

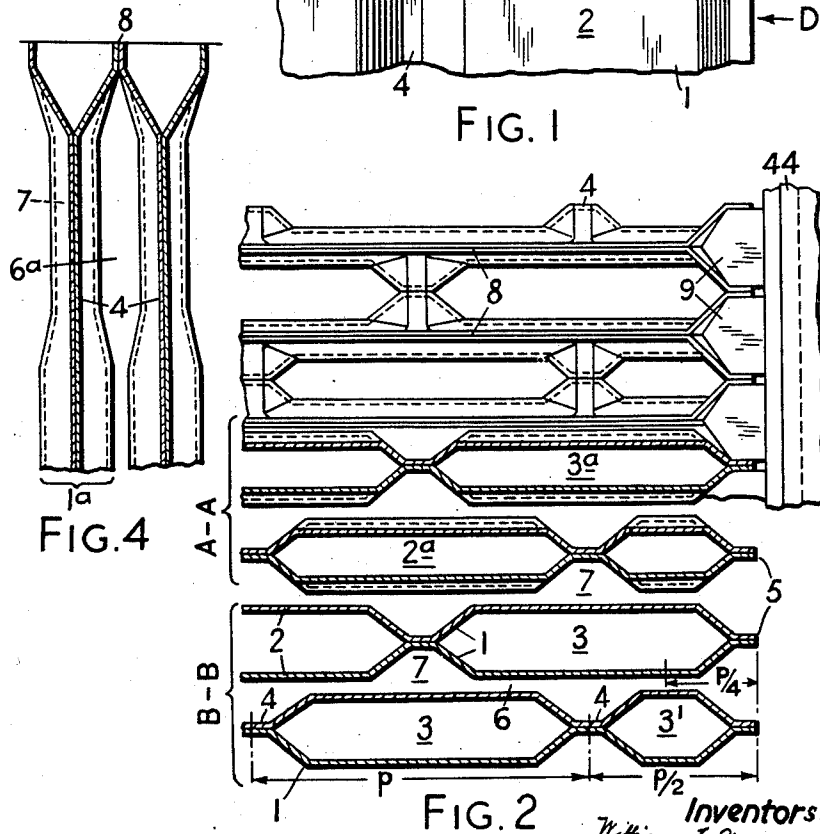
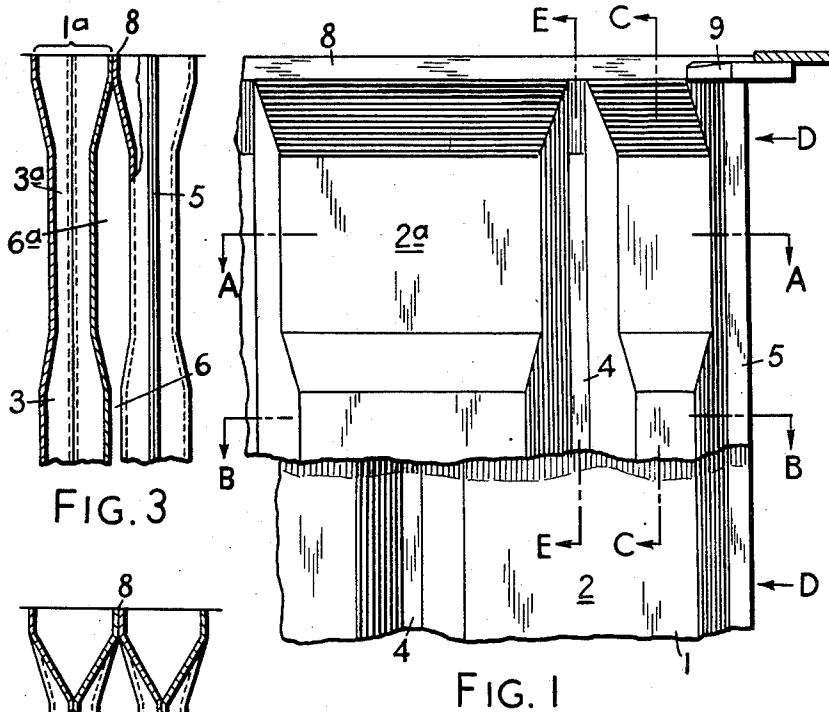
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W. L. GROSS ET AL
PLATE TYPE HEAT EXCHANGER

2,620,169

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3 Sheets-Sheet 1



Inventors:
William L. Gross
John A. P. Hughes
Paul H. W. Hoff
Rudolf Frankel
By *Balch & Balch* Attorney

