May 9, 1933. J. DANIELS 1,908,409

REGENERATOR

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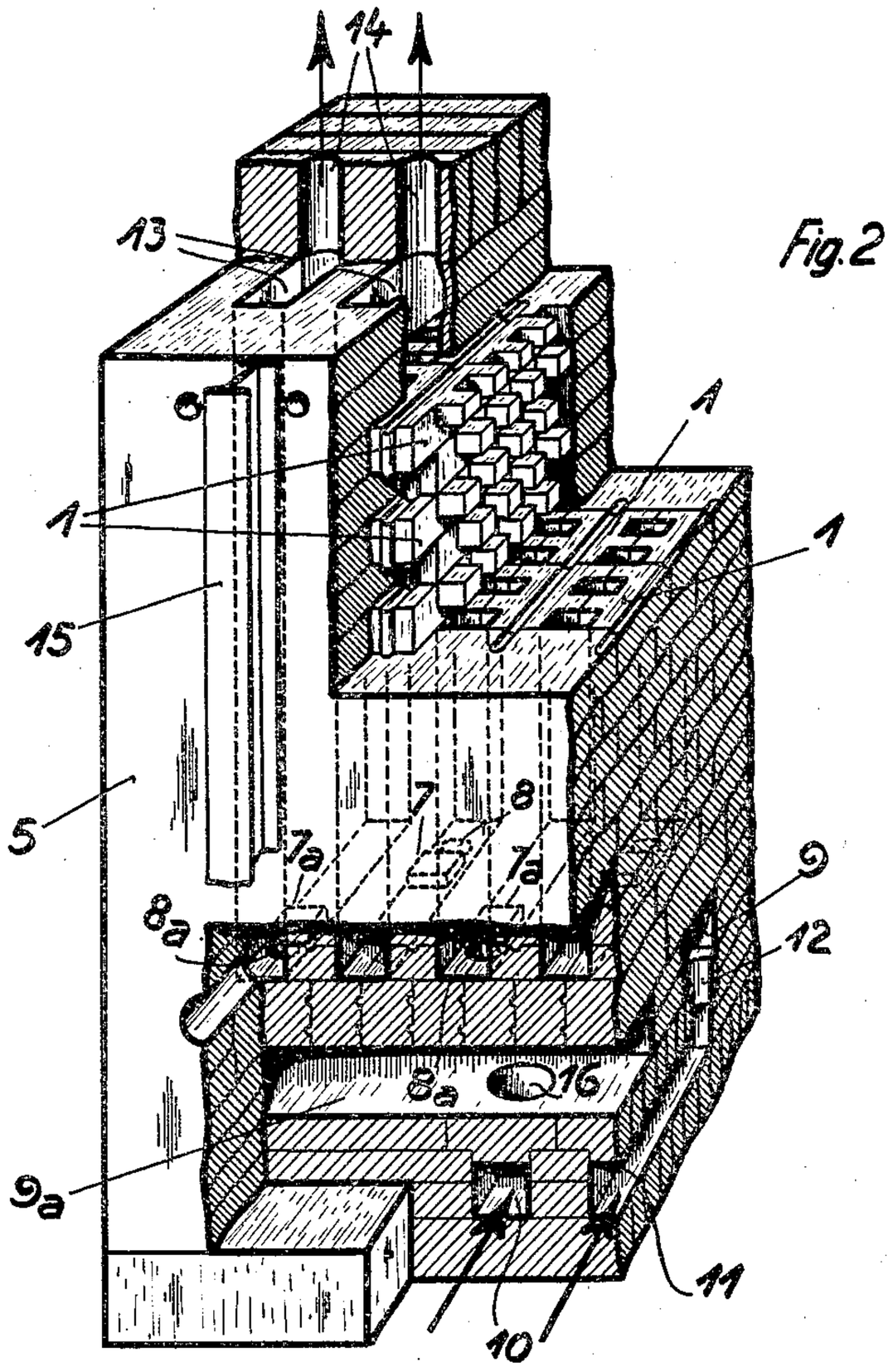

Fig. 2

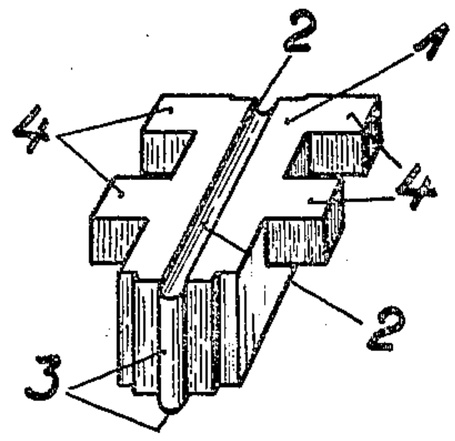

Fig. 1.

