

Dec. 26, 1939.

F. M. YOUNG

2,184,657

HEAT EXCHANGER

Filed April 10, 1936

2 Sheets-Sheet 1

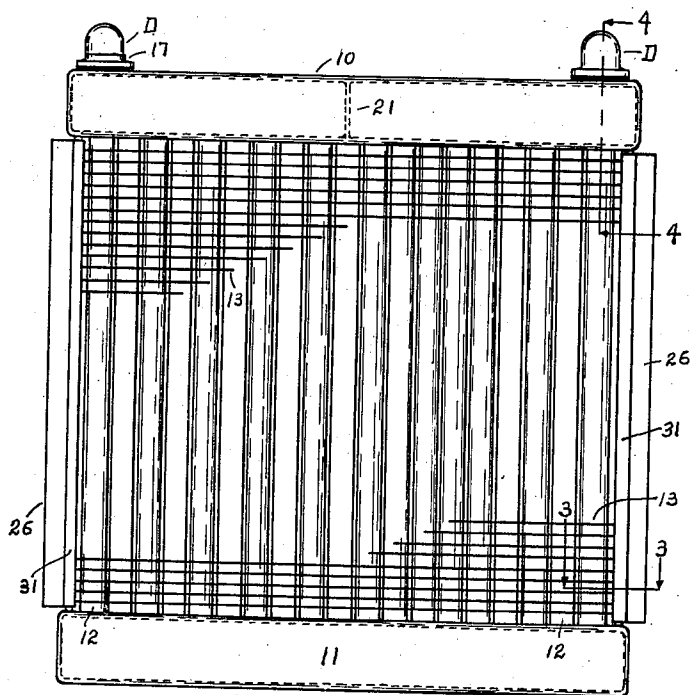


FIG. 1

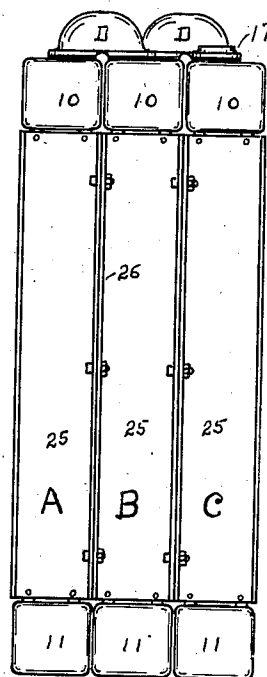


FIG. 2

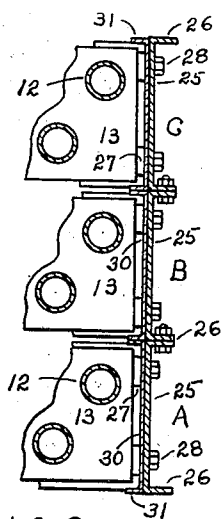


FIG. 3

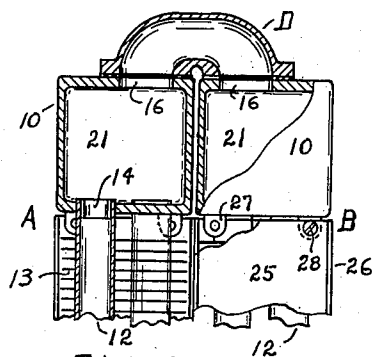


FIG. 4

INVENTOR  
Fred M. Young  
By A.S. Kroth  
ATTORNEY

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F. M. YOUNG

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2 Sheets-Sheet 2

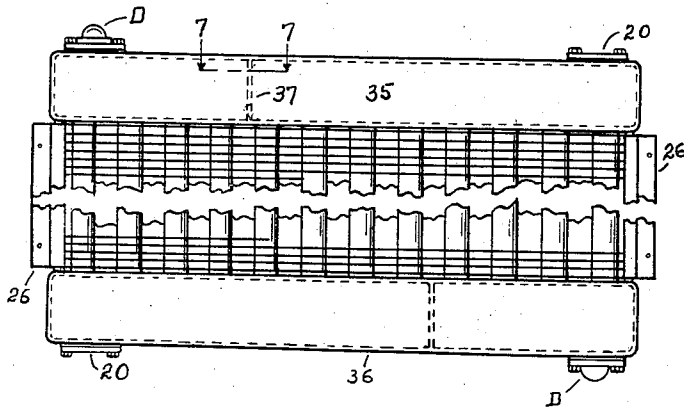


FIG. 5

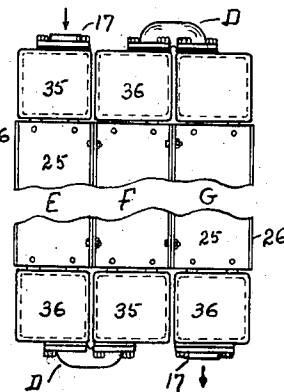


FIG. 6

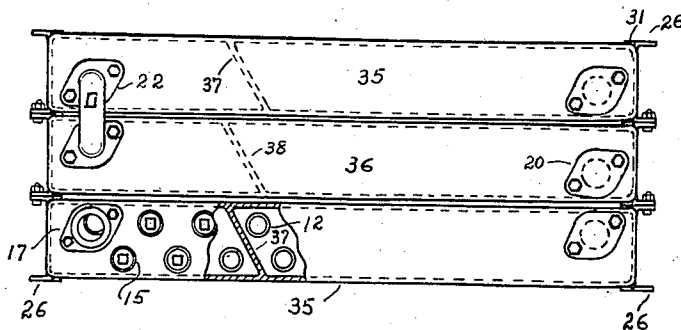


FIG. 7

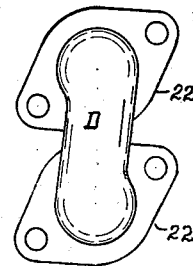


FIG. 8

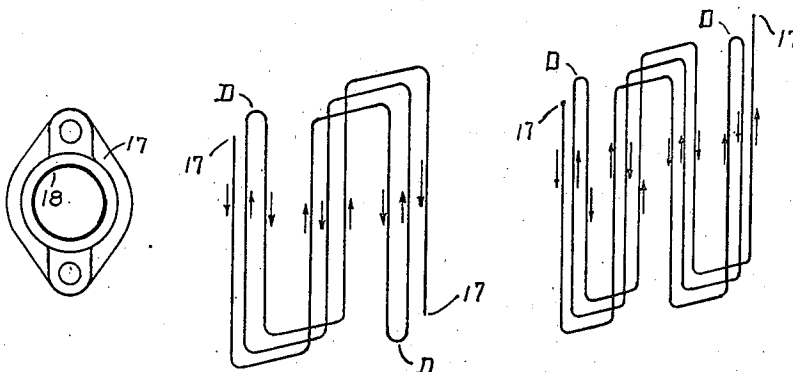


FIG. 9

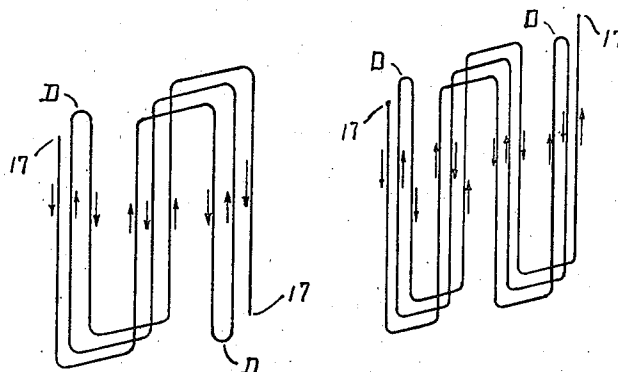


FIG. 10

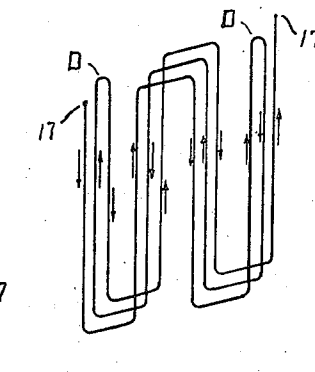


FIG. 11

INVENTOR  
Fred M. Young  
By A. S. Kroth  
ATTORNEY

## UNITED STATES PATENT OFFICE

2,184,657

## HEAT EXCHANGER

Fred M. Young, Racine, Wis.

Application April 10, 1936, Serial No. 73,607

2 Claims. (Cl. 257—154)

My invention relates particularly to air blast heating and cooling units, and provides means whereby units may be readily assembled in shapes and sizes suitable for the various equipment needs, and a device that will operate efficiently.

One of the objects of my invention is to provide a design which may be manufactured or shipped in a number of individual sections which may be conveniently fastened together when being installed, without the use of screw threaded pipe fittings, thus to facilitate manufacturing, shipping and installing operations.

Other objects are to provide unitary sections having novel means for protecting the fin corners, to connect the sections together in a novel manner and, without additional parts, to form an air passageway enclosure for the core.