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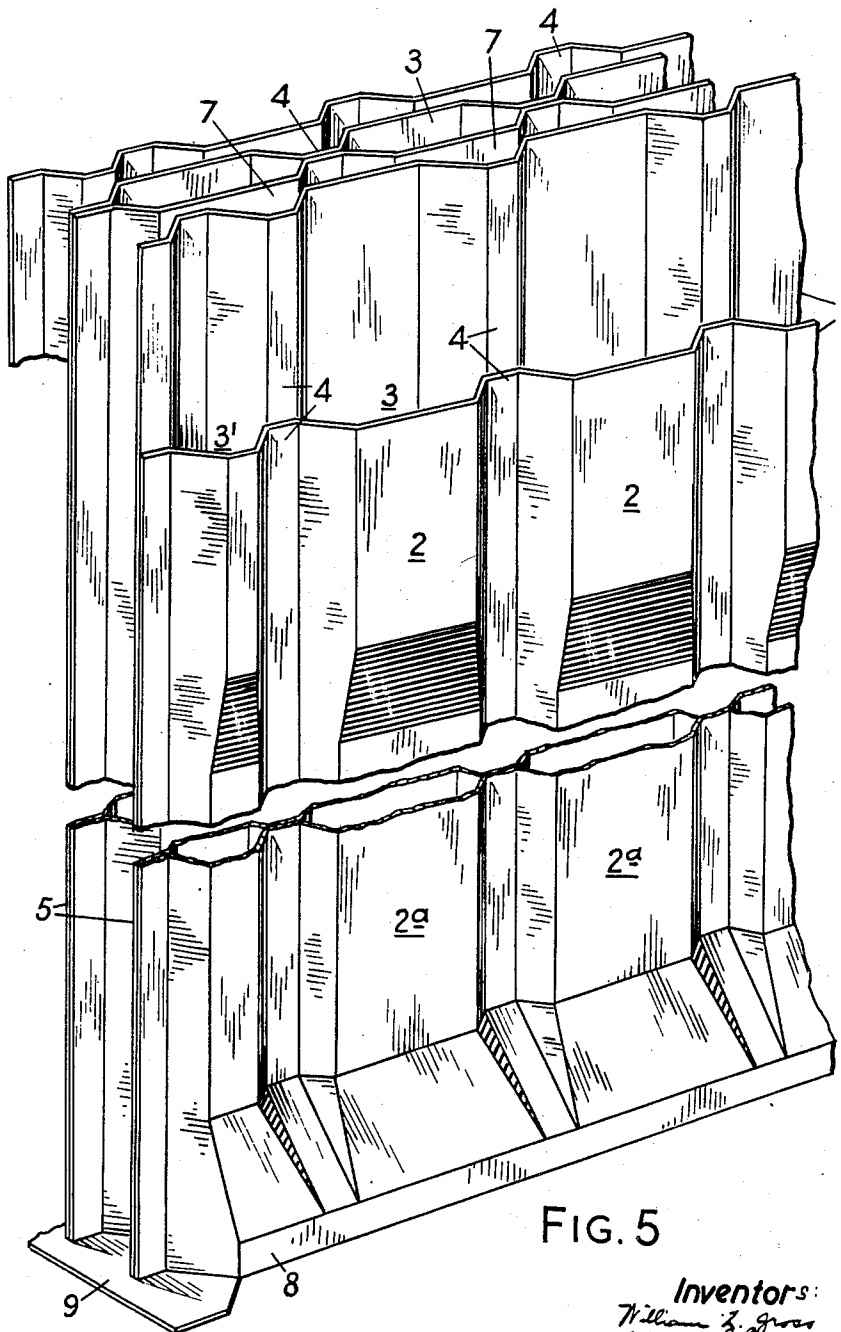


FIG. 5

Inventors:
William L. Gross
John W. P. Hughes
Paul H. H. Wolff
Adolf Frankel
By Babcock & Babcock
Attorneys

