

May 6, 1952

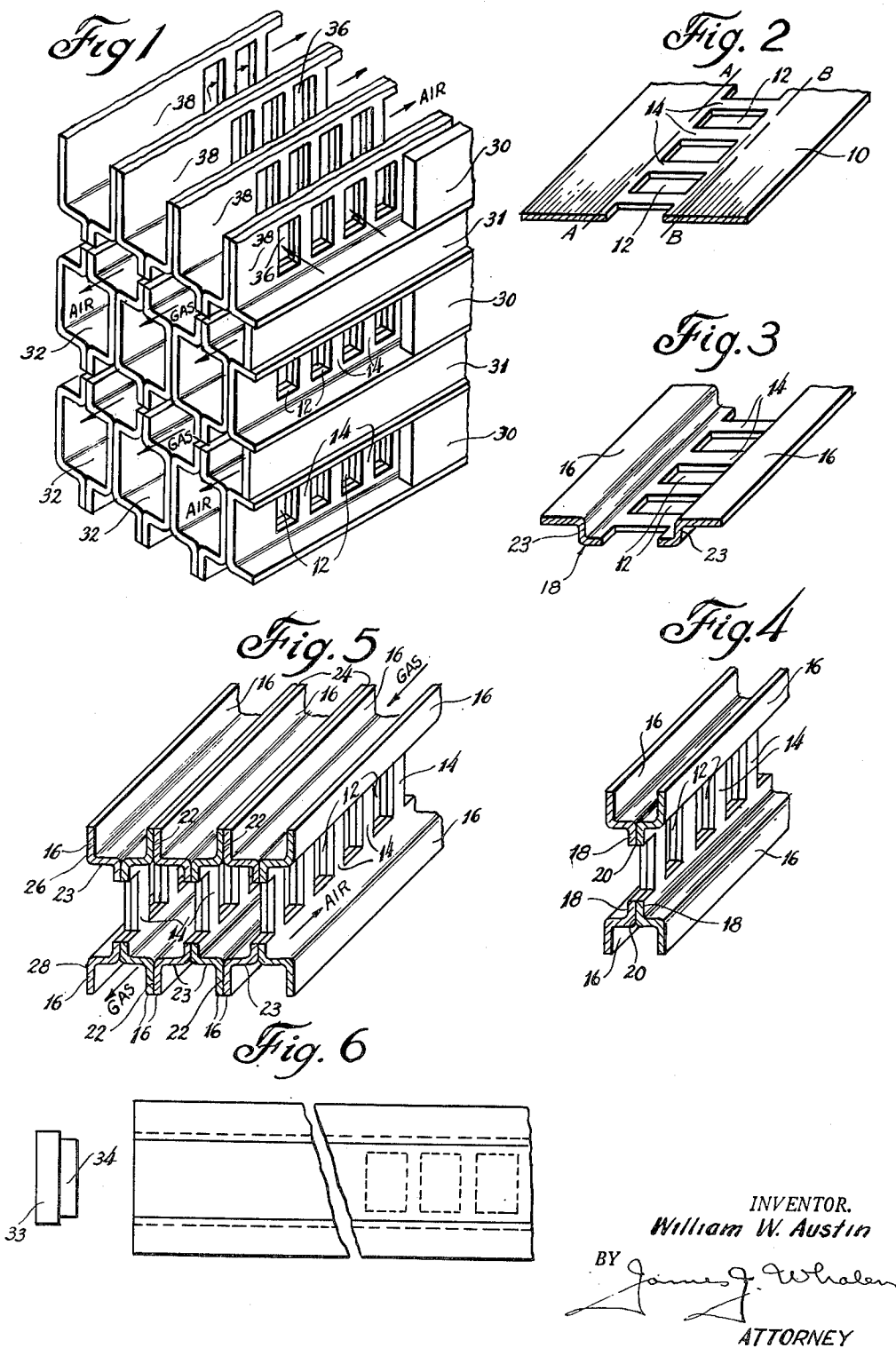
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2,595,440

