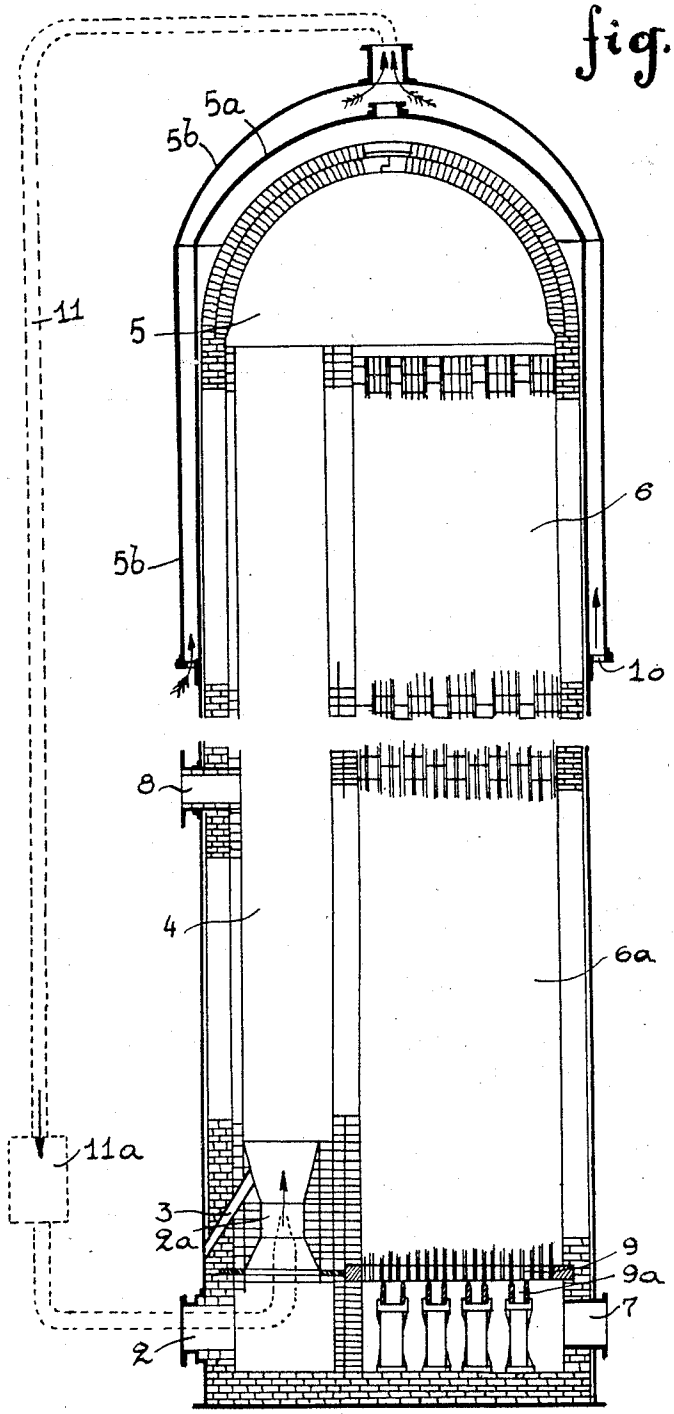
Jan. 24, 1933. G. SIMON 1,895,235

HEAT RECUPERATING APPARATUS OF THE COWPER TYPE AND A BRICK FOR THE HONEYCOMB STRUCTURE

Filed Dec. 23, 1931 3 Sheets-Sheet 1

fig. 1.




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HEAT RECUPERATING APPARATUS OF THE COWPER TYPE AND A BRICK FOR THE HONEYCOMB STRUCTURE

Filed Dec. 23, 1931 3 Sheets-Sheet 2

fig. 2.

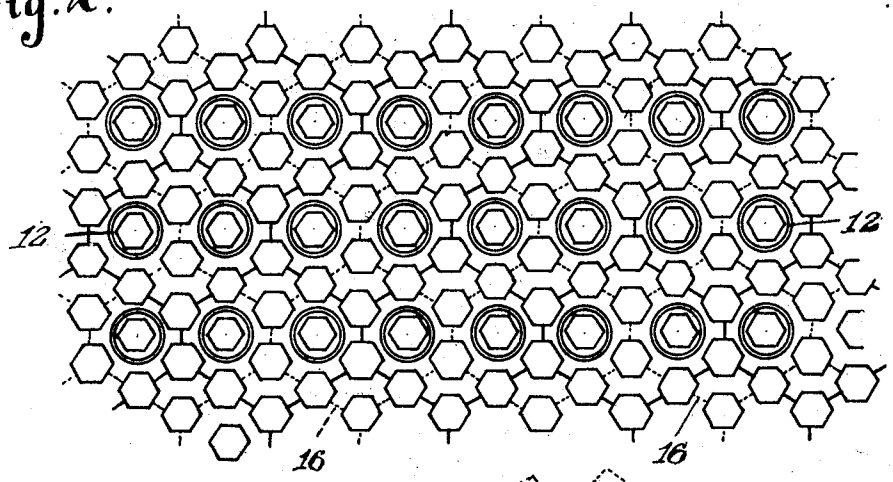



fig. 3.

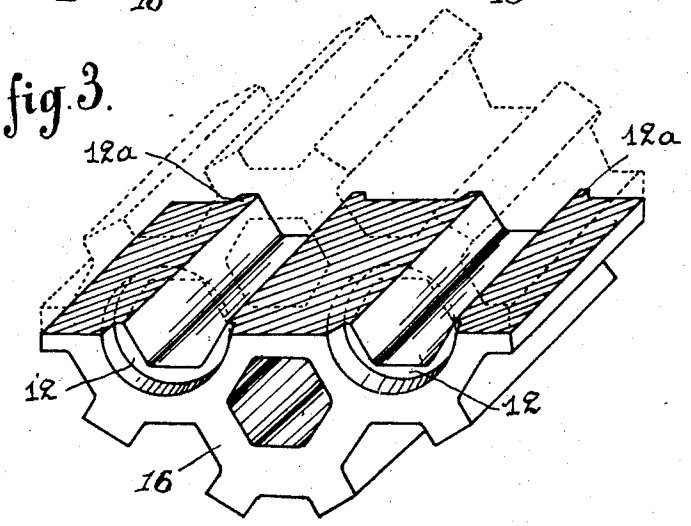
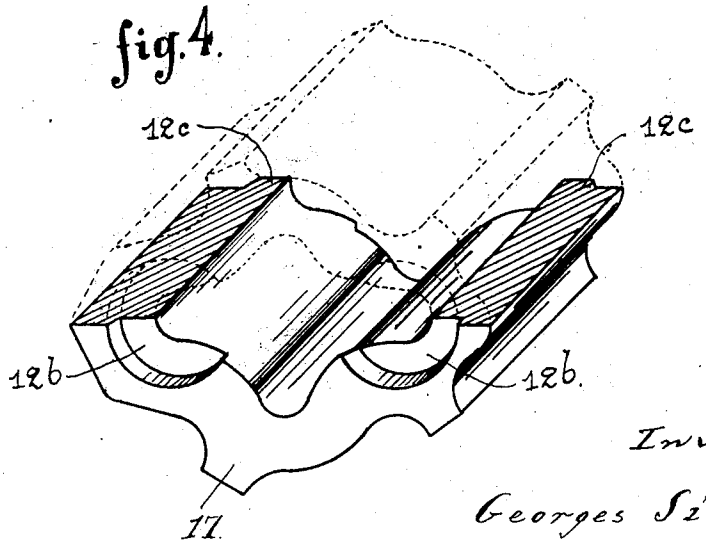



fig. 4.




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Filed Dec. 23, 1931 3 Sheets-Sheet 3

fig. 5.

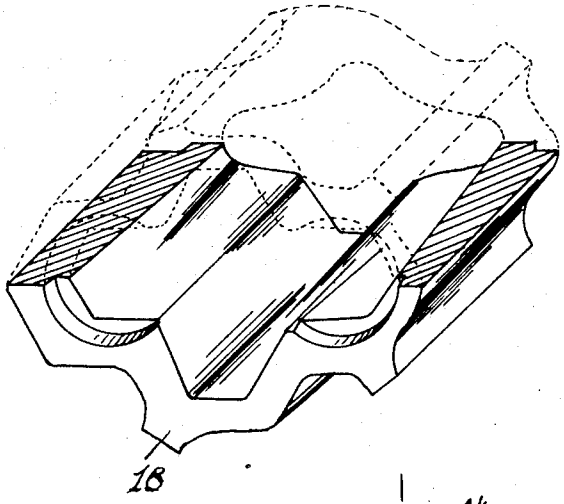
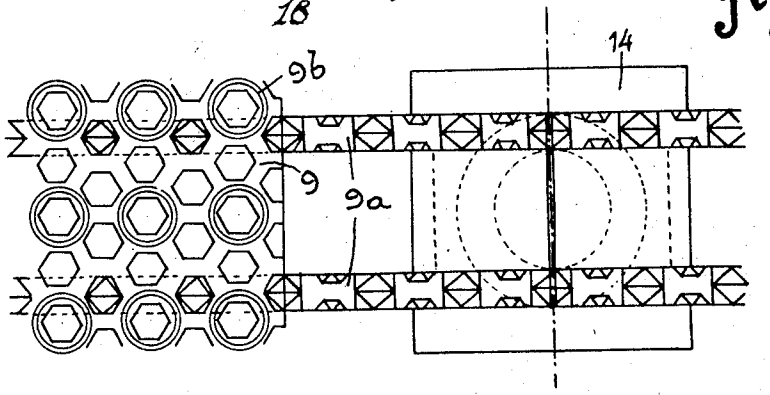



fig. 6.



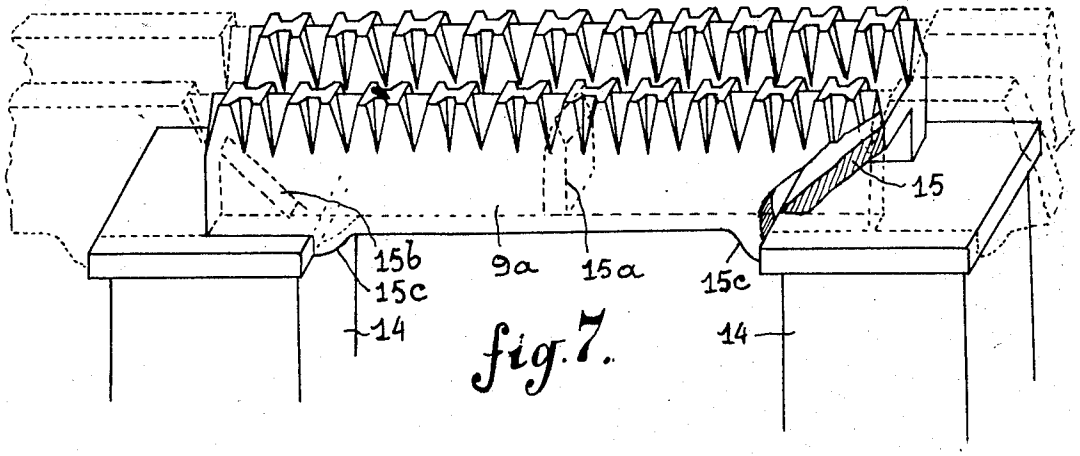




fig. 7.

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# UNITED STATES PATENT OFFICE

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## HEAT RECUPERATING APPARATUS OF THE COWPER TYPE AND A BRICK FOR THE HONEYCOMB STRUCTURE

Application filed December 23, 1931. Serial No. 582,897.

The present invention relates to a heat recuperating apparatus of the Cowper type, comprising a checkerwork or stack of refractory bricks, forming longitudinal ducts through which the gases flow.

These checkerworks which are of hexagonal section have been in current use for five years, and are at the present time employed in some thirty installations. They have the great advantage in the first place of comprising no sharp angles (right angle or acute angle) and in the second place of having a heating surface which is strictly proportional to the heat capacity. The gas passes through them with practically no resistance, and without leaving any trace of dust therein.

Up to the present time these interlocking bricks formed long "candles" mounted at fairly considerable heights, and, like all other systems, employing the same type of stacking that formed an arrangement which in time, as the result of contractions, developed tendencies to move, to deviate from their original vertical position and to collapse at certain points for a height of several metres.

Moreover, whatever may be the conditions of working with this type of stacking, heat is transmitted in a very rapid and intense manner to the upper part of the apparatus, thus producing distortions and irregular contractions and a very low thermal efficiency in the lower two thirds of the apparatus, together with very different fluid speeds. In spite of these phenomena, the efficiency of the apparatus reaches 84%.

According to the invention and in order to remove this disadvantage, the exchange of heat between the hot gases and the bricks is increased as these gases approach the outlet end of the apparatus, and for this purpose the stacking is formed of different bricks which, while leaving a practically constant section of passage for the gases, have, in the direction of flow of the hot gases, a useful surface increasing in ratio with their volume.

These bricks and particularly the lower bricks of the checkerwork are so shaped that they permit a locking and interengaging stacking to be formed.

The grating supporting these bricks is shaped to suit the checkerwork it supports. In comparison with existing gratings it has the advantage of being lighter and more simple.

In the known regulating apparatus with accelerated draught it has up to the present time been possible to recover from 80–87% of the heat. The losses may be considered to be due to:

1. 3–7% at the chimney;
2. 10–13% by radiation (average 12%).

The greater part of this radiation comes from the cupola and to 7 or 8 metres below the cupola. The cupola in fact concentrates the highest internal temperature and cannot be insulated as perfectly as the remainder of the apparatus. Moreover, on account of its elevated position, it is more strongly subjected to all atmospheric influences, such as rain or snow, wind and frost.

This difficulty has hitherto been remedied by increasing the thickness of refractory material and also by making the cover of the apparatus overlap. Neither the radiation nor the result of the above mentioned influence has been completely overcome.

In order to remove this disadvantage, according to the invention, the air intended for the combustion is made to flow through a casing which surrounds the upper part of the apparatus. In this manner the air injected, instead of being cold, is raised to a temperature for example of 70–80° C. by the recuperatiton of a part of the radiated heat, and the apparatus is thus actually removed from atmospheric influence.

The accompanying drawings illustrate by way of example and in a nonlimiting manner one embodiment of the invention. The invention also extends to the various original features which the arrangement shown comprises.

Figure 1 is a diagrammatic sectional view of a Cowper apparatus according to the invention.

Figure 2 is a plan view of a portion of a lower layer of bricks in the checkerwork.

Figures 3, 4 and 5 are respectively perspective partial views of a brick in the lower

part of the honeycomb, a brick in the upper part of the honeycomb, and an intermediate connecting brick. These various bricks are cut along a plane passing through their centre with the object of making the drawing more clear.

Figure 6 is a plan view of a portion of the grating and of the support carrying the grating.

Figure 7 is a perspective view of a support with parts cut away.

In the apparatus shown in Figure 1, the combustible gases (blast furnace gases) are led through the duct 2, passed through a convergent-divergent nozzle 2*a* and then burned in the presence of oxidizing air injected under pressure. The combustion of the gases is completed in the well 4. When the burnt gases have reached the cupola 5 they again descend through the ducts 6 and 6*a* of the checkerwork, which they heat and then escape through the ducts 7 to the chimney.

When the apparatus cools, fresh air enters through the duct 7, passes through the checkerwork in which it is heated and then escapes through the duct 8 from which it is delivered to suitable consuming apparatus such as blast furnaces.

The upper part 6 of the checkerwork is formed by a stack of bricks 17 in which the ratio between the surface and the volume of each brick 17 is smaller than the same ratio in the case of the bricks 16 forming the lower part 6*a* of the stack.

Between these two parts of the checkerwork is interposed a layer of bricks 18 of special form, for connecting together the shapes of the upper and lower bricks. These various kinds of bricks are described hereinafter.

The checkerwork structure is carried by a grating 9 resting on supports 9*a*.

The sheet metal cupola 5*a* is covered by another cupola 5*b* which is substantially concentric, and projects out over a certain part of the height of the apparatus, for example a quarter. These two cupolas between them form a spherical and cylindrical air jacket. The base of this jacket is pierced with numerous holes such as 10. The upper part of this jacket is connected by a heat insulated pipe 11 (shown in dotted lines) with a fan shown diagrammatically at 11*a*. The air for combustion is drawn in through the holes 10, heated by its passage through the jacket, flows through the duct 11 and is delivered by the fan to the duct 2*a*. Thus, instead of delivering cold air, air is injected which has a temperature of about 70–80° C.

The advantages of this method are chiefly as follows:

1. The initial cupola 5*a* and the apparatus itself are protected in a practical manner from atmospheric influences;

2. The loss in temperature is very small, as the ducts such as 11 are heat insulated, as also may be the cupola 5*b* itself;

3. The saving in heat is about 1% on the total delivery of the blast furnace to which the Cowper apparatus is coupled.

The bricks forming the lower part 6*a* of the stack comprise four holes, as will be seen in Figures 2 and 3. Two of these holes are provided on one side with a seating 12 while the other side of the brick comprises a circular projection 12*a* whereby the bricks can interengage. When a number of these bricks are connected together, they have in plan view the appearance shown in Figure 2, in which the joints between each of the bricks are shown in full lines. The arrangement of two successive layers of bricks is established by a relative displacement between the bricks of each layer, so that one brick in the upper layer serves for connecting two adjacent bricks in the lower layer.

In Figure 2 the joints between the bricks in the upper layer are shown in dotted lines. This enables the arrangement of these bricks to be followed with ease. The locking and interengaging stack of bricks thus formed is very rigid. Moreover, the holes in the bricks coincide and form ducts which have no sharp angles.

Figure 4 shows a view of a brick forming the upper part of the checkerwork. This brick comprises one hole only. In comparison with the brick shown in Figure 3 the ratio of the useful surface to the volume of the brick is smaller than in the case shown in Figure 4. This brick also comprises seatings and projections 12*b* and 12*c* similar to those shown in Figure 3.

The connection between the upper part of the stack employing the bricks shown in Figure 4 and the lower part employing the bricks shown in Figure 3, is obtained by bricks such as that shown in Figure 5. These bricks comprise one hole only, which on one face (back face) is identical to the holes in a brick of the upper checkerwork and on the other face (front face) has the form of a cover for the four holes in a brick of the lower part of the honeycomb.

Seatings and projections identical to those shown in Figures 3 and 4 are provided on the bricks shown in Figure 5.

The grating 9 (Figure 6) is formed of plates of suitable dimensions with regard to the distance between the supports such as 9*a*. These plates are pierced with holes which are identical both in form and arrangement to those in the lower bricks. Some of these holes may be provided with projections such as 9*b* for cooperating with the recesses in the lower stack of bricks.

The supports 9*a* which carry these gratings are placed on supporting columns 14. They are formed by two parallel beams 9*a* stayed

by cross ribs 15, 15*a*, 15*b* cast with the beams. These beams are also provided at their lower part with abutments 15*c* cooperating with the upper part of the columns 14.

As shown in Figure 7, the upper part of each of the beams is provided with recesses for giving freedom to the holes in the grating which are situated immediately below these beams (Figure 6).

For this purpose the recesses are formed laterally in the case of holes which only fall partly on the said beams, while the upper part of these beams is bevelled when the holes lie over the whole thickness of the beam.

Naturally the invention is not limited to the form of the recesses shown.

It is to be understood that the method and apparatus described above must simply be considered as a constructional example of the invention, and that numerous modifications may be made in the spirit of the invention or in the scope of the following claims.

What I claim is:

1. In a heat recuperating apparatus of the Cowper type, a checkerwork of refractory material formed by superposed horizontal layers of joined bricks, each brick being elongated and provided with a plurality of apertures for the formation of channels for the passage of gas, the bricks of successive layers being intercrossed in a manner such that the apertures forming passages of one brick of one layer correspond with the apertures of a plurality of bricks of adjacent layers, annular seats surrounding one extremity of two of the apertures of each brick, annular projections corresponding to the seats formed at the other extremity of the two apertures, the bricks of each layer being constructed in a manner such that the apertures provided with seats and the annular projections are positioned at the angles of regular polygonal figures, the sides of which are equal and parallel, the projections provided on one brick of one layer being engaged in the seats of two bricks of an adjacent layer.

2. In a heat recuperating apparatus of the Cowper type, a checkerwork of refractory material formed by superposed horizontal layers of joined bricks, each brick of the lower portion of said checkerwork being elongated and provided with a plurality of apertures for the formation of channels for the passage of gas, the bricks of successive layers being intercrossed in a manner such that the apertures forming passages of one brick of one layer correspond with the apertures of a plurality of bricks of adjacent layers, annular seats surrounding one extremity of two of the apertures of each brick, annular projections corresponding to the seats formed at the other extremity of the two apertures, the bricks of each layer being constructed in a manner such that the apertures provided with seats and the annular projections are positioned at the angles of regular polygonal figures, the sides of which are equal and parallel, the projections provided of one brick of one layer being engaged in the seats of two bricks of an adjacent layer, the bricks in the upper part of the checkerwork being constructed similarly to those in the lower portion but having a single gas passage aperture extending therethrough of a cross-section larger than that of the apertures of the bricks of the lower part of the checkerwork, an intermediate layer of bricks, each brick having the same number of apertures as the bricks in the upper part of the checkerwork and adapted to connect the apertures of the bricks in the upper and lower parts of the checkerwork, the extremities of the passage of the bricks in the upper portion of the checkerwork being provided with interlocking seats and projections and the bricks in the intermediate layer being provided with interlocking seats and projections adapted to cooperate with those in both the upper and lower parts of the checkerwork.

In testimony whereof I have signed my name to this specification.

GEORGES SIMON.