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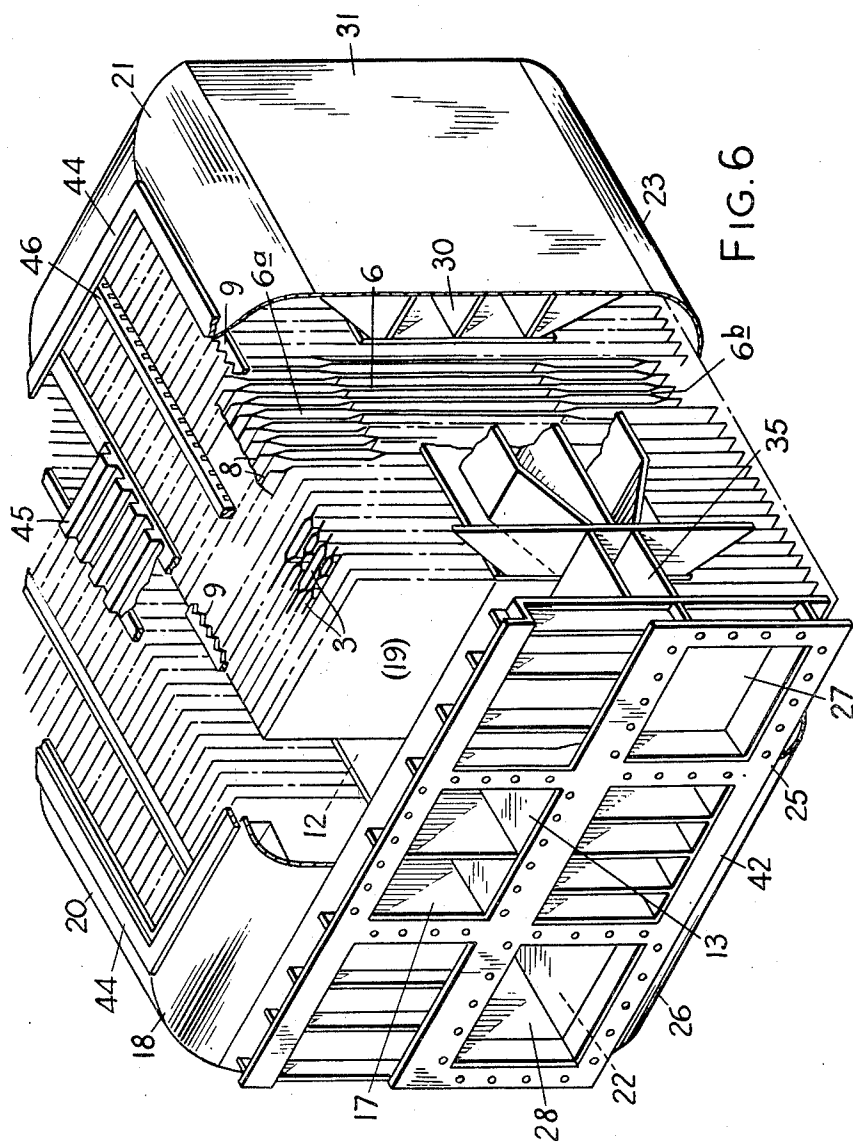


FIG. 6

Inventors:
William L. Gross
John P. P. Hughes
Paul H. W. Wolff
Adolf Frankel
By
Babcock & Babcock Attorneys

UNITED STATES PATENT OFFICE

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PLATE TYPE HEAT EXCHANGER

William Lawrence Gross, John Oliver Philip Hughes, Paul Heinz Walter Wolff, and Adolf Frankel, Rugby, England, assignors to The English Electric Company Limited, London, England, a British company

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1 Claim. (Cl. 257-245)

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The invention relates to plate type heat exchangers for heat exchange between gaseous fluids in general, and without prejudice to this general applicability, in particular to heat exchangers for use in gas turbine plant, such as for the heat exchange between the exhaust gases of a gas turbine and the compressed air fed into its combustion chambers.

It is an object of the invention to provide a heat exchanger which is of a high thermal efficiency, i. e. wherein the ratio of heat transferred from one fluid to the other, to the heat which can theoretically be transferred, is high.

It is another object of the invention to provide a heat exchanger which is of a high mechanical efficiency, i. e. wherein the pressure drop in either or both passes is low.

Other objects are:

Freedom from stresses due to differential thermal expansion; small requirements of space, for mobile plant particularly in the dimensions across the direction of movement; low weight.

Other objects will become apparent later from the description of some preferred embodiments of the invention wherein a balanced combination of the aforementioned objects has been achieved.

According to one aspect of the invention a plate type heat exchanger comprises identical plates arranged in pairs, each plate having parallel corrugations, the plates of each pair being reversed relatively to and connected with one another so as to enclose separate channels for the one heat exchanging fluid between their corrugations facing one another, adjacent pairs being spaced from one another so as to enclose continuous duct spaces for the other heat exchanging fluid and being connected with one another on their transverse edges so as to isolate the said continuous duct spaces from the said separate channels, the said continuous duct spaces being laterally open adjacent the ends of said plates, and closed intermediately.