Another object is to provide a number of sections having means to pass the heating or cooling medium through groups of tubes in each section in series, sinuously, and from the inlet to the outlet of the unit through loops having gaskets and bolts whereby they may be operatively united by means of these connections.

Another object of my invention is to provide a unit which will occupy a minimum space and wherein individual sections may be easily removed and replaced, and whereby very few headers may be used with which to make up an almost innumerable number of sections of varying sizes; also whereby very few sections may answer with which to make units suitable for a number of installations; thus to simplify and reduce manufacturing and installing costs.

I accomplish one of the foregoing by means of transverse partition walls in the headers whereby the heating or cooling liquid may pass through certain groups of tubes in individual sections in series, thus to double or triple the distance between the inlet and outlet connections of the unit to thereby increase the speed of travel of the heating or cooling medium, two, three or more times that of the liquid if it passed through all of the tubes of each section in multiple, as is common practice.

It has been demonstrated that in sections whose tubes are divided into two liquid paths in series instead of one path in multiple, there will be a gain in heat transfer capacity of around 17%, and if the section is divided into three groups of tubes in series, the increase in capacity is around 27%; therefore the units may be made correspondingly smaller and still have the same capacity, by the use of my invention.

To these and other useful ends my invention

consists of matter hereinafter set forth and claimed and shown in the accompanying drawings in which:

Fig. 1 is a front elevation of my improved unit comprising three sections.

Fig. 2 is a side elevation of the device shown in Figure 1.

Fig. 3 is an enlarged fractional section taken on line 3—3 of Figure 1.

Fig. 4 is an enlarged side view illustrating a fraction of sections A and B, taken on lines 4—4 of Figure 1.

Fig. 5 is a fractional elevation of the device shown in Figure 1, differing only in that the unit is made of 3-pass sections and operatively connected accordingly.

Fig. 6 is a fractional end elevation of the unit shown in Figure 5.

Fig. 7 is a top view of the unit shown in Figures 5 and 6, having a portion of one header cut away on lines 7—7 of Figure 5.

Fig. 8 is a top plan view of the loop used for operatively connecting one header to another.

Fig. 9 is a top view of a screw threaded flange fitting with which to make inlet and outlet connections to the unit.

Fig. 10 is a diagrammatic drawing showing the path taken by the heating or cooling liquid when passing through a three section unit having 3-pass sections as illustrated in Figures 5, 6 and 7.

Fig. 11 is a diagrammatic drawing showing the path taken by the heating or cooling medium, when passing through a three section unit having 4-pass sections.

As thus illustrated in Figures 1 to 4, my complete heat exchanger unit comprises three sections designated in their entirety, by means of reference characters A, B and C. Each section comprises an upper header 10 and a lower header 11, having a number of operatively connected spaced tubes 12 and a multiplicity of closely spaced fins 13 through which tubes 12 extend, forming a core, the tubes being shown as staggered and positioned in two rows, and secured in their openings in the headers preferably by means of ferrules 14, as is the custom in heat exchangers of the class.

The headers are preferably cast integral and are then provided with screw threaded openings which are in axial alignment with the tubes, whereby a suitable tube and ferrule expanding tool may be used to secure the tube ends into their openings, after which screw threaded plugs 15 are used to seal these openings as shown fractionally on head 35 in Figure 7. I provide openings

16, preferably one at each end of the headers, with which to make suitable inlet and outlet connections to the unit and suitable connections between the sections in the following manner:

- 5 For the inlet and outlet connections to a unit I preferably provide flanges 17 having screw threaded openings 18; flanges 17 register with corresponding surfaces surrounding openings 16 and are removably bound and sealed to the headers by means of suitable gaskets and cap screws in the usual well known manner and as illustrated in some of the figures of the drawings. When no connection is needed for openings 16, I provide plates 20 which are bound and sealed to 10 the header similar to flanges 17 (see Figure 7).

- In Figures 1 and 2 I illustrate three 2-pass sections; that is, midway the upper header 10 I provide a partition wall 21 (shown by dotted lines in Figure 1). This wall is necessarily positioned at an angle (see Figure 7), because of the staggered position of the tubes and is located to thereby provide two chambers of equal length in headers 10; thus the heating or cooling medium may enter section A at flange 17, pass downward through the tubes at one side of partition 21, thence through header 11 and return through the tubes on the other side of the partition.

- I provide loop D having flanges 22 similar in shape to flanges 17, the chamber in this loop registering with openings 156. These loops are bound and sealed to the headers in a manner similar to flanges 17; thus it will be seen that a suitable and direct passageway from one header to the other may be made by means of this loop as clearly illustrated in Figure 4.

