

Sept. 9, 1930.

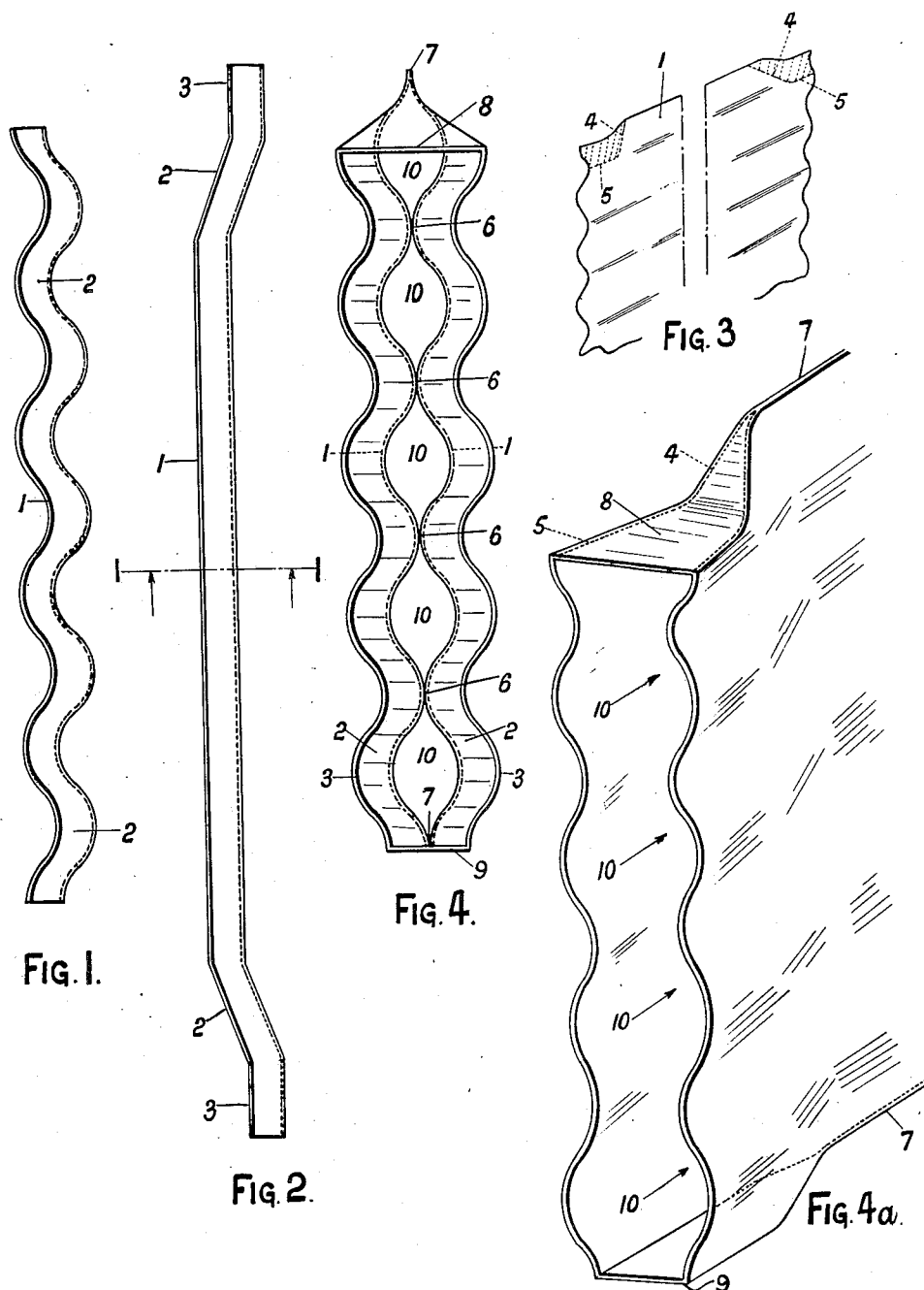
J. H. HUME

1,775,103

APPARATUS FOR HEATING FLUIDS

Filed March 19, 1929

5 Sheets-Sheet 1



Investor:
James Hawden Hume
By
Penne Davis Morris & Edward
attorneys

Sept. 9, 1930.

