

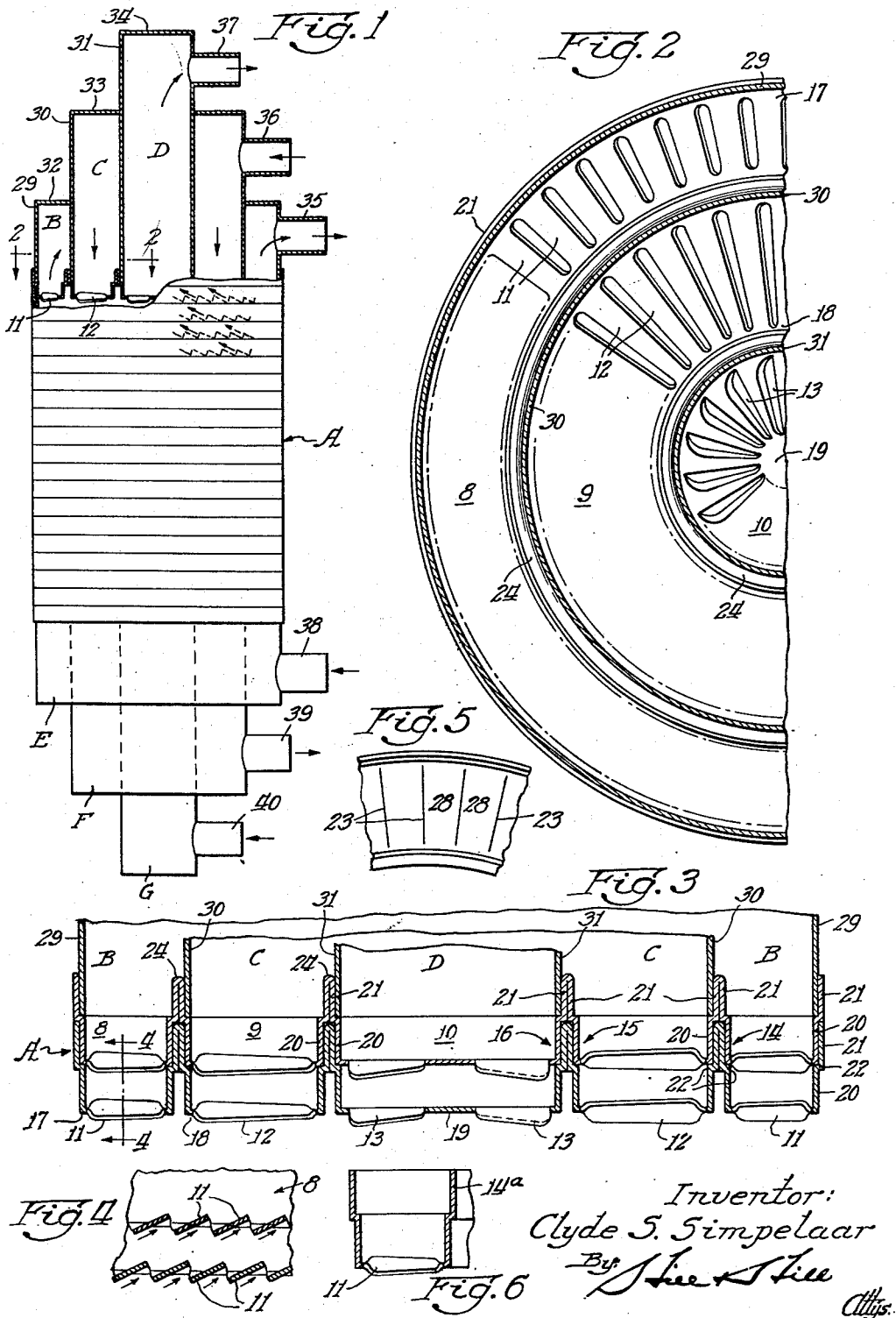
March 8, 1955

C. S. SIMPELAAR

2,703,701

HEAT EXCHANGER

Filed May 20, 1946



1

2,703,701

HEAT EXCHANGER

Clyde S. Simpelaar, Racine, Wis., assignor to Modine Manufacturing Company, Racine, Wis., a corporation of Wisconsin

Application May 20, 1946, Serial No. 670,893

7 Claims. (Cl. 257—246)

This invention relates to heat exchangers and its principal object is to provide a heat exchanger embodying the principle of the short strip type fins shown and described in my application for patent Serial No. 664,542, filed April 24, 1946. The relationship between the two applications lies in the use in both cases of the nested channel-shaped fin with a perforated bottom to form strip type fins formed from flat sheet, the fluid flow in each case being normal to the strip fin surface and permitting extremely close spacing of the fin strips.