- As thus illustrated in Figures 1 and 2, one end of header 10 in section A is provided with an inlet flange 17, the other end of this header being operatively connected to the adjacent end of header 10 in section B by means of loop D; the other end of header 10 of section B, is similarly connected to the adjacent end of header 10 in section C; thus it will be seen that the liquid entering section A through flange 17, will pass in series successively, through the sections and through the two groups of tubes in each section, providing twice the length of travel and having one half the tube area in the path of the liquid, as compared with the conventional section; therefore, with a fixed pump capacity, the speed or velocity of the liquid is doubled, resulting in an increased heat transfer capacity and increased efficiency, because the liquid is kept in a far greater state of turbulence and the tubes will not so readily clog or coat with lime or mud.

- In order to provide means to hold the sections in spaced relation, I provide housing plates 25 having outwardly extending flanges 26, plates 25 being secured to the header projections 27 by means of screws or bolts 28. When the sections are assembled in a unit, flanges 26 are bolted together as illustrated in Figures 2 and 3, thus forming a rigid assembly. I provide preferably, a plate 30 having inturned flanges 31 which extend far enough to protect the corners of fins 13 as indicated in Figure 3. In this figure member 30 is shown as positioned under member 25. I may elect to make this member in two separate angles and either attach them permanently to member 25 or otherwise shape and attach them to this member. Clearly if one of my sections is to be used separately, members 30 may be dispensed with and members 25 reversed so their flanges 26 will protect the fins.

Referring now to Figures 5 to 7. When a 3-

pass unit is desired I provide each header with a transverse partition wall as illustrated. The partitions 37 and 38 in the headers are positioned so as to form an inlet or outlet chamber one third the length of the header. The lower headers may be exactly like these upper headers except that they are turned end for end and positioned on the sections as illustrated in Figure 6, loops D being used to operatively connect the headers as illustrated in these figures. Figure 10 clearly illustrates the path taken by the liquid through these 3-pass sections when assembled in a 3 section unit. Figure 11 illustrates the path taken in a 3 section unit having 4-pass sections.

Clearly any number of 2-pass sections may be readily operatively connected by means of loops D, the loops all being between headers 10, whereas 3-pass sections require loops positioned alternately on opposite ends and sides of the sections as illustrated in Figures 5, 6, 7 and 10.

Thus it will be seen that I have provided a simple and inexpensive means to increase the efficiency and capacity of heat exchangers of the present class; that the sections comprise each a complete operative device, independently or assembled in groups; that the headers are closely spaced thus to cooperate with the side plates to form a neat outward appearance, protect the core and provide a novel air passage enclosure. It will be understood that minor detail changes of headers and connections therebetween, may be adapted to my invention and that the sections may be used separately and made with one or more rows of tubes, without departing from the spirit and scope of the invention as recited in the appended claims.

Having thus shown and described my invention, I claim:

1. A heat exchanger unit of the class described, comprising two or more individual sections, each section having spaced headers and a number of tubes operatively connected therebetween, a multiplicity of closely spaced fins through which said tubes extend, forming a core, transverse partition walls in said headers positioned to thereby separate the tubes into a series circuit for the passage of the heating or cooling medium, connections between the ends of said series forming a series connection between said sections, inlet and outlet connections at the ends of said last series, whereby the cooling or heating medium will be caused to pass in series through and between said sections, side channels having their flanges turned outwardly and being secured to the ends of said headers forming independent frames for each section, said flanges being positioned on substantially the same plane as the front and rear edges of said headers and adjacent flanges being secured together and cooperating with said headers to thereby form a single air duct surrounding said cores, means secured to said channels being positioned to thereby form an airtight between said cores and channels.

2. A heat exchange unit of the class described, comprising two or more individual sections, each section having spaced headers and a number of tubes operatively connected therebetween, a multiplicity of closely spaced fins through which said tubes extend forming a core, side channels having their flanges turned outwardly and being secured to the ends of said headers forming independent frames for each section, the outer edges of said channels being positioned on substantially the same plane as the front and rear edges of said headers, the adjacent flanges being

secured together and cooperating with said headers to thereby form a single air duct surrounding said cores, transverse partition walls in certain headers positioned to thereby separate the tubes into a series circuit for the passage of the heating or cooling medium, connections between the ends of said series forming another series connection between said sections, inlet and out-

let connections at the ends of said last series whereby the cooling or heating medium will be caused to pass in series through and between said sections, means secured to said channels being positioned to thereby form an air lock between the cores and channels.

FRED M. YOUNG.