

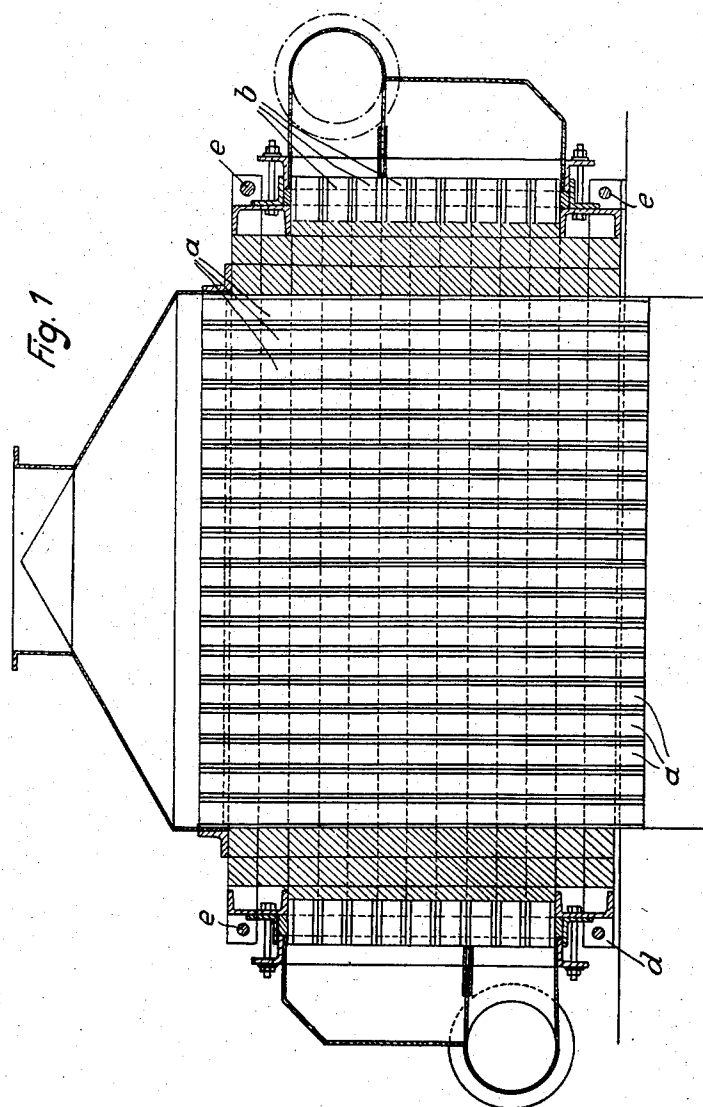
March 24, 1959

E. FOLGER
HEAT EXCHANGER

2,879,050

Filed Sept. 28, 1954

3 Sheets-Sheet 1



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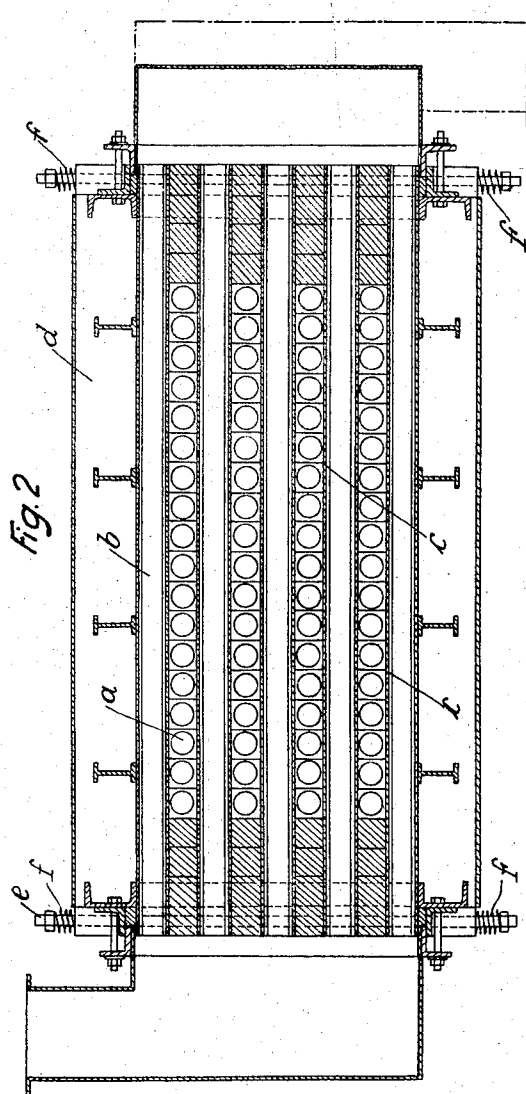
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3 Sheets-Sheet 2