Another of its objects is to provide a heat exchanger in which a plurality of fluids may be simultaneously treated with a heat exchanger medium.

The invention has particular reference to heat exchangers in which a gas, such as air, is used as the heat exchange fluid for the transfer of heat to or from other gases, such as oxygen and nitrogen.

Another object is to provide a heat exchanger having several concentric passages provided with obliquely extending short fins or vanes for directing the flow of the fluids through the passages along helical paths.

Another object is to provide a heat exchanger composed of nested together and bonded together channel shaped fin elements formed with openings through their cross walls and formed with obliquely extending vanes struck up from the cross walls of the fin elements.

Another object is to provide a heat exchanger of which the fin elements are of channel formation with outwardly offset flanges and bonded together and providing walls between the several passages and also at the periphery of the device.

Another object is to provide concentric circular inlet headers, one for each passage, and concentric circular outlet headers, one for each passage.

With these and other objects and advantages in view, this invention consists in the several novel features hereinafter fully described and more particularly defined in the appended claims.

The invention is clearly illustrated in the drawing accompanying this specification, in which:

Fig. 1 is a view partly in side elevation and partly in central longitudinal section of a heat exchanger embodying a simple form of the present invention;

Fig. 2 is a fragmental horizontal section upon an enlarged scale and taken along the line 2—2 of Fig. 1;

Fig. 3 is a central vertical fragmental section taken along two of the fin elements and the adjacent headers;

Fig. 4 is a detail fragmental vertical section of two of the fin elements taken along the line 4—4 of Fig. 3;

Fig. 5 is a fragmental plan of one of the fin elements illustrating certain slits in the cross wall thereof; and

Fig. 6 is a detail vertical diametric section of a slightly modified form of fin element.

Referring to said drawing and first to Figs. 1 to 5 inclusive, the reference character A designates the heat exchanger unit per se. C designates an inlet header and B and D designate two outlet headers connected to one end of the heat exchanger unit and E, G designate two inlet headers and F designates an outlet header, all connected to the other end of the heat exchanger unit A. The heat exchanger unit A is divided into three concentric passages 8, 9, 10 (see Fig. 3) and in said passages are located obliquely extending fins or vanes 11, 12, 13 which serve to direct the flow of the fluids through the passages in helical directions from the inlet headers to the outlet headers, thereby causing the fluids to travel

2

through a greater distance in the passages than if they were to flow in a straight line from the inlet headers to the outlet headers.

The several passages are formed by concentric channel shaped fin elements 14, 15, 16 nested and bonded together. The three fin elements 14, 15, 16 may be composed of a single stamping initially struck up with bottom or cross walls 17, 18, 19 and side walls 20 provided with outwardly offset flanges 21 which provide ledges or shoulders 22 upon which the next adjacent fin element seats. The inner side walls are joined at their upper ends as shown at 24 to provide a single fin unit.

The openings through the bottom walls of the innermost fins are formed by striking down vanes 13 from the bottom wall 19 and bending the struck up portions to stand at a suitable angle, whereby to direct the flow of the gas through a helical path.

Reference is now made to Fig. 5 which shows a fragment of one of the fin elements 14 before the vanes are struck up into their inclined position. In forming the vanes the material of the cross wall 17 is first slit along radial lines, as at 23 and the portions 28 between the slits are struck up with suitable dies to stand in inclined directions of any desirable angle (see Fig. 4).

Referring now to Fig. 4, it will be seen that fluid flowing through the passage 8 is caused to flow in a helical direction, said vanes dividing the passage into several helically disposed paths.

The inlet and outlet headers are substantially alike and a description of one will suffice for both.