HEAT EXCHANGER MADE FROM PUNCHED PLATES

Filed July 8, 1950

2 SHEETS—SHEET 1



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2 SHEETS—SHEET 2

Fig. 7

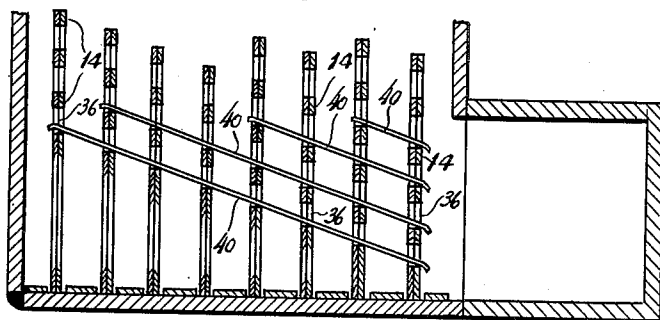


Fig. 8

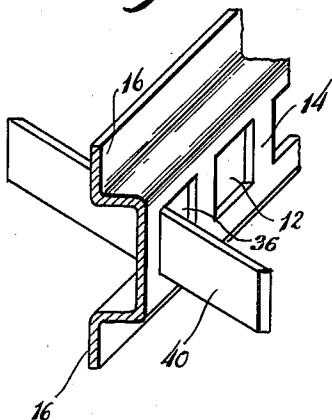


Fig. 9

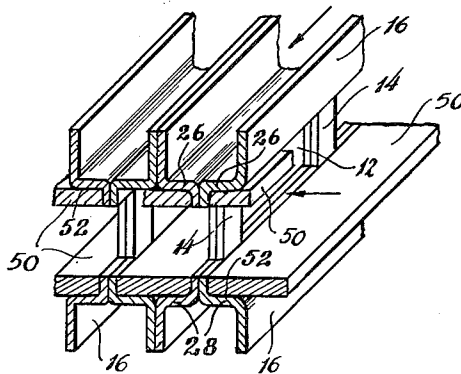
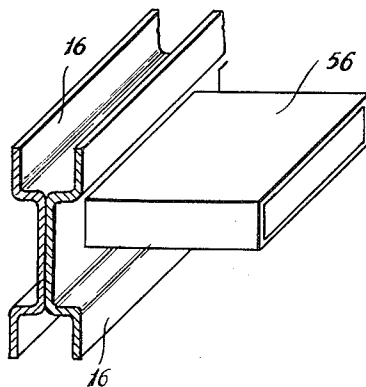


Fig. 10



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HEAT EXCHANGER MADE FROM PUNCHED PLATES

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1 Claim. (Cl. 257—245)

1

The present invention relates to heat exchange apparatus and particularly to improvements in plate type exchangers utilized for the transmission of heat between two confined fluids.

One well known form of heat exchanger for the transfer of heat between two confined fluids is made up of a plurality of spaced metallic plates forming passages through alternate ones of which a heating fluid, such as a hot gas, flows in heat exchange relationship with the fluid to be heated, such as air, traversing the intermediate passages. The present invention contemplates providing the passage walls through which heat is exchanged with pin-like fins constituted by the ligaments between perforations in rows punched in metallic strips which after being centrally dished or depressed are bonded together to form not only the fin elements but the walls of the passages in which they are located.

The invention will best be understood upon consideration of the following detailed description of illustrative embodiments thereof when read in conjunction with the accompanying drawings in which:

Figure 1 is a perspective view of a portion of a plate type heat exchanger having a series of heat exchange envelopes embodying the present invention.

Figure 2 is a perspective view of one of the basic elements of the heat exchanger, shown as consisting of a metallic plate punched with a row of perforations.

Figure 3 is a perspective view illustrating the plate of Fig. 1 in a second stage in which the central portion thereof has been dished or depressed.

Figure 4 shows a pair of plates of Fig. 3 mounted back to back to form one of the finned components from which the heat exchange envelopes are constructed, the view being in section.

Figure 5 is a transverse sectional view through a finned heat exchange envelope made up of a plurality of the components shown in Fig. 4.

Figure 6 is a side view corresponding to Fig. 5. Figure 7 is a fragmentary sectional plan view showing the manner in which the air passages of the heat exchanger are connected with the inlet and outlet headers for air.

Figure 8 is a fragmentary perspective view illustrating one manner of providing the flow deflecting vane shown in Fig. 7.

Figure 9 is also a fragmentary perspective view showing flow plates mounted in the portions of the air passage traversed by fluid flowing transversely of the finned components at the inlet and outlet ends of the passages.

2

Figure 10 is a fragmentary perspective view of a further arrangement for connecting the air passages to the inlet and outlet headers.

The heat exchanger of which a part is shown in Fig. 1 is basically of the plate type wherein spaced metallic plates form air and gas passages arranged in alternation so that the heat of gas, for example, flowing in alternate passages is transmitted through the intervening plate walls to air passages on either side of and intermediate the gas passages. In accordance with the present invention a plurality of so-called envelopes are formed which consist essentially of a pair of spaced plates defining opposite boundaries of an air passage with the spaces at the side edges of the plates being bridged by closure members which combined with the plates form a rectangular envelope open at opposite ends for connection to the inlet and outlet manifolds. The plates have extended surface in the form of fins projecting into the air passage and to build up a heat exchanger a plurality of these envelopes are superimposed upon each other and maintained separated by suitable spacer members to form the intermediate gas passages.