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Fig. 4

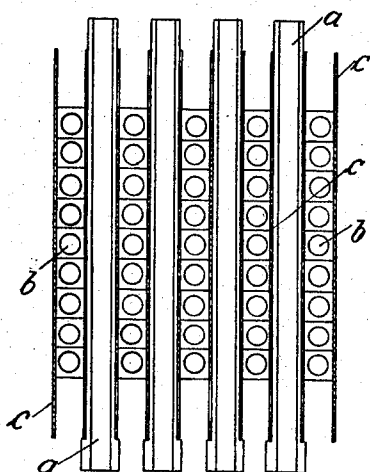
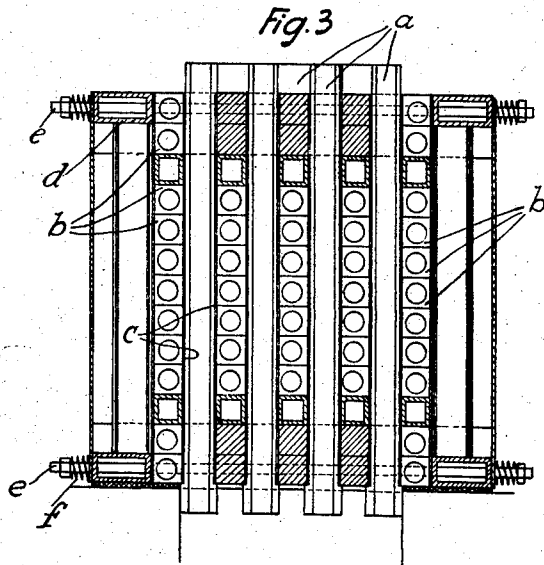


Fig. 3



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HEAT EXCHANGER

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Application September 28, 1954, Serial No. 458,745

Claims priority, application Germany October 1, 1953

4 Claims. (Cl. 263—20)

The invention relates to a heat exchanger, primarily for use in heating air and gases, which is intended to be operated at high air and gas pressures and at especially high temperatures.

Recuperators are known which consist of apertured or hollow bricks assembled to form a block having in it channels running in the same direction or across one another, so that the operating media may traverse them in the same direction, in counterflow or in intersecting directions. To achieve in such air heaters, having regard to the porosity and danger of breakage of the bricks, an effective isolation between the gas and the air channels it has been proposed to embed metal walls in the gaps between the bricks and so to arrange matters that all channels are completely enclosed by the metal walls. The metal walls can be constituted by abutting sheets embedded in the gaps of the brickwork and running in intersecting directions or by sheets having a cruciform or U-section.

Such heat exchangers consist in some measure of a metal skeleton, the walls of which completely enclose either the gas-conducting hollow bricks or the air-conducting hollow bricks or all of the hollow bricks. This construction, however, is disadvantageous because of deficient surface pressure between the ceramic hollow bricks and the metal walls surrounding them, and as a result of the differential thermal expansion of the bricks and the metal walls there is not the intimate surface contact between the parts which is necessary for effective heat transference. Moreover the manufacture of such heat exchangers is difficult and involves the use of a large amount of metal. From the long term view the isolation is questionable because the absence of intimate surface contact leads to serious corrosion at the metal walls, which at high operating temperatures scale or melt and flow into the expansion gaps in the brickwork. Finally, it is also difficult so to construct the metal skeleton surrounding the channels that the gas and air channels can be disposed in intersecting directions.

The present invention aims at removing the above mentioned disadvantages and providing a heat exchanger having channels formed by apertured or hollow ceramic elements of rectangular shape in cross-section and providing flow in the same direction, counterflow or flow in intersecting directions, which is particularly easy to manufacture. The invention also provides an improved isolation or sealing means between the several tiers of hollow elements which sealing means is of a more permanent character to insure an intimate surface contact with the adjacent tiers of conduit elements so as to provide a good heat transference between the adjacent tiers. This is attained according to the invention by assembling the apertured or hollow ceramic elements without intermediate layers to form individual tiers and separating these tiers by flat intermediate layers of heat conductive material extending over their adjoining surfaces.