The header B is composed of a cylindrical wall 29 that is bonded to the outermost fin element and the header C is formed of a cylindrical wall 30 bonded to the intermediate fin element and the header D is formed of a cylindrical wall 31 bonded to the innermost fin element. A top wall 32 connects the outer wall 29 with the wall 30 of the intermediate header, and a top wall 33 connects the wall 30 of the intermediate header with the central one, and a top wall 34 closes the upper end of the innermost header. An inlet pipe 36 and outlet pipes 35 and 37 lead to the respective headers, and in the form of the invention illustrated the inlet pipe 36 conducts air to the intermediate inlet header C. The outlet pipe 35 conducts a gas, such as nitrogen, away from the outermost header, and the outlet pipe 37 conducts a gas, as for instance oxygen, from the innermost header. Inlet pipes 38 and 40 conduct gas to the outermost and innermost headers E, G respectively and a discharge pipe 39 conducts gas, such as air, from the header F.

In the operation of the heat exchanger, the several gases are forced through the heat exchanger and flow in helical directions through the passages as caused by the inclined vanes. The walls and vanes conduct the heat from the warmer fluid to the cooler one which absorbs the heat and carries it away.

In the modified form of the heat exchanger shown in Fig. 6, the several channel shaped fin elements 14a of each fin unit are made separate, instead of making the several fin units from a single stamping, and are nested and bonded together in concentric relation to form the complete heat exchanger unit.

The above described heat exchanger has been designed especially for use in connection with oxygen plants, but obviously its use is not limited thereto as it may be used wherever a heat exchanger is required for gas.

Having thus described my invention, it is obvious that various immaterial modifications may be made in the same without departing from the spirit of my invention; hence, I do not wish to be understood as limiting myself to the exact form, construction, arrangement and combination of parts herein shown and described or uses mentioned.

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

1. In a multipass heat exchanger, the combination of a plurality of fin elements, each having a series of cylindrically shaped side walls, concentrically positioned and radially spaced with respect to one another, with said walls extending substantially parallel to their axis of generation, said side walls being offset intermediate their

3

edges in an outward direction relative to the element, and a plurality of relatively closely spaced, narrow strip fins extending between and having their ends integrally connected to the respective side walls to form openings between the strip fins, said fin elements being interlocked with the edge portions of the respective side walls of each element overlying the side wall of an adjacent fin element and bonded together to form a unitary fluid pass having concentric side walls connected by a plurality of series of strip fins, whereby a multipass heat exchanger is adapted to be formed by the openings formed by the strip fins between the series of cylindrically shaped side walls.

2. In a multipass heat exchanger, the combination of a plurality of fin elements, each having a series of cylindrically shaped side walls, concentrically positioned and radially spaced with respect to one another, with said walls extending substantially parallel to their axis of generation, said side walls being offset intermediate their edges in an outward direction relative to the element, a series of relatively closely spaced, narrow strip fins extending between and having their ends integrally connected to the respective side walls to form openings between the strip fins, said fin elements being interlocked with the edge portions of the respective side walls of each element overlying the side wall of an adjacent fin element and bonded together to form a unitary fluid pass having concentric side walls connected by a plurality of series of strip fins, the fins in each series being positioned in substantially a common plane extending substantially parallel to the planes of the other series, with the respective fins of a series extending at an angle relative to the plane of such series and corresponding fins of adjacent series extending substantially parallel to one another to form a helical flow path for fluid passing therethrough, whereby a multipass heat exchanger is adapted to be formed by the openings formed by the strip fins between the series of cylindrically shaped side walls.

3. In a multipass heat exchanger, the combination of a plurality of series of concentric, channel-shaped fin elements, each having cylindrically shaped side walls, concentrically positioned and radially spaced with respect to one another, with said walls extending substantially parallel to their axis of generation, said side walls being offset intermediate their edges in an outward direction relative to the element, a plurality of relatively closely spaced, narrow strip fins extending between and having their ends integrally connected to the respective side walls to form passages therebetween, the respective fin elements of each series being interlocked with the edge portions of the respective side walls of each element overlying the side wall of an adjacent fin element, with the respective series of elements concentrically positioned, one within the other, all of said fin elements being bonded into a unitary structure having a plurality of concentric fluid passes formed by the strip fins between the cylindrically shaped side walls, the side walls of each pass being connected by a plurality of strip fins.