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UNITED STATES PATENT OFFICE

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REGENERATOR

Application filed December 11, 1931, Serial No. 580,409, and in Germany August 25, 1930.

This invention relates to heat exchanging devices known as regenerators for utilizing the sensible heat of hot gases, particularly hot combustion gases, for the purpose of heating cold gases such as air for combustion.

In the known regenerators, the heat is transferred from the hot gases to the gases which are to be heated by means of ceramic or like elements which are usually set loosely in chambers composed of fireproof brickwork or the like. These heat exchanging elements preferably have the form of a long prism.

Owing to the fact that in the usual regenerators the heat exchanging elements are set in the regenerator chambers after the latter have been built, it is necessary to construct the said chambers of relatively large breadth, at least sufficiently broad as to allow them to be entered, but in many cases it is impossible to employ such broad regerenator chambers which can be entered by a man. Such conditions exist for instance in the case of tunnel ovens operating with regenerative heating which are used for burning ceramic material and the like, and wherein a series of closely adjacent air and gas nozzles are provided in the combustion zone of the tunnel, by means of which a continuous band flame of uniform intensity is obtained in the interior of the oven, each of the said gas and air nozzles being connected with a regenerator extending transversely of the longitudinal axis of the tunnel. In this type of tunnel ovens the regenerators have to be considerably narrower than is otherwise usual; consequently it is impossble for them to be filled with heat exchanging elements after they have been constructed.

One object of my present invention is to provide an improved heat exchanging element for regenerators which permits the construction of extremely narrow regenerators or regenerator chambers.

The essential feature of the heat exchanging element according to the invention is that it has the form of an ordinary brick as used for constructing the walls of the regenerator chambers, and that this brick is provided on the side facing the regenerator chamber, i. e. the inside, with one or more projections extending into the regenerator chamber. These projections are of such size that when the regenerator is erected they apply themselves against the projections of the opposite wall of the regenerator. Thus loosely arranged heat exchanging elements are no longer used in the regenerators according to the present invention. The exchange of heat takes place only on the projections of the regenerator wall bricks and on the surface of the bricks themselves. As the projections apply themselves firmly against each other in the finished regenerator, the whole structure is extraordinarily stable and pressure resistant.

The projections of the bricks are preferably arranged in staggered relationship to each other, for instance in the form of a checker board. Also, according to the invention the regenerator walls are provided with heat exchanging projections on both sides and are also provided with ordinary tongues and grooves which engage in each other when the walls are erected so as to make the latter gas-tight.

The invention also provides an improved construction of regenerator which is characterized by great stability and strength against external strain. According to the invention the narrow regenerator chambers which in one period of operation are opened temporarily to gas or air, are disposed inside a chamber which is provided with great strength by strong brickwork and external stays and into which the individual heat exchanging elements provided with projections on one or both sides are built, as formerly the loose heat exchanging elements were set in the regenerator chambers, in such a manner that the chamber is divided into a whole series of narrow regenerators.

In such a narrow regenerator comprised in a block and built up with the bricks according to the invention, the employment of longitudinal tongues and grooves on the bricks for obtaining better sealing of the joints between the various bricks is of advantage in order to prevent the gaseous media escaping from one regenerator into the adjacent regenerator although even when bricks without grooves are used it is hardly

possible for short circuits to occur between the various regenerators owing to the absence of differences in pressure.

With these and other objects of my invention in view I will now describe the nature of my present invention with reference to the accompanying drawing, in which,

Figure 1 illustrates a regenerator wall brick constructed according to the invention, and

Fig. 2 illustrates partly in section a regenerator block composed of the bricks illustrated in Fig. 1.

In Fig. 1 the body 1 of the regenerator brick is constructed prismatically and is provided on the top and on one end face with a continuous groove 2 while the bottom and the other end face are provided with a longitudinal tongue 3. The grooves 2 and tongues 3 are so formed that when the bricks are set together the tongues 3 engage in the grooves 2 of the adjacent bricks.