Preferably these plates have parallel corrugations of uniform shape and arranged at uniform pitch except the last corrugation adjacent the one longitudinal edge of the plate, the plates of each pair being reversed relatively to one another about an axis parallel to their plane and transverse to the direction of the corrugations

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and alternate pairs being reversed with respect to one another about an axis perpendicular to the aforesaid axis so as to stagger the said channels in alternate pairs relatively to one another.

These pairs of plates or "plate sandwiches" as they may be called registering in outline with one another form a bank having straight-through channels enclosed within each individual plate sandwich but with the continuous duct spaces between adjacent sandwiches left laterally adjacent their ends but closed intermediately open. Baffles or side walls have therefore to be arranged in order to separate entrance openings on both sides of the one end of these continuous duct spaces from similar exit openings on the other end. The entrance openings on each side of the bank of plate sandwiches are connected to an entrance manifold, and the exit openings on each side of the said bank are connected to an exit manifold, the two entrance manifolds and the two exit manifolds, respectively, being in connection with one another preferably at a front end of the said bank.

The straight-through channels will offer in general less resistance and consequently cause a smaller pressure drop than the continuous duct spaces.

Preferably these straight-through channels will therefore form the hot pass of the heat exchanger, for example for the exhaust gases of a gas turbine, while the continuous duct spaces form the cold pass, for example for the air delivered from the compressor to the combustion chamber of a gas turbine, so that the smaller pressure drop occurs on the exhaust side of the gas turbine whereby it affects the overall efficiency of the gas turbine-compressor-set less than it would on the high pressure side.

These and other features of the invention will be explained in detail with reference to some preferred embodiments.

In order to be better understood and readily carried into effect, the invention will now be described by way of example with reference to the accompanying drawings of which:

Fig. 1 is a broken-off part elevation of consecutive pairs of plates of a preferred embodiment of the invention.

Fig. 2 is a corresponding plan view, partly in

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top view and partly in section on the lines A—A and B—B, respectively, of Fig. 1.

Fig. 3 is a side elevation to Fig. 1 partly in section on line C—C and partly as viewed in the direction of the arrows D—D of Fig. 1.

Fig. 4 is a side elevation in section on line E—E of Fig. 1.

Fig. 5 is an isometric part view of two consecutive pairs of plates.

Fig. 6 is an isometric overall view, partly broken away, of the heat exchanger.

Referring now to Figs. 1 to 5, each plate 1 has parallel grooves 2 of trapezium shaped cross section arranged at a pitch p from another (Fig. 2). The grooves nearest to the edges of the plate are at half the said pitch ($p/2$) and a quarter the said pitch ($p/4$) from their respective edges. The latter grooves are of reduced width.

Two plates reversed with respect to one another about an axis parallel to their own plane perpendicular to the longitudinal direction of said grooves form a pair or sandwich of plates 1a enclosing between themselves hexagonal channels 3 of a uniform size except the channel 3' adjacent to one of their longitudinal edges which is of reduced size.

These plate sandwiches are preferably resistance welded at the contacting strips 4 between adjacent channels, and arc welded at the edges 5.

By reversing alternate plate sandwiches about an axis parallel to the grooves or perpendicular to the plane of the plates the pattern shown in Fig. 2 is obtained according to which the channels 3 in adjacent pairs or sandwiches are staggered one half pitch ($p/2$).

The cross section of the continuous spaces 5 between adjacent plate sandwiches has lateral projections 7 between adjacent channels which projections, being complementary to the trapezium shaped grooves 2, are themselves trapezium shaped.

By the staggering of the channels 3, these projections 7, too, are staggered, and made to face with their large open bases the flat portion of the adjacent plate in the middle of each channel.

When the channels 3 and the duct spaces 6, 7 are passed by the two heat exchanging fluids in countercurrent in the central portion of the plates, the most favourable flow and heat exchange conditions are obtained.

At their transverse edges 8 (upper edge, Figs. 1-4 and lower edge, Fig. 5) the opposite plates of adjacent plate sandwiches are welded together so as to close the duct spaces 6, 7 there, while leaving the channels 3, 3' open (Figs. 3 and 4).

