June 18, 1946. C. A. SEWELL 2,402,262

HEAT EXCHANGE FIN

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Fig. 1.

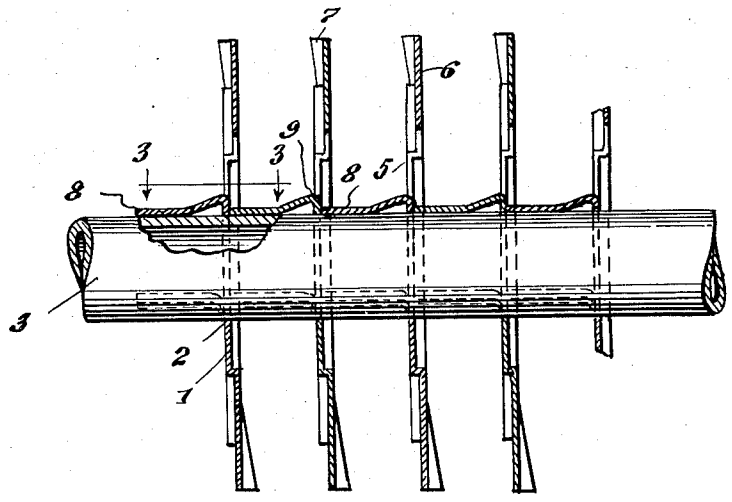


Fig. 2.

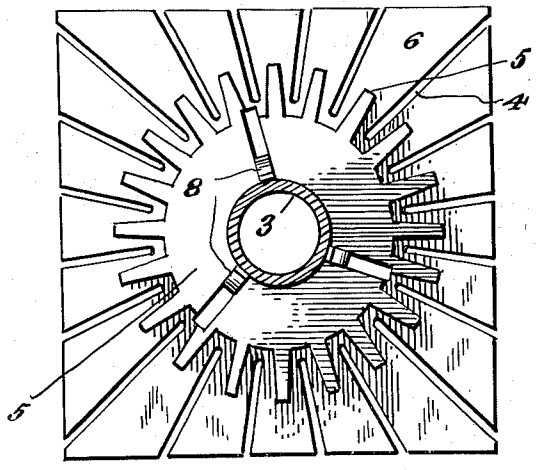


Fig. 3.

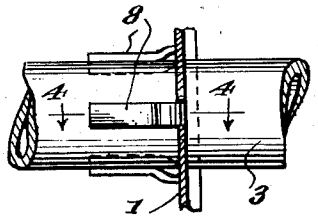
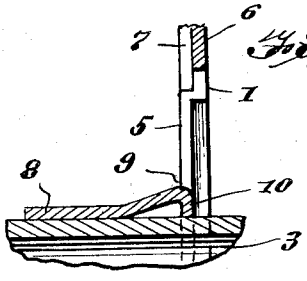


Fig. 4.



Inventor

CLEVELAND A. SEWELL

By Wilfred Lawson

Attorney

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Fig. 5.

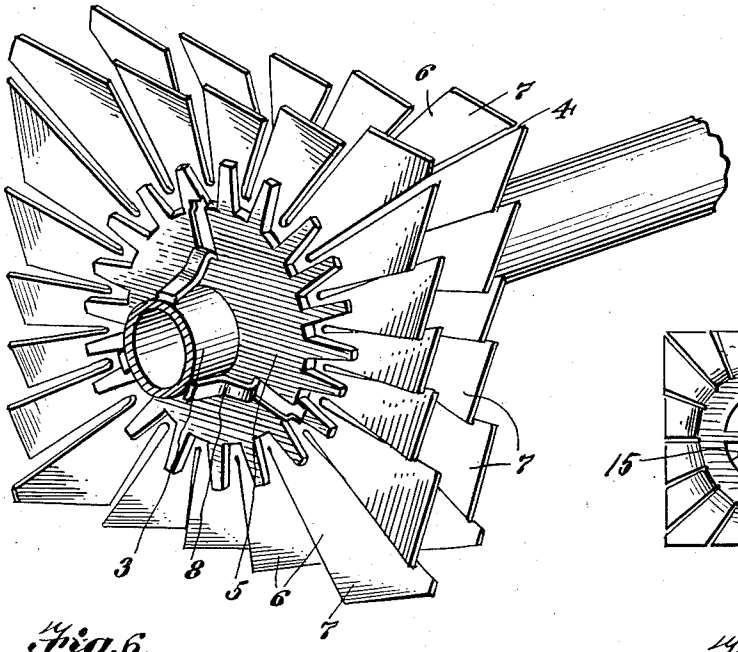
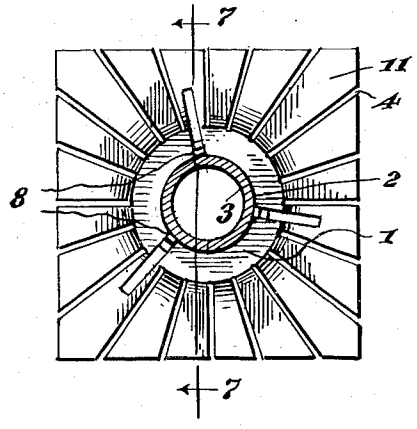


Fig. 6.



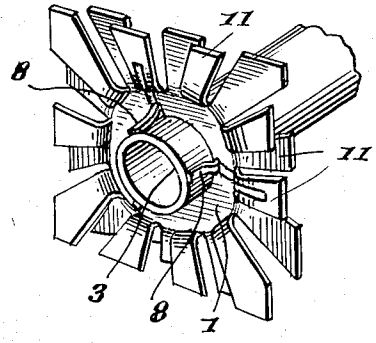


Fig. 7.

Fig. 9.

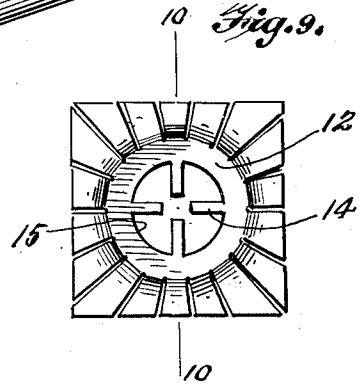


Fig. 8.

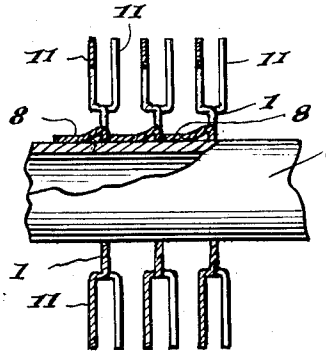
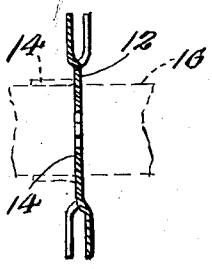


Fig. 10.



Inventor
CLEVELAND A. SEWELL

By Wilfred Lawson
Attorney

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UNITED STATES PATENT OFFICE

2,402,262

HEAT EXCHANGE FIN

Cleveland A. Sewell, Newark, N. J., assignor to American Coils Co., Newark, N. J., a firm consisting of Bessie Binder, Thomas Binder, and Harold Binder

Application August 30, 1943, Serial No. 500,567

4 Claims. (Cl. 257—262)

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This invention is directed to a method of fabricating and the construction of heat-exchange fins, with the particular purpose of increasing the heat-exchange function, avoiding the possibility of fin insulation by retarded air flow, and provide for a perfect mechanical bond between the fin and the carrying tube.

In heat exchange constructions involving the provision of a carrying tube and a plurality of heat-exchange fins secured thereon, it has been found that the conventional arrangement is more or less inefficient for desired heat exchange, in that it usually provides a flat surface with parallel air flow, causing a small film of air in immediate contact with the fin to act as an insulating layer for the fin and materially retard the effective heat exchange, and necessitating the increase of fin surface or the quantity of air passing over the fins for proper results.

An essential object of the present invention is therefore to so form the fin area as to, in effect, materially increase the fin area with which the air contacts to thereby expose a relatively greater fin surface to the flow of air per lineal feet of fin surface, to thereby avoid insulating air film and permit effective heat exchange with air under lower volume and pressure.

Again many fins have been designed to create turbulence in the air stream to break up interfering and insulating air films, but such constructions have, for effective heat exchange, been formed to retard the air flow and require higher air-flow pressure or greater volume of air.

It is a further object of the present invention to form the fin with a view to creating the necessary turbulence without material retarding of air flow to thereby permit active clearance of air past the fin in a manner to insure maximum heat exchange.

The conventional heat-exchange units involve the use of a tube and heat-exchange fins secured to the tube normal to its axis, with the fins having integral spacer strips which overlie and bear on the tube and limit the positions of the adjacent fins. The conventionally formed spacer strips have their roots in the margin of the tube receiving opening in the fin, and in this particular provide a decided objection to the use of a mechanical bond between the fin and tube, especially where such mechanical bond involves the expanding of the tube to embed the edge of the fin opening.

A further, and particularly important feature of the present invention is the provision of the desired spacer strips for the fin with such strips

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integral with and extending from the fin, but with the strips so connected to the fin that the edge margin of the tube opening in the fin is completely free of any strip connection, to permit such edge margin of the tube opening to retain throughout its circumferential length its normal relatively sharp edge for conveniently embedding the tube under expansion of the latter, for certainty and rigidity of fin mounting without sacrificing any purposes or functions of the spacer strips.

The invention is illustrated in preferred form in the accompanying drawings, in which:

Fig. 1 is a vertical sectional view of one form of fin, the tube being shown in broken elevation.

Fig. 2 is a front elevation of the same.

Fig. 3 is a section on line 3—3 of Fig. 1.

Fig. 4 is a section on the line 4—4 of Fig. 3.

Fig. 5 is a perspective view of the form of fin construction shown in Fig. 1.

Fig. 6 is a front elevation of a slightly modified type of fin construction.

Fig. 7 is a perspective view of the modified type of fin shown in Fig. 6.

Figure 8 is a view partly in elevation and partly in section of the modification shown in Figures 6 and 7.

Fig. 9 is an elevational view of a fin constructed in accordance with another embodiment of the invention, and

Fig. 10 is a sectional view taken substantially on the line 10—10 of Fig. 9, a second position of the spacer strips being indicated by broken lines.

The method of construction resides in slitting the outer edge of the fin body on radial lines extending a predetermined distance toward but not meeting the usual tube receiving opening formed centrally of the fin, and then deflecting the independent vanes so formed from the normal plane of the fin body to provide increased heat-exchange surface; the method also involving the provision of fin-spacer strips integral with the fin, but with their roots projecting from the fin body at points outwardly of the margin of the tube opening, to insure that the margin remain uninterrupted for service as a tube penetrating edge when securing the fin under tube expansion.

In carrying out the method an appropriate size and form of fin material is centrally formed with an opening to snugly receive the tube on which the fins are to be secured and the margin of the fin is slitted on radial lines to provide fin-vanes, separated from each other throughout their lengths but connected with the fin body at an appropriate distance from the margin of the

tube opening, the fin-vanes being then relatively distorted or deflected with respect to the normal fin plane; the fin body being then cut out at desired spaced intervals to provide spacer strips, the spacer strips being so cut from the body as to have their root portions extending from the body at points adjacent but wholly beyond the margin of the tube opening in the fin, for the purpose of leaving such margin completely uninterrupted for mechanical bonding of the fin and tube.

With a view to a better understanding of the method the mechanical construction of the fin will be explained in the light of the drawings.

In the form shown in Figs. 1 to 5 inclusive, the fin body 1 is shown as rectangular in form, centrally formed with an opening 2 to receive the conventional tube 3. The tube is of a character to permit a mechanical bond between the tube and fin by appropriately expanding the tube after application of the fins to cause the edge of the opening 2 to embed itself in the material of the tube, and obviously to provide a proper thermal contact and effective securing of the fin in place, the full, uninterrupted margin of the tube opening 2 must be so embedded.

The outer edge of the fin body is slitted on radial lines 4, opening through the outer edge and extending toward the tube opening 2, but terminating materially short thereof to leave a flat area 5 in the normal plane of the fin between the tube opening 2 and the ends of the radial slits 4. The slits provide fin-vanes 6, each connected with the fin body but each independent of the other beyond the area 5 of the body.

The fin-vanes are in the form being described twisted on their longitudinal axes, as at 7, to present one half of each vane on opposites of the normal plane of the body. The vanes 6 are so twisted as to present parallel air contact areas definitely spaced one from the other and each at a slight angle to the normal plane of the fin relative to the tube. The material of the flat area 5 of the fin is utilized to form the spacer-strips indicated at 8, which strips are cut from the flat area 5 so as to leave the connected portion or root of the strip at a point 9, which as clearly shown in Fig. 4 is outwardly of and wholly free of the margin of the tube opening 2. The strips 8 are then bent from their roots into a position to extend at substantially right angles to the fin to overlie and bear on the tube 3 when the fin is applied. This particular construction of the spacer strips, of which there may be any desired number, avoids any interference with the sharp edge of the margin of opening 2 and at the same time leaves a small margin of fin body, as at 10 to provide an abutting area for the ends of the strips of adjacent fins for spacing purposes. It is of course understood that the spacer strips are of such lengths as to provide the usual spacing function relative to adjacent fins in the application of the fins.

In the form of the invention shown more particularly in Figs. 6, 7, and 8, the construction of the fin is identical with that previously described, and the same reference numerals are used in these figures to identify the same parts previously described. This modified form, however, differs from the preferred form in that the fin-vanes, shown in the modified form at 11, are not twisted in angular relation to the normal plane of the fin, but are bodily deflected at the roots in successively opposite directions from the normal plane of the fin and then extended in planes radial of

but slightly offset from the normal plane of the body. In this form, viewing the fin in edge relation, the vanes 11 are successively oppositely positioned and define an uninterrupted space between them for air flow, with the marginal edges fully open to air contact.

In this modified form the spacer strips 8 are formed as previously described, and in effect the modified form differs from the preferred form only in the relation of the fin-vanes to the normal plane of the fin body.

From the constructions described it will be seen that the amount each fin vane is deflected off the center of the plane of the fin is equal to one-half the fin spacing of the final surface, and in setting the fins on the tube care must be taken that the alternate fins be the full fin spacing, so that vanes of adjacent fins when on the tube shall project on the similar sides of the fin planes to maintain this spacing.

The fin vanes act as individual fin sections, but as they act alternately and oppositely on the air stream, the air is permitted to flow through without undue obstruction, and yet no part of the air stream is permitted to form an air film adjacent the fin surface. By this formation approximately fifty per cent more of the