J. H. HUME

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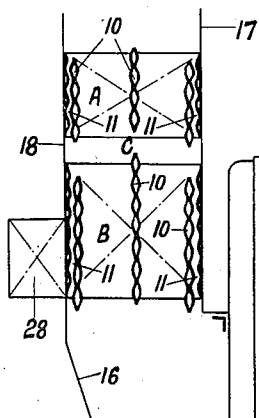


Fig. 9.

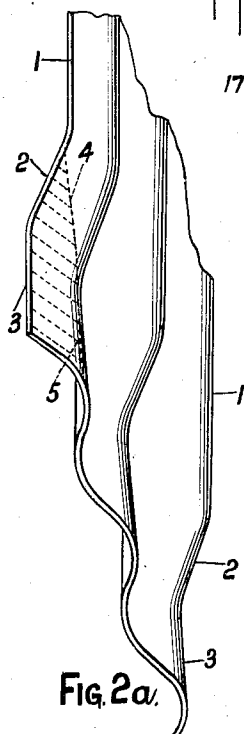


Fig. 2a.

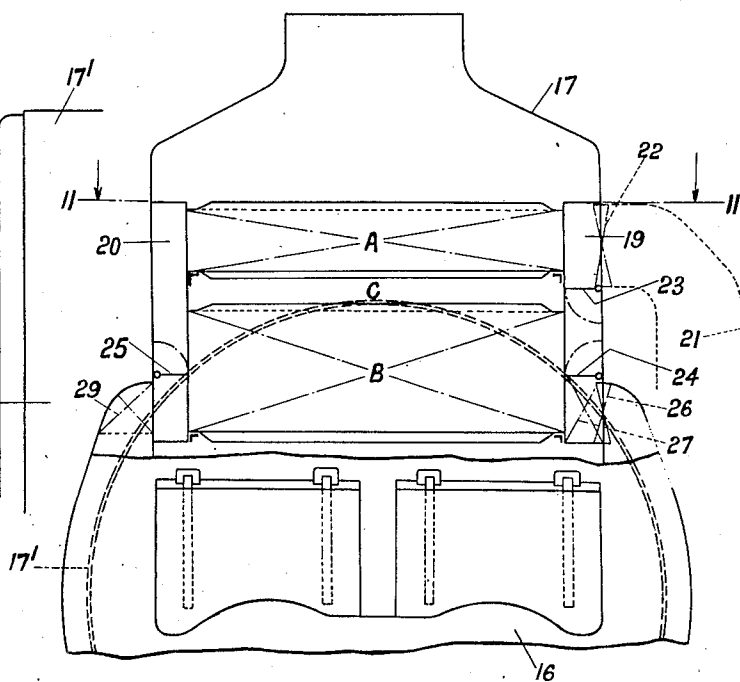


Fig. 10.

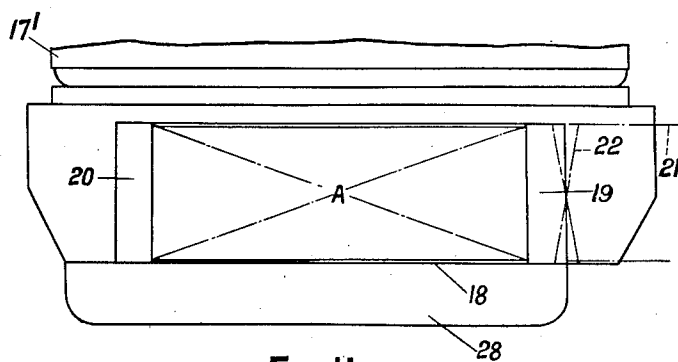


Fig. 11.

Inventor:
James Henderson Hume
By Bennie Davis, Marion + Glenoch
attorneys

Sept. 9, 1930.