Adjacent the sealed transverse edges 8 the duct spaces 6 are enlarged so as to form entrances 6a adjacent the upper edge and exits adjacent the lower edge. These enlargements are achieved by reducing the depth of the grooves 2 in the region of section A—A (Figs. 1-4) to that of shallower grooves 2a resulting in somewhat reduced channel sections 3a in this region.

Adjacent sandwiches of plates are spaced in plan by means of racks or combs 9 engaging their longitudinal edges 5 near their ends. The racks 9 are eventually welded to the plate sandwiches (Figs. 1 and 2).

Referring now to Fig. 6, two banks of plate sandwiches 2 of the kind described in detail hereinabove with reference to Figs. 1-4 are arranged side by side in a common casing.

The straight-through channels 3 within the plate sandwiches, the upper ends of which are

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visible in Fig. 6, form a system of honeycomb open at both ends, the lower end being adapted to be connected with the exhaust elbow of a gas turbine and the upper end to the stack leading to the open atmosphere.

The continuous duct spaces 6 are closed on the top and bottom at 8, and laterally open, and the common casing of the heat exchanger is divided horizontally into an upper entrance space, communicating with the lateral entrance openings 6a of these duct spaces, and a lower exit space, communicating with the lateral exit openings 6b.

The casing consists of a front flange plate 42 with an entrance opening 17 in the middle of the upper half and two exit openings 27, 28 on both sides of the lower half, side walls 31 and arched manifolds 20, 21 and 22, 23 linking up with the said side walls, front plate, and arched transverse front ducts 18, 19 and 25, 26. There is also a rear wall and transverse ducts on the rear of the casing.

The inner edges of the arched transverse ducts and arched manifolds are connected by rectangular frames, of which the one 44 on the top of the heat exchanger is partly shown in Fig. 6. These frames are provided for connection with the exhaust of the gas turbine and with the stack, respectively.

Between the two banks of plates there are enclosed an upper central entrance manifold 12 and a lower central exit manifold which is not visible in Fig. 6.

These central manifolds are covered on top and bottom respectively by a pressure-resisting, preferably corrugated, cover strip 45. Combs 9 (Figs. 1 and 2) are connected with the edges of these cover strips and the longitudinal inner edges of the frames 44. Similar combs or racks 46 run along the longitudinal centre lines on top and bottom of each bank of plates so as to keep the latter properly spaced and to prevent any accordion-like sagging thereof. These racks 46 are connected with the front and rear edges of the frames 44.

The whole structure of the heat exchanger is carried by the middle horizontal plate member 13, which is connected to box girders 30 and 35, so as to enclose two rectangular openings through which the two banks of plates are passed.

While we have described a preferred embodiment of our said invention, we do not wish to exclude the various modifications thereof which may readily offer themselves to those skilled in the art.

What we claim as our invention and desire to secure by Letters Patent, is:

A plate type heat exchanger comprising a pressure-resisting casing, pairs of plates each having longitudinal corrugations at substantially regular intervals, the corrugations of the two plates of one pair contacting one another and between one another enclosing separate channels for one of the heat exchanging fluids, said pairs forming sandwiches registering with one another in outline and forming a bank of such sandwiches arranged within said casing, racks attached to said casing adjacent the ends of the said sandwiches and spacing the same from one another, side walls of the said pressure-resisting casing baffling the lateral edges of the said sandwiches merely at their middle portions, the spaces formed between adjacent sandwiches thus being laterally open on both sides adjacent the ends of said plates and substantially closed intermediately, and being moreover closed at their transverse

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edges for the enclosure of continuous duct passages for a second heat exchanging fluid, resilient arched walls connecting the edges of said side walls with the said racks and with the top and bottom edges of the plates at both ends of the said bank, the said resilient arched walls enclosing separate manifolds respectively connecting the said continuous duct passages where laterally open.

WILLIAM LAWRENCE GROSS. 10
JOHN OLIVER PHILIP HUGHES.
PAUL HEINZ WALTER WOLFF.
ADOLF FRANKEL.

REFERENCES CITED

15

The following references are of record in the file of this patent:

6

UNITED STATES PATENTS

Number	Name	Date
1,417,387	Jungerheld	May 23, 1922
1,647,997	Jacobus	Nov. 8, 1927
1,726,458	Tellander	Aug. 27, 1929
1,734,962	Clarke	Nov. 12, 1929
1,775,103	Hume	Sept. 9, 1930
1,805,652	Caracristi	May 19, 1931
1,831,533	Hubbard	Nov. 10, 1931

FOREIGN PATENTS

Number	Country	Date
285,550	Great Britain	Feb. 16, 1928