The intermediate layers provided between the tiers or conduit elements may be composed of flat plates or foils

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of metal or other heat conducting material. In order to permit operation of the heat exchanger according to the invention at maximum temperatures lying far above the melting point of iron the intermediate layers are conveniently constituted by plates or foils of mineral substances.

Such a heat exchanger, according to the present invention, is composed of a plurality of adjacent tiers of hollow elements of rectangular cross-section. The said hollow elements are composed of ceramic brick and are arranged in each tier in flat face intimate engagement with each other. The adjacent tiers are separated or sealed from each other by means of a thin sheet of metal or mineral foil of high thermal conductivity. The sheet of metal or foil is positioned between adjacent tiers and has intimate contact therewith so as to conduct heat from one tier to the other. The said hollow elements of alternate tiers constitute parallel conduits within such tier for the passage of hot gases in heat exchange relation to air or other gases to be heated in an adjacent tier. The hollow elements may be arranged so that the hot gases and air can be conducted therethrough. Inasmuch as all elements of each tier are arranged in parallel surface contact and inasmuch as the partitions of metal or mineral foil are arranged in intimate surface contact with the flat faces of adjacent tiers a high efficiency thermal contact is assured. This thermal contact between the several tiers and the elements of each tier is made more efficient by resiliently clamping the elements of the structure as a whole. This clamping function is obtained by the provision of metallic frame work at opposite sides of the ceramic structure and connecting the frame by means of tension bars associated with spring elements for exerting resilient clamping pressure on the assembly as a whole.

The accompanying drawing shows one embodiment of heat exchanger according to the invention. In the drawing:

Fig. 1 is a longitudinal section through the heat exchanger,

Fig. 2 is a plan view,

Fig. 3 is a cross section and

Fig. 4 is a section through the heating register alone, this being formed from layers of hollow bricks and plain intermediate layers.

The heat exchanger consists of hollow bricks or ceramic tubes *a* traversed by flue gases and transversely running hollow bricks in the form of ceramic conduits *b* which are assembled in adjacent tiers to form a block. Between the tiers of similar elements *a* for the hot gases and the channel layers *b* for the air are disposed metal sheets *c* or foils of mineral substances, which effectively isolate or seal the adjoining tiers from each other and prevent the passage of air or gas between them. The hollow elements *a* and *b* which are united by cement to form a block and the separating plates or foils are held elastically together by a girder structure *d*, anchor bolts *e* and compressing springs *f* so that the flat intermediate elements *c* are placed under pressure by the springs and are held in intimate surface contact with the respective tiers. By the elastic bonding of the parts together the differential thermal expansions can be effectively accommodated.

What I claim as my invention and desire to secure by Letters Patent is:

1. A heat exchanger comprising a series of adjacent tiers of hollow conduit sections arranged end to end and having flat sides arranged in heat transfer relation to each other, the conduits of alternate tiers providing passages for gaseous media and air, respectively, with the conduits in one tier extending transversely of the conduits in tiers at opposite sides thereof, a thin sheet of mineral

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substance having high thermal conductivity disposed between two consecutive tiers of conduit elements with the flat sides of said conduits in intimate and continuous contact with said thin sheet of mineral substance throughout the entire length of said sheet; and means for resiliently clamping the several tiers of the assembled conduit elements together.

2. A heat exchanger as defined in claim 1 characterized in that the mineral substance between adjacent tiers of conduit elements is a metallic plate.

3. A heat exchanger as defined in claim 1 characterized by the provision of a metallic frame work at opposite sides of the assembly, tension bars extending along the assembly and through said side frames and spring elements supported on said tension bars for exerting resilient pressure against said frames, whereby the individual elements of the structure as a whole are resiliently clamped against each other.

4. A heat exchanger comprising a series of adjacent tiers of hollow members having flat sides arranged in heat transfer relation to each other, the conduits of alternate tiers providing passages for gaseous media and air, respectively, with the conduits in one tier extending

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transversely of the conduits in tiers at opposite sides thereof, a thin sheet of mineral substance having high thermal conductivity disposed between the flat sides of two consecutive tiers of conduit elements and in intimate and continuous contact therewith along its entire length, and means for exerting resilient clamping pressure on the assembled structure including metallic frame members at opposite sides of the assembly, tension bars extending transversely of the assembly and through said frame members, and coiled springs interposed between said metallic frames and an abutment on each end of said tension bar.

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