J. H. HUME

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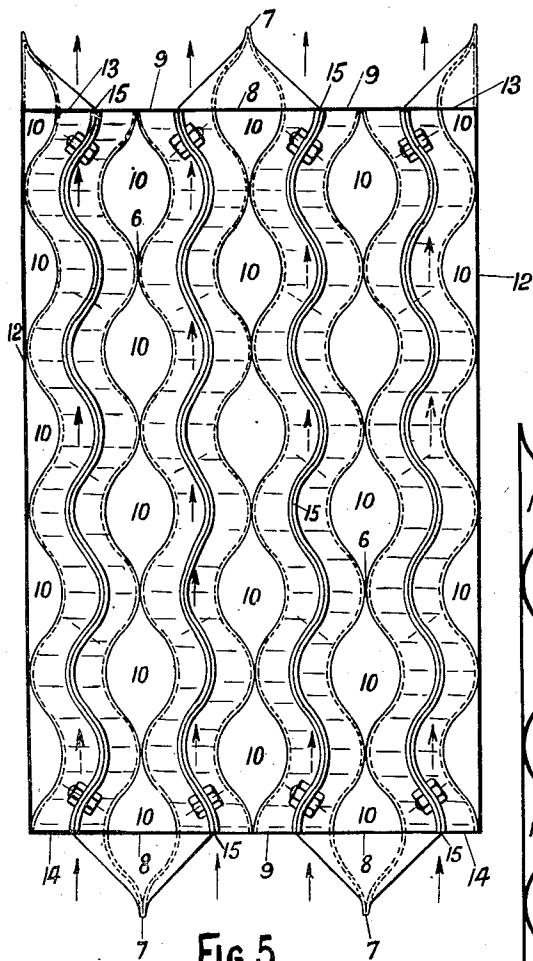


FIG. 5.

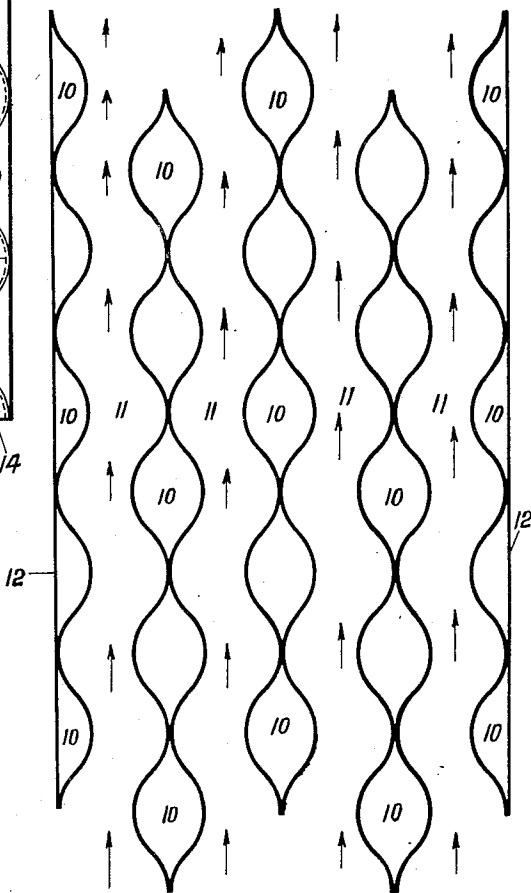


FIG. 7.

Inventor:
James Harold Hume
By
Bernie Davis Marvin & Edmonds
attorneys

Sept. 9, 1930.