4. In a multipass heat exchanger, the combination of a plurality of series of concentric, channel-shaped fin elements, each having cylindrically shaped side walls, concentrically positioned and radially spaced with respect to one another, with said walls extending substantially parallel to their axis of generation, said side walls being offset intermediate their edges in an outward direction relative to the element, a plurality of relatively closely spaced, narrow strip fins extending between and having their ends integrally connected to the respective side walls, the respective fin elements of each series being interlocked with the edge portions of the respective side walls of each element overlying the side walls of an adjacent fin element, with the respective series of elements concentrically positioned, one within the other, all of said fin elements being bonded into a unitary structure having a plurality of concentrically fluid passes formed by the strip fins between the cylindrically shaped side walls, the side walls of each pass being connected by a plurality of series of strip fins, the fins in each series in the respective passes being positioned in substantially a common plane extending substantially parallel to the planes of the other series in such pass, with the respective fins of a series extending at an angle relative to the plane of such series and corresponding fins of adjacent series therein extending

4

substantially parallel to one another to form a helical flow path for fluid passing therethrough.

5. In a heat exchanger, the combination of a plurality of fin elements, each formed from a single sheet of material and having a plurality of spaced concentric series of relatively closely spaced, narrow strip fins formed therein, and providing passages between adjacent fins of each series, cylindrically shaped side walls concentrically positioned with respect to one another and bounding the respective series of fins, with said side walls extending substantially parallel to their axis of generation, said side walls each having an offset therein whereby the edge portion of each wall is offset with respect to the remainder thereof, said fin elements being interlocked with one another, with the edge portions of the respective side walls of each element overlying the corresponding side wall of an adjacent fin element, and bonded together to form a unitary structure having a plurality of concentric fluid passes, each pass having a plurality of series of strip fins therein.

6. In a heat exchanger, the combination of a plurality of fin elements, each formed from a single sheet of material and having a plurality of spaced concentric series of relatively closely spaced, narrow strip fins formed therein, and providing passages between adjacent fins of each series, cylindrically shaped side walls concentrically positioned with respect to one another and bounding the respective series of fins, with said side walls extending substantially parallel to their axis of generation, said side walls each having an offset therein whereby the edge portion of each wall is offset with respect to the remainder thereof, said fin elements being interlocked with one another with the edge portions of the respective side walls of each element overlying the corresponding side wall of an adjacent fin element, and bonded together to form a unitary structure having a plurality of concentric fluid passes, each pass having a plurality of series of strip fins therein, the corresponding series of fins in each pass being positioned in substantially a common plane extending substantially parallel to the planes of the other series, with the respective fins of a series extending at an angle relative to the plane of such series and corresponding fins of adjacent series of the same pass extending substantially parallel to one another to form helical flow paths for fluids passing through the respective passes.

7. A heat exchanger fin comprising a disk of high heat conducting material, said disk having a central opening adapted to fit over a tube, an integral flange on the periphery thereof, a second integral flange defining said central opening and having in the face thereof a series of closely spaced passages disposed radially relative to said central opening, said passages being formed by cutting said disk along closely spaced lines disposed substantially radially of said central opening and deflecting the material between contiguous lines to provide vanes defining the side walls of said passages, each of said vanes extending substantially equidistantly above and below the original plane of said disk and having the opposite terminal ends thereof integral with said flanges, substantially the entire surface of the face of said disk being thus deflected without waste to produce said vanes and being thus utilized as a heat exchange surface, said disk adapted to be stacked with at least one of said flanges of each disk except one terminal disk in substantially abutting relationship with the face of a contiguous disk to provide a relatively large mass of high heat conducting material per unit of heat exchanger volume permeated by a multiplicity of said passages for flow of a fluid medium therethrough in surface contact with said vanes.

References Cited in the file of this patent

UNITED STATES PATENTS

75	1,340,266	Hildebrand	May 18, 1920
	1,563,182	Gargiulo	Nov. 24, 1925
	1,591,323	Karmazin	July 6, 1926
	1,734,274	Schubart	Nov. 5, 1929
	1,736,906	Flintermann	Nov. 26, 1929
80	1,854,619	Mortensen	Apr. 19, 1932
	1,880,533	Thomas	Oct. 4, 1932
	2,016,164	Williams	Oct. 1, 1935
	2,059,114	Karmazin	Oct. 27, 1936
	2,212,864	Karmazin	Aug. 27, 1940
85	2,532,288	Buschow	Dec. 5, 1950