July 18, 1939. P. SCHWARZE 2,166,375

HEAT-EXCHANGING STRUCTURE AND ITS CONSTRUCTIONAL ELEMENTS

Filed April 20, 1938

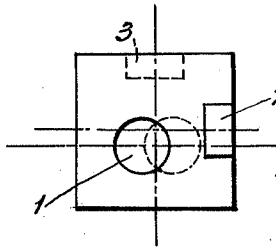


Fig. 1.

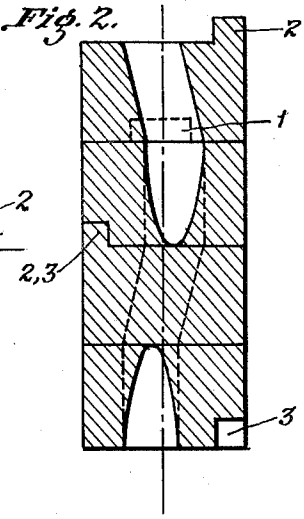
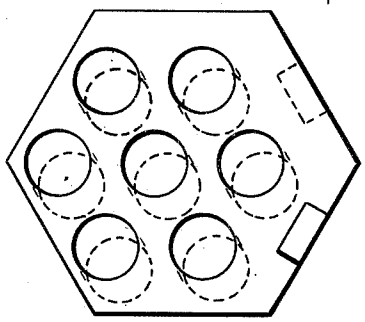


Fig. 2.

Fig. 3.



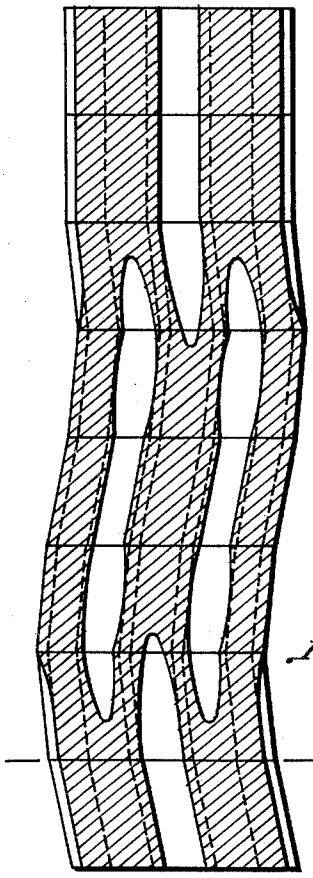


Fig. 6.

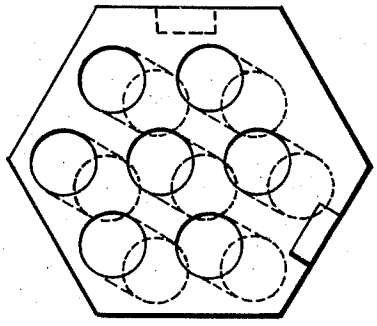


Fig. 4.

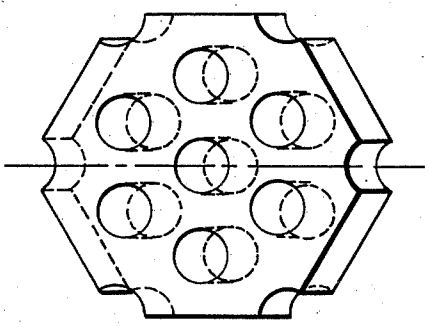


Fig. 5.

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HEAT-EXCHANGING STRUCTURE AND ITS CONSTRUCTIONAL ELEMENTS

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6 Claims. (Cl. 263—51)

In heat exchanging structures, more especially air heaters for blast furnaces, it is known that if the flues or channels for the heating gases and the heating air are arranged helically instead of rectilinear, a considerably better and quicker heat transmission is produced. Attempts have therefore been made to construct refractory bricks or blocks with helical passages. Moreover, bricks are known which consist of an internal core with lateral fins and which are formed in such a manner that when the bricks are placed side by side, passages of a helical shape are formed by the fins.

These earlier attempts to construct packings for air heaters with helical passages or channels were unsuccessful because it is difficult and expensive to manufacture such bricks. The present invention eliminates this disadvantage and provides a constructional brick of simple construction with one or more substantially straight passages which are so arranged that when the bricks are assembled the passages combine to continuous channels of a helical course.

Several embodiments are represented, by way of example, in the accompanying drawing:

Fig. 1 is a plan view of a single-hole brick of rectangular cross-section.

Fig. 2 is a longitudinal section of four superposed single-hole bricks according to Fig. 1.

Fig. 3 is a plan view of a hexagonal seven-hole brick.

Figs. 4 and 5 also show hexagonal seven-hole bricks of different construction.

Fig. 6 is a longitudinal section of six superposed hexagonal seven-hole bricks according to Fig. 5 and of two seven-hole bricks of known type.

Figs. 1 and 2 are diagrammatic examples of the invention as illustrated by a single-hole brick. The passage 1 is arranged at an angle to the horizontal sectional plane in such a way that the openings on the top and bottom brick surfaces present the same appearance only turned through 90 degrees. Upon erection, the second brick is placed upon the first in such a manner that it is turned through 90 degrees whereby the opening at its bottom surface registers with that on the top surface of the brick below. The assembly can be facilitated by each brick being provided at one end with a projection 2 and at the other end, displaced through 90 degrees, with a corresponding recess 3. It will be obvious that, in this manner, by placing bricks of absolutely the same type and with simple passages one upon the other, helically extending channels are produced.

In practice, hexagonal bricks with several passages are frequently employed with advantage as packing bodies for blast furnace air heaters. Fig. 3 represents such a hexagonal brick with seven passages. In this construction as is apparent from the figure, the conduits extend in such a manner that, when erected, each brick must be turned through 60 degrees and that consequently one helical turn is formed by the assembly of six bricks. With the bricks of the same external shape, as shown in Fig. 4, the inclination of the passages is arranged in such a manner that the form of the openings on the bottom brick face is displaced through 120 degrees with respect to those on the upper face. In this case the bricks when assembled must be turned through 120 degrees and consequently one complete helical turn is formed by three bricks.

It is also possible so to shape the bricks that the side faces are not perpendicular, but are also inclined, i. e. are disposed parallel to the passages as shown in Figs. 5 and 6. In this case the openings on the top and bottom surfaces present exactly the same appearance and the distance through which each subsequent brick is to be turned for assembly depends on the distribution of the passages, the external shape of the bricks and the desired helical form. According to Fig. 6 each brick is displaced through 60 degrees but with the same form of brick turns of 120 degrees could be executed. As also shown in Figs. 5 and 6 recesses may be provided on the side faces of the bricks which in known manner when the bricks are placed side by side, provide supplementary conduits between adjacent bricks. The passages themselves can be of any suitable shape and, more especially, it is possible to make them round or oval in cross-section perpendicular to the longitudinal axis.

In order to increase the capacity of air heaters by the employment of more brick-weight within a given volume and simultaneously larger heating surfaces, constructional bricks with passages becoming narrower and more numerous are used. This development which has its limitation in practical manufacturing difficulties is combinable with the present invention, but the increase in capacity conditional upon the latter will make it possible in many cases to return to wider passages.

Although generally purified gases are being used for the heating of heat storage structures, it is often expedient to be able to pass light or an instrument through the flues. As will be seen from Fig. 2, the bricks and passages can be so shaped that on being assembled a rectilinear vertical passage is produced in the common vertical

axis of the helical channel formed by the part conduits. For this purpose, the conduits must be so arranged that the openings at the end surfaces of the assembled bricks, upon vertical projection, register over a common central area. Such an arrangement also produces a reduced resistance to the flow of the gas or air.

The horizontal transverse connection of the passages by recesses on the top or bottom sides or by interposing suitably shaped bricks, which is frequently employed and is useful if blockages occur, can also be carried out with the arrangement according to the invention.

Heat exchanging and heat storage structures according to the present invention can be built vertically or horizontally. The first-named type can be constructed as single-zone apparatus, by bricks of the same shape being used for the complete packing, or as multi-zone apparatus, of which a part is shown in Fig. 6, in such a manner that the first or upper zone is provided in known manner with bricks which form straight conduits, whereas the second zone and if required further zones are provided with bricks which produce helical channels. If more than one zone with helical channels is employed, the lower zone is conveniently so selected that a spiral form with a greater inclination, i. e. with paths deviating by a greater angle from the vertical, is provided. In this way, in the lower zones, with the external shape of the bricks remaining constant and with the cross-section of the conduits also remaining constant, the weight of the bricks is reduced and the heating surface increased, which in many cases increases the capacity. At the same time, a certain throttling of the gas flow and thus a good distribution of the heating gases over the total cross-section of the air heater, is obtained.

The packing according to the present invention can also be used in such a manner that, in the individual zones, the number of the conduits and the cross-section thereof can be varied, so that, according to the object to be obtained, an increase or decrease of the conduits and an increase or reduction of the cross-sections in a downward direction, is effected. The form of construction has to conform to existing conditions and the desired result.

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

1. Packing for heat exchanging structures or the like, more especially air heaters, comprising bricks having substantially straight passages inclined to the end surfaces, said bricks being assembled in angular relation in such a way that said straight passages combine to continuous helical channels.

2. Packing for heat exchanging structures or the like, more especially air heaters, comprising bricks having substantially straight passages inclined to the end surfaces, said bricks being assembled in angular relation in such a way that said straight passages combine to continuous helical channels and that a rectilinear conduit is formed in the mean vertical axis of each of said continuous helical channels.

3. Packing for heat exchanging structures or the like, more especially air heaters, comprising bricks having substantially straight passages inclined to the end surfaces, said bricks being assembled in such a way that said straight passages combine to continuous helical channels and said bricks being provided with projections and recesses displaced relatively through a definite distance, thereby causing each brick to be turned for assembly in relation to the preceding brick through said distance.

4. Heat exchanging structures or the like, more especially air heaters, comprising columns of superposed bricks with helical channels extending through the columns, said helical channels being formed by bricks with substantially straight passages arranged at an angle to the end surfaces and by said bricks being assembled in the direction of their passages in such a way that each brick is turned in relation to the preceding brick through a predetermined distance.

5. Heat exchanging structures or the like, more especially air heaters, with a plurality of zones, comprising zones with rectilinear channels and zones with helical channels, said helical channels being formed by bricks with substantially straight passages arranged at an angle to the end surfaces and by said bricks being assembled in the direction of their passages in such a way that each brick is turned in relation to the preceding brick through a predetermined distance.

6. A refractory brick for the formation of helically extending channels in the checkerwork of air heaters or the like, said brick having a plurality of substantially straight passages inclined to the end surfaces and parallel to each other, the openings of said passages at both end surfaces forming uniform geometrical figures.

PAUL SCHWARZE.