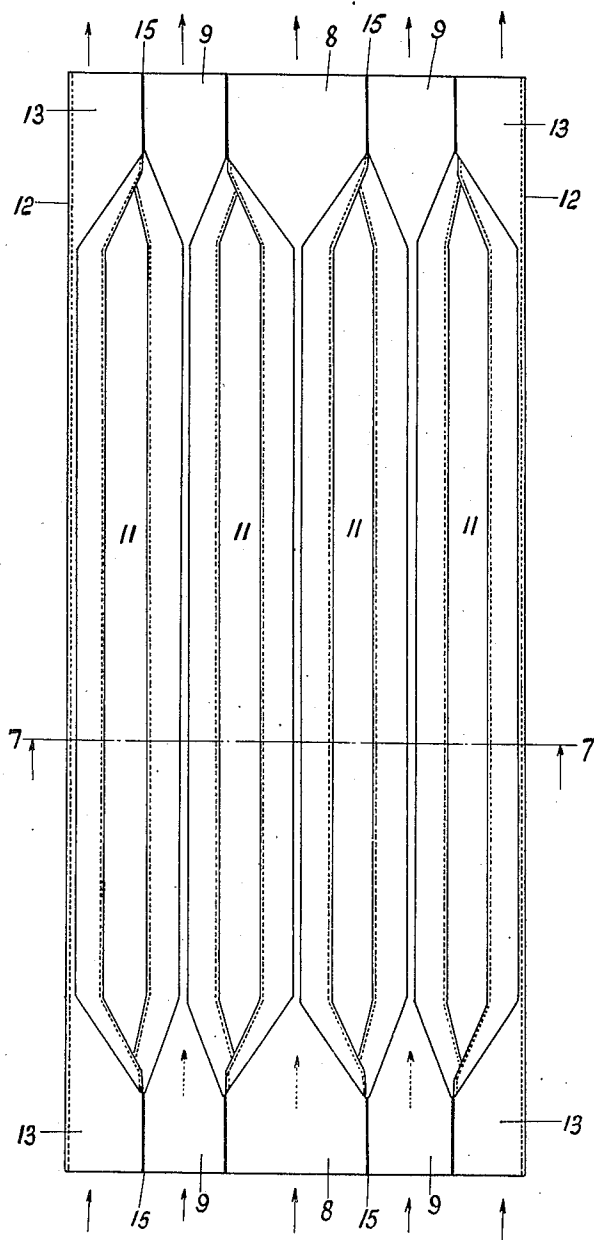
J. H. HUME

1,775,103

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A

FIG. 6.

Inventor
James Houston Hume
By
Pennie Davis Martin & Edwards
attorneys

Sept. 9, 1930.

J. H. HUME

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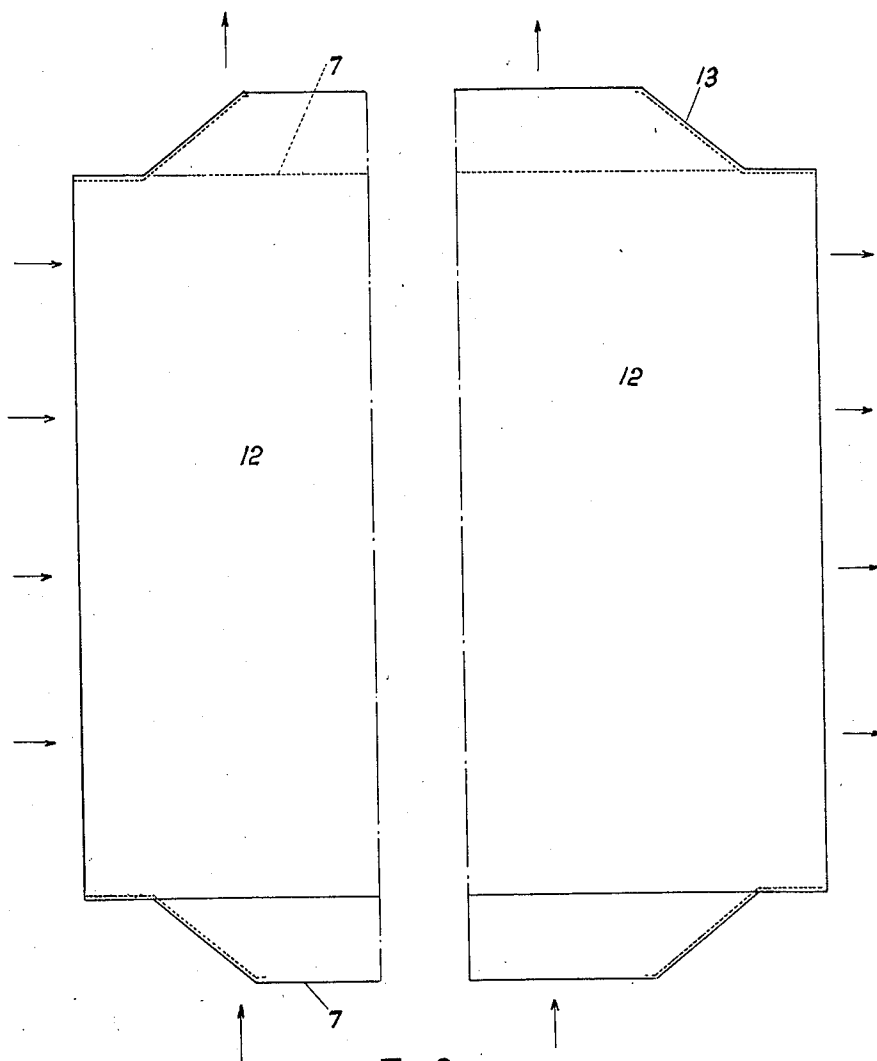


Fig. 8.

Inventor:
James Howard Hume
By
Gennie Davis, Martin & Edmonds
attorneys

UNITED STATES PATENT OFFICE

JAMES HOWDEN HUME, OF LONDON, ENGLAND

APPARATUS FOR HEATING FLUIDS

Application filed March 19, 1929, Serial No. 348,214, and in Great Britain December 28, 1928.

This invention relates to improvements in heat exchangers of the type comprising an assembly of elements consisting of united pairs of corrugated plates whose corruga-
tions present rows of straight parallel ducts to be traversed by fluid alternating with rows of sinuous passages extending transversely of said ducts and to be traversed by fluid at a different temperature.

A heat exchanger according to the invention is built up of elements in which the opposed edges of each plate extending transversely of the corrugations are stepped, being first off-set at an inclination to the body of the plate and then again off-set in parallelism with the body of the plate, the off-set edges of the plates of the pair being spaced apart.

The two plates are welded together along the ridges of the corrugations so that there is formed between the plates a row of parallel ducts.

To constitute a heat exchanger section adjacent elements are connected together along the off-set edges whereby there are formed between the adjacent plates of adjacent elements sinuous passages extending transversely of the ducts.

Conveniently, the outer elements of the section each comprise one stepped corrugated plate and a flat plate welded thereto, the flat plate thus constituting a plane outer wall.

The plates may be simply corrugated or they may be corrugated along waved lines so as to lengthen the paths to be traversed by the fluids, to increase the surface efficiency and to obtain increased turbulence.

In the accompanying drawings Fig. 1 is a section on the line 1—1 of Fig. 2 showing a stepped corrugated plate forming one half of an air-heater element according to the invention; Fig. 2 is a view at right angles to Fig. 1; Fig. 2^a is a fragmentary perspective view illustrative of the stepping of the corrugated plates; Fig. 3 is a fragmentary perspective view; Fig. 4 is an end elevation showing a pair of plates welded together to form an element; Fig. 4^a is a fragmentary perspective view of one end of an element; Fig. 5 is an end elevation showing a plurality of elements assembled to form a heater sec-

tion; Fig. 6 is a plan view of the section; Fig. 7 is a section on the line 7—7 of Fig. 6; Fig. 8 is an elevation at right angles to Fig. 5; Figs. 9, 10 and 11 are more or less diagrammatic views showing a pair of air heater sections fitted in the gas pass of a boiler uptake, Fig. 9 being a vertical section longitudinally of the boiler, Fig. 10 a front elevation with plates removed to expose the interior of the uptake casing and Fig. 11 a horizontal section on the line 11—11 of Fig. 10.

Referring to the drawings, 1 (Figs. 1—3) denotes a corrugated plate of which opposed edges extending transversely of the corrugations are stepped, the plates being first off-set at 2 at an inclination to the body of the plate and then again off-set at 3 in parallelism with the body of the plate. Two corners of the stepped portions of the plate (shown hatched in Figs. 2^a and 3) are cut away to present an inclined edge portion 4 and an edge portion 5 parallel with the corrugations, the distance from the top edge of the plate to the edge portion 5 being equal to one half of the pitch of the corrugations.

A plate thus formed constitutes one half of an element.

To form an element two plates are placed together as shown in Figs. 4 and 4^a so that they contact along the ridges of their corrugations, the off-set portions 2, 3 of the two plates being spaced apart. The plates are then welded together along the ridges at 6 and along their edges 7 parallel with the corrugations, i. e., their top and bottom edges.

To close the gaps formed between the off-set portions of the plates at the upper and lower edges shaped closing pieces 8, 9 are welded to the edge portions 4 and 5.

To constitute a heater section a plurality of elements are bolted together along the off-set portions 3 of the plates as shown in Fig. 5, said portions 3 presenting sinuous jointing faces, whereby there are formed between the adjacent plates of adjacent elements sinuous passages 11 (Figs. 6 and 7) extending transversely of the ducts 10 between the plates forming each element.

For incorporation in the gas pass of a

boiler uptake or the like it is convenient to pass combustion-supporting air to be heated through the ducts 10, and flue gases through the sinuous passages 11.

As shown in Figs. 5 and 7 alternate elements are inverted.

The outer elements of the section each comprise one stepped corrugated plate and a flat plate 12 welded to the ridges of the corrugated plate, closing pieces 13, 14 (Fig. 5) being welded into the gaps formed between the stepped portions of the corrugated plates and the flat plates 12 of the outer elements.

Asbestos cord, tape or the like packing may be interposed at 15 between the sinuous jointing faces of the elements (Figs. 5 and 6).

A, B (Figs. 9-11) denotes superposed sections of an air heater constructed in accordance with the invention interposed in series between the smoke box 16 and the uptake 17 of a marine boiler 17', the sections A and B being located within a casing 18 presenting closed chambers 19, 20 serving as air entrance and exit boxes.

The height of the upper section A is only a fraction, say one third, of the height of the lower section B, the respective heating surfaces presented by the sections being in proportion. The arrangement is such that, the upper section A being more subject to deterioration than the lower section B, the section A may be readily removed and replaced by a new section whereby considerable economy in the upkeep of the heater may be effected.

The sections A and B are separated by a space C which may serve to accommodate apparatus for cleaning the gas passages 11.

Combustion-supporting air to be heated is supplied by way of an air trunk 21 opening into an aperture 22 at the top of the chamber 19 adjacent to the flue gas exit.

The sinuous passages 11 are vertical and constitute one pass only for the flue gases, whereas the horizontal ducts 10 present a plurality of passes in series, said passes being controlled by valves 23, 24 located in the chamber 19 and by a valve 25 located in the chamber 20.

Cold air enters the aperture 22 and flows counter to the flue gases.

The bottom of the chamber 19 is open at 26 to the right-hand air leg communicating with the furnaces and at 27 to an air trunk 28 extending to an opening 29 communicating with the left-hand air leg leading to the furnaces.

I claim:—

1. A heat exchanger comprising an assembly of elements consisting of united pairs of corrugated plates whose corrugations present rows of straight parallel ducts alternating with rows of sinuous passages extending transversely of said ducts, the opposed edges of each plate extending transversely

of the corrugations being stepped, the plates of each element being welded together along the ridges of their corrugations, and adjacent elements being connected together along the off-set edges.

2. A heat exchanger comprising an assembly of elements consisting of pairs of corrugated plates, the plates of said pairs enclosing passages extending lengthwise of the corrugations, and the spaces between adjacent elements forming sinuous passages extending transversely of the first mentioned passages, the opposed edges of each plate extending transversely of the corrugations being offset, and adjacent elements being connected together along the off-set edges.

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

JAMES HOWDEN HUME.