The body 1 of the brick is provided on both sides with preferably prismatic projections 4 which project into the regenerator chambers comprised by the wall bricks and are flowed over successively by the hot gases whose sensible heat is to be utilized and the gases which are to be heated. By arranging the projections 4 unsymmetrical, when the regenerator wall is erected the said projections take up a staggered position in relation to each other in the form of a chequer board.

The structure of a regenerator composed of the bricks shown in Fig. 1 is illustrated in Fig. 2.

The regenerator block according to Fig. 2 consists of a chamber formed of fireproof brickwork 5. The walls 5 are held together externally by stiffeners 15 or other suitable stays. In the interior of the regenerator block or the chamber thereof, the bricks 1 illustrated in Fig. 1 are arranged in such a manner as to form a series of narrow adjacent regenerator chambers, the bricks being placed so closely together that the projections 4 of opposite bricks touch each other with their end faces, so that the partition walls of the individual regenerator chambers are mutually supported. Consequently the whole oven block is rendered extraordinarily solid.

Beneath each regenerator in the base of the regenerator block various outlets 8, 8*a* controlled by valves 7, 7*a* are provided. The openings 8*a*, that is, those of the one set of alternate regenerators, open into a bottom channel 9*a* of the regenerator block, whilst the other openings 8 open into a channel 9. These channels 9 and 9*a* serve to distribute the media which are to be passed through the regenerators to all the regenerators in the block. The media are supplied to the distributing channels 9 and 9*a* through the channels 10 and 11, of which as shown in the drawing, the channel 10 is connected by the opening 16 with the channel 9*a* and the channel 11 by the opening 12 with the channel 9.

In the operation of the regenerators the gaseous media to be preheated are passed through the regenerators from the bottom upwardly. At the upper end of each regenerator a gas collecting space or chamber 13 is provided from which channels 14 lead up out of the block.

In the drawing the projections on the regenerator bricks are shown as of prismatic construction, but it is possible to make them circular or of any other suitable form.

The regenerator according to the invention or the block form of regenerator illustrated in the drawing is particularly suitable for preheating different media having approximately the same pressure, such as heating gas and combustion air. In cases where media of substantially different pressure are to be preheated in one regenerator block it is preferred to assemble the regenerators for the various media in groups and separate them by walls of greater thickness from the group of regenerators through which the media of a different pressure are passed. The method is advantageous for instance for preventing heating gas passing into the waste heat regenerators.

I claim:—

1. In a regenerator, a regenerator chamber-forming wall composed of superposed courses of wall bricks having regenerator-brick projections extending from the regenerator chamber side of the wall, each of the regenerator-brick projections being of less length and depth than the length and depth of their respective wall bricks and the side faces of the regenerator-brick projections being perpendicular to the sides of the regenerator chamber-forming wall, and the regenerator-brick projections of each course of wall brick being disposed in planes between each two regenerator-brick projections of an adjacent course, thereby providing zig-zag gas flow spaces between the regenerator projections of adjacent courses and between each two regenerator-brick projections in the same course.

2. In a regenerator, a regenerator chamber-forming wall composed of superposed courses of wall bricks having regenerator-brick projections extending on two opposite sides of the wall, each of the regenerator brick projections being of less length and depth than the length and depth of their respective wall bricks and the side faces of the regenerator-brick projections being perpendicular to the sides of the regenerator chamber-forming wall, and the regenerator-brick projections of each course of wall brick on each side of the wall being disposed in planes between each two regenerator-brick projec-

tions of an adjacent course, thereby providing zig-zag gas flow spaces between the regenerator projections of adjacent courses and between each two regenerator-brick projections in the same course.

3. A regenerator comprising two oppositely disposed imperforate gas-tight regenerator chamber-forming walls forming a regenerator chamber therebetween, each of the walls comprising superposed courses of wall brick, the wall bricks of each course in each of said walls having regenerator-brick projections extending into the chamber toward the other wall thereof, each of the regenerator-brick projections being of less length and depth than the length and depth of their respective wall bricks and each projection having side faces perpendicular to the regenerator walls, the regenerator-brick projections of the wall bricks of each course being disposed in planes between each two regenerator-brick projections of an adjacent course, and the regenerator-brick projections of the two chamber facing sides of said walls being disposed opposite each other and meeting, thereby providing communicating zig-zag gas flow spaces between the regenerator-brick projections of adjacent courses of wall bricks in both walls and between each two projections in the same courses of bricks.

In testimony whereof I have hereunto set my hand.

JOSEPH DANIELS.