

Jan. 23, 1940.

P. SCHWARZE

2,188,289

AIR HEATER FOR BLAST FURNACES

Filed Oct. 14, 1938

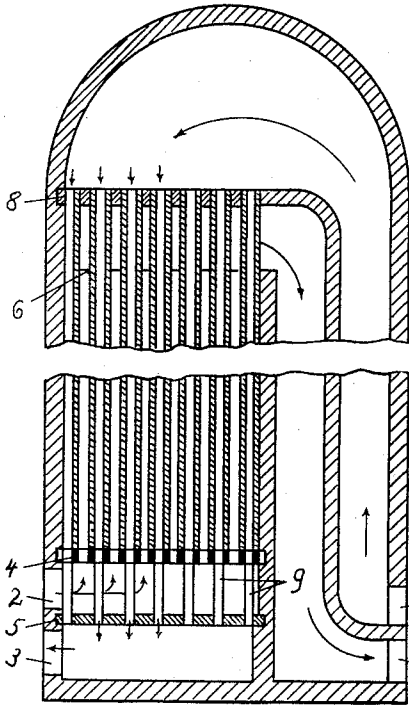


Fig. 1

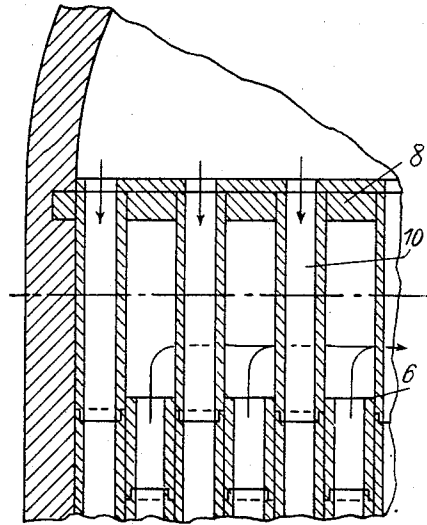


Fig. 2

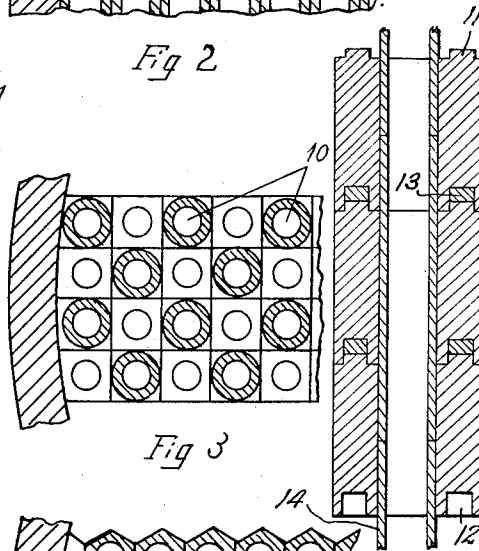


Fig. 3

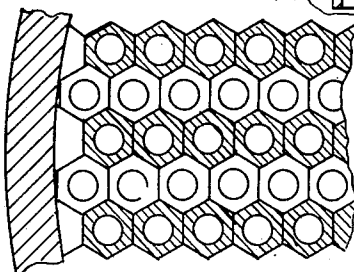


Fig. 4

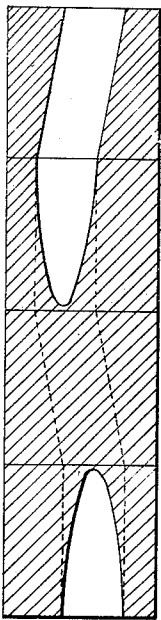


Fig. 7.

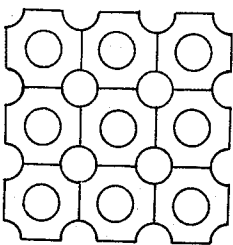


Fig. 5

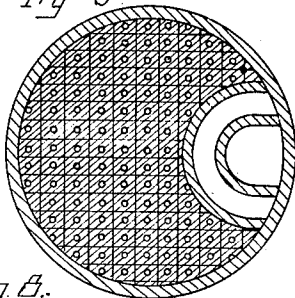


Fig. 8.

Inventor:

[Signature]

UNITED STATES PATENT OFFICE

2,188,289

AIR HEATER FOR BLAST FURNACES

Paul Schwarze, St. Gallen, Switzerland

Application October 14, 1938, Serial No. 235,011
In Germany October 21, 1937

8 Claims. (Cl. 263-20)

As air heaters for blast furnaces almost exclusively heat accumulators of brick are used which are alternately changed over to gas and air. They operate intermittently and not with constant temperature. Therefore, lately it has been attempted to heat the air in recuperators, in which the air flows in steel tubes externally heated by the hot gases. By employing high grade steel the temperatures necessary for blast furnace operation can be maintained. Although such recuperators operate continuously, they require frequent repairs and their useful life is comparatively short.

The present invention has for its object to provide an air heater, which operates after the manner of the said recuperators, but is made wholly or mainly of firebrick, thereby combining the advantages of continuous operation and constant temperature with the durability of the well known hot blast stoves. It consists in employing, for the purpose of enabling the construction of sufficiently long and tight flues required for obtaining the necessary temperatures, hollow bricks with one or more passages of a similar type as those already used or proposed for heat accumulating structures. The bricks are built up to form within the usual outer walls adjacent columns which mutually support one another. The passages of the bricks form flues in known manner substantially parallel to each other but, according to the invention, only part of them is used for the passage of the hot gases, while the remaining part is arranged for the simultaneous passage of the air to be heated, preferably in counterflow.

Various embodiments of the invention are illustrated by way of example in the accompanying drawing.

Fig. 1 is a longitudinal section of an air heater according to the invention.

Fig. 2 shows a section of the upper part of Fig. 1 on a larger scale.

Fig. 3 is a cross section of Fig. 2.

Figs. 4 and 5 show other embodiments of the inner structure.

Figs. 6 and 7 are longitudinal sections of details of the inner structure.

Fig. 8 is a cross section of the centre part of an air heater showing another arrangement of the combustion and air shafts.

In Fig. 1 the outer shape corresponds to that of the well known hot blast stoves for blast furnaces. The combustion shaft is subdivided, because under otherwise equal conditions only about half the quantity of gas is required. The

gases enter the shaft at 1, are burnt as usual by the admission of air and the heating gases enter the flues from the dome. The flues are formed by superposing suitably shaped hollow bricks. Part of the flues is closed at the top by the panel 8. Thus the gases can only enter the passages which are open at the top and are discharged at 3 to flow to the chimney. The air enters the flues not used for the gases at 2 and flows upwards. These flues terminate at 6 and owing to the provision of the closing panel 8 the air must turn into the discharge shaft and leave the recuperator at 7 to pass into the blast furnace.

Figs. 2 and 3 show the manner in which the upper part of the air heater may be constructed. Square bricks provided with round passages are used. The passages for the air terminate at 6, while the gas passages are continued up to the panel 8 and through this. The panel 8 covers the space above the air conduits, it may also be formed as an arch and conveniently a further closure may be provided above the panel for better sealing. In order that the air may pass laterally past the upwardly extending gas conduits, the bricks above the line 6 are not of square shape, but tubular, whereby sufficient interspace is provided for the lateral passage of the air. Obviously, this may be achieved by other constructions, for example as shown in Fig. 4. In this case hexagonal bricks with round openings are employed and some rows of these terminate at the line 6, while the other rows are continued upwards, whereby the conduits of the gas and air form sheets.

The construction of the lower part may be effected in a similar way. In Fig. 1 the usual grate is indicated at 4 and carries the columns of bricks, while the downwardly extended tubes 9 are carried by the plate 5. The tubes 9 as also the plate 5 may be made of metal, because at this point only comparatively low temperatures occur.

In the embodiment shown in Figs. 3 and 4 separate bricks are provided for the gas and air conduits, the joints of said bricks being preferably staggered. In this case the heat transfer must take place through two contacting walls of brick. In order to avoid this, hollow bricks of the kind may be employed which form additional passages when placed side by side owing to their shape or the provision of recesses in their edges, as shown for example in Fig. 5. It is useful to provide for good fit by means of projections and recesses at the end surfaces of

the bricks, and also to provide good connection with the aid of refractory mortar or cement, to avoid mingling of gas and air through the joints. It may also be of advantage for this purpose to insert fitting metal tubes into the gas or air passages, as shown at 14, Fig. 6. This figure also shows how the bricks are provided with projections 11 and recesses 12 and sealed by the mortar 13.

It is also possible to employ bricks with a plurality of passages and offering relatively large heating surfaces, as used in heat accumulators, and such, which on assembly provide additional passages of larger or less diameter between the bricks, than the passages in the bricks themselves.

Under otherwise equal conditions the length of the flues may be reduced by employing bricks according to my copending United States application Serial Number 203,063, filed April 20, 1938. As shown in Fig. 7 they have straight or approximately straight passages, but upon assembly form helical passages or passages which extend helically along the walls only. Thereby the transfer of heat is considerably speeded up.

The bricks in the lower and central part of the air heater may be the usual firebricks, the heat conductivity of which improves with the increase of temperature. These bricks are generally better heat conductors the higher their specific weight. For the upper zones of the air heater, which are exposed to high temperatures, bricks of suitable quality must be employed. For this purpose silicon carbide bricks may be used, which in addition to greater resistance have a greater heat conductive capacity. A silicon carbide mass may also be used for coating the passages in the firebricks, whereby the heat transfer is speeded up. The uppermost parts of the gas tubes may be made of high grade steel.

The combustion shaft and air shaft may be disposed otherwise than in Fig. 1, for example the latter may surround the combustion shaft as shown in Fig. 8. The air and gas may be guided otherwise than shown in Fig. 1, for example so that the air enters at 3 and is discharged at 1. Complete reversal is also possible, in such a way that the lower part of the air heater serves as combustion chamber and the gases are guided upwards, while the wind flows through the flues from the dome downwards.

The present invention enables the air heater to be built of firebricks and to work it continuously at constant temperature, whereby in consequence of sufficiently long flues the air temperature necessary for the operation of blast furnaces is obtained in spite of the comparatively great thickness of the brick walls. The almost unlimited durability of refractory bricks makes a recuperator constructed in this manner much superior to metal constructions.

What I claim as my invention and desire to secure by Letters Patent of the United States is:

1. Air heaters for blast furnaces comprising adjacent columns of hollow bricks; the passages in said bricks combining to form continuous and substantially parallel flues in said columns; one part of said flues being adapted to conduct

the heating gases; and the other part of said flues being adapted to simultaneously conduct the air to be heated.

2. Air heaters for blast furnaces comprising adjacent columns of hollow bricks; the passages in said bricks combining to form continuous and substantially parallel flues in said columns; one part of said flues being adapted to conduct the heating gases from above downwards and the other part of said flues being adapted to simultaneously conduct the air to be heated in the opposite direction.

3. Air heaters for blast furnaces comprising adjacent columns of hollow bricks; continuous flues in said columns formed by the passages in said bricks; supplementary and substantially parallel flues between said columns; one part of said flues being adapted to conduct the heating gases; and the other part of said flues being adapted to simultaneously conduct the air to be heated.

4. Air heaters for blast furnaces comprising adjacent columns of bricks; said bricks having passages inclined to their end surfaces; said inclined passages combining to form helically extending flues when the bricks are assembled in angular relation; one part of said flues being adapted to conduct the heating gases and the other part of said flues being adapted to simultaneously conduct the air to be heated.

5. Air heaters for blast furnaces comprising hollow bricks which are superposed to form columns whereby said hollow bricks combine to form continuous flues; one part of said flues being adapted to conduct the heating gases; the other part of said flues being adapted to simultaneously conduct the air to be heated; and metal tubes inserted into said flues.

6. Air heaters for blast furnaces comprising hollow bricks which are superposed to form adjacent columns whereby said hollow bricks combine to form continuous flues; one part of said flues being adapted to conduct the heating gases; the other part of said flues being adapted to simultaneously conduct the air to be heated; and extensions to said flues at the top and bottom adapted to leave room for deflecting the gas or air.

7. Air heaters for blast furnaces comprising hollow bricks which are superposed to form adjacent columns whereby said hollow bricks combine to form continuous flues; one part of said flues being adapted to conduct the heating gases; the other part of said flues being adapted to simultaneously conduct the air to be heated; and projections and recesses at the end surfaces of said bricks adapted to stop up the joints with refractory cement.

8. Air heaters for blast furnaces comprising hollow bricks which are superposed to form adjacent columns whereby said hollow bricks combine to form continuous flues; one part of said flues being adapted to conduct the heating gases; the other part of said flues being adapted to simultaneously conduct the air to be heated; and a combustion shaft which is wholly or partly surrounded by the air shaft.

PAUL SCHWARZE.