficiency of the heat transfer.

It is an object of our invention to provide a new and improved method of heating air, particularly for blast furnaces or the like.

It is a further object to provide a method whereby increased temperatures may be secured without undue loss of heat through the stack.

It is an additional object to provide a method whereby the temperature of the hot blast may be adequately controlled throughout the cycle of operation without undue heat losses.

It is also an object to provide a method which may be adapted to existing stoves by the addition of suitable apparatus and thereby raise the temperature of the blast supplied by said stoves.

Other and further objects will appear as the description proceeds.

We have illustrated somewhat diagrammatically in the accompanying drawings one preferred embodiment of apparatus for car-

rying out our invention. The single figure of the drawing is a diagrammatic showing of a construction adapted for carrying out our invention, certain parts being shown in section.

The cold blast main 11 is connected to the portion 12 of the recuperator 13, this portion 12 being also connected through the passage 14 with the secondary cold blast main 15. The connection between the passage 14 and the passage 15 is controlled by valve 16. The passage 14 is also connected by means of passage 17 with the hot blast main 18, this connection being controlled by valve 19. The cold blast main 11 is also cross-connected by passage 20 with the secondary cold blast main 15, the passage 20 being controlled by valve 21.

The secondary main 15 is connected to the hot blast stoves 22, 23, 24 and 25 by means of passages 26, 27, 28 and 29 which are controlled by valves 30, 31, 32 and 33, respectively. The stoves 22, 23, 24 and 25 are connected to the hot blast main 18 by passages 34, 35, 36 and 37, controlled by valves 38, 39, 40 and 41, respectively. The stoves 22, 23, 24 and 25 are connected to the outgoing flue 42 by means of passages 43, 44, 45 and 46, controlled by valves 47, 48, 49 and 50, respectively. The flue 42 is connected by passage 51 with the portion 52 of the recuperator 13, which portion of the recuperator is also connected by flue 53 to the stack 54. The cold blast main 11 is cross-connected to the hot blast main 18 by means of the passage 55, this connection being controlled by the mixing valve 56.

The connections for introducing the combustible gases and air for combustion to the stoves may be of any suitable form and have not been shown as they are well known in the art and have no bearing on the present invention.

In the operation of the stoves, normally three of the stoves will be heated by blast furnace gases burned therein while the remaining stove is serving to heat the blast air for the blast to the furnace. For example, if stoves 22, 23 and 24 are being heated, valves 38, 39 and 40 will be closed, disconnecting the stoves from the hot blast main, and valves 30, 31 and 32 will be closed disconnecting the stoves from the secondary cold blast main 15. The products of the combustion in the stoves will pass through passages 43, 44 and 45, the control valves being open, to the flue 42, and through passage 51 and portion 52 of the recuperator by passage 53 to the stack 54. These gases will serve to heat any air passing through the other portion 12 of the recuperator.

The fourth stove 25 will be serving to heat the air being sent to the furnace for blast purposes. The temperature of this air may be controlled in several manners. All of the air will enter through the cold blast main 11. The valve 21 may be open partially so that some of the air from the main, which air is at atmospheric temperature, may pass through passage 29, valve 33 being open, directly to the stove 25. In addition, the valve 16 may be open so that some air from the cold blast main 11 may pass through the recuperator 13 and be heated therein and then pass through the secondary cold blast main 15 and mix with the air at atmospheric temperature, passing through the passage 29 to the stove 25. By varying the adjustment of valves 16 and 21, any desired proportion of preheated air and cold air may be provided for introduction into the stove.

The valve 41 will be opened and the heated air from the stove will pass through passage 37 to the hot blast main 18. The temperature of this air blast may be modified by the admixture of controlled quantities either of air at atmospheric temperature or of air which has been preheated in the superheater or of air from both such sources in any desired proportion. If air from the superheater is to be used the valve 19 will be open any desired amount and this air will pass through passage 17 to the hot blast main 18. If air at atmospheric temperature is desired, the mixing valve 56 may be open any suitable amount and atmospheric air will be led from the cold blast main 11 through passage 55, to the mixing valve and there mixed with hot blast air from the stove or from the stove and the superheater, if air from the superheater is used.

It will be apparent that by means of our construction and method of operation a very wide control may be maintained over the temperature of the blast air. The stoves may be operated at high efficiency since the temperature of the outgoing blast gases from the stove may be high as a further recovery of the heat of these gases is made in the superheater. This high temperature of the outgoing end of the stove for blast gases permits the air to be introduced into the stove at an end of the stove which is at high temperature and results in increased heating efficiency.

We have shown somewhat diagrammatically one form of layout suitable for carrying out our invention, but this is to be understood to be illustrative only as other constructions may be used and we contemplate such changes and modifications as come within the spirit and scope of the appended claims.

We claim:

1. The method of providing hot blast air for furnaces which comprises heating a portion of the required air to a high temperature, heating another portion of air to a lower temperature, and mixing said heated portions in controlled amounts to provide a hot blast of the desired temperature.

2. The method of providing hot blast air

for furnaces which comprises heating a portion of the required air to a high temperature, heating another portion of air to a lower temperature, drawing a third portion of air from the atmosphere at normal temperature, and mixing said three portions of air in controlled amounts to provide a hot blast of the desired temperature.

3. The method of providing hot blast air for furnaces which comprises heating said air to a lower temperature, further heating a portion of said heated air to a higher temperature, and mixing said portions of air at higher and lower temperatures in controlled amounts to provide a hot blast of the desired temperature.

4. The method of providing hot blast air for furnaces which comprises heating said air to a lower temperature, further heating a portion of said heated air to a higher temperature, and mixing said portions of air at higher and lower temperatures together with a third portion of air at atmospheric temperature in controlled amounts to provide a hot blast of the desired temperature.

5. The method of providing hot blast air for furnaces which comprises passing the air through a recuperator to raise its temperature, passing a portion of the air through a stove to further raise its temperature, and mixing air from the stove and air direct from the recuperator in controlled proportions to provide a hot blast of the desired temperature.

6. The method of providing hot blast air for furnaces which comprises passing the air through a recuperator to raise its temperature, passing a portion of the air through a stove to further raise its temperature, and mixing air from the stove and air direct from the recuperator together with additional air at atmospheric temperature in controlled proportions to provide a hot blast of the desired temperature.

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