In accordance with this invention the basic element of the heat exchanger consists of a metallic strip somewhat greater in length than the passages to be traversed by the fluids between which heat is exchanged. In the first operation the metallic strip 10 shown in Fig. 2 has a plurality of closely spaced perforations 12 punched therein in a single row extending longitudinally of the strip. The plate ligaments remaining between the perforations after formation of the latter constitute a plurality of pin-like fins 14 for the walls of the air passage of the heat exchange envelope as will be apparent from consideration of Fig. 1. In a second operation the perforated plate of Fig. 2 has its central portion dished, depressed or bent along lines A—A, B—B close to each side of the row of perforations and parallel to its axis so that the fin parts 14 become disposed in a plane parallel to and spaced from by the shoulders 23 the remaining portions of the strip which now assume the form of raised lateral flanges 16 on the strip. A pair of the dished strips of Fig. 3 are then mounted back to back Fig. 4 with the strip portions 18 at and along opposite sides of the row of perforations 12 in contact with each other and they are then integrally joined together as by seam welds between these parts at 20.

To construct a heat exchange envelope a series of the components shown in Fig. 4 are mounted

alongside each other Fig. 5 with the outer faces of the flange parts 16 in contact with each other and they are then welded together as by seam welding at 22 between the contacting faces of the flanges. Alternatively, these flanges may be welded together along their outer edges where they contact as at 24. Thus, the shoulder parts 23 of the various dished plates which are substantially perpendicular to the lateral flanges and the web or body of the strip aline with each other to constitute opposite walls 26 and 28 of the gas passage while the plate ligaments separating the perforations 12 become pin fins 14 projecting from these walls into the air passage and bridging the latter at intervals. At the same time the flange portions 16 of the components become longitudinally extending fins disposed in what will be the gas passages at either side.

A plurality of envelopes such as shown in Fig. 5 having been constructed, they are mounted in superposed relation (Fig. 1) with the space between their side edges closed by members 30. Other members 31 not only space the envelopes but serve to form the side closures for the intermediate gas passage. These side closures 31 are of sufficient height to maintain the longitudinal flange-like fins 16 of adjacent envelopes out of contact along their longitudinal edges. The ends of the gas passages provided in the envelopes themselves are connected in conventional manner to the inlet and outlet manifolds. The ends of the air passages are closed as shown in Fig. 6 by the plates or strips 33 which have a series of spaced bosses or projections 34 to fit within the section of the subdivisions of the gas passage created by the fins 14 bridging the latter.

The other fluid such as air to be heated is admitted from the side of the heat exchanger as shown in Figs. 1 and 7 to 10. As shown in Fig. 1 the envelopes extend somewhat beyond the air passages proper and the dished parts are formed with a series of relatively large openings 36 with an imperforate portion 38 at the outer end. There is progressively one less opening 36 in each dish portion transversely of the exchanger in the direction proceeding from the side at which the air inlet header is located.

As shown in Figs. 7 and 8 guide strips 40 are fitted through the openings 36 in the longitudinal fins 16 and extend transversely of the air passage in inclined relation so as to guide and distribute the air uniformly across the air passage into the various channels into which the passage is divided by the fins 16. The guide strips 40 are of progressively longer length so that the fluid is divided into a series of streams each of which is led directly to one of the channels or subdivisions in the air passage formed between the longitudinally extending fins 14.

To provide pin fins in the air passages the longitudinal flanges 16 are formed with a plurality of perforations 44 so that the intervening plate

ligaments 46 constitute pin fins or may be said to provide an interrupted strip fin in the air passage.

In the form shown in Fig. 9 a flow plate 50 is attached to the side of one of the components and located in the passage to bridge the valley or gap 52 between the ligaments 13 extending from the passage walls 26; 28 between the pin fins 14 so as to reduce pressure drop.

In Fig. 10 instead of utilizing the guide strips shown in Fig. 8, rectangular tubes 56 are fitted through the openings 12 to lead the air streams directly to the channels formed in the passages. Here the series of perforations 36 are near the outer ends of the flanges because the tubes would traverse several fins and those for the inner channels would otherwise block flow to outwardly located channels.

What I claim is:

A heat exchange envelope of the type having spaced walls defining a passage for circulation of one fluid in heat exchange relationship with another fluid flowing in contact with the outer surfaces of said walls comprising; a plurality of metallic strips each punched with a row of closely spaced perforations and centrally dished or bent along lines paralleling the axis of said row of perforations and closely adjacent the latter to form a pair of lateral flanges along each edge of the strip spaced from the body thereof by substantially perpendicular shoulders, said strips being mounted in pairs back to back with the central dished portions bordering the rows of perforations in contact and bonded together and a plurality of joined pair components being mounted in abutment in a row with the outer faces of their lateral flanges bonded together to form an envelope having a central passage with the strip ligaments between the perforations constituting pin-like fins extending from the passage walls constituted by said shoulders of the dished portions of the strips and with the lateral flanges of the strips constituting longitudinal fins on the outer faces of the passage walls for contact with the other fluid; and means at the sides of said envelope bridging the spaces between the walls formed by abutment of said components for closing the envelope at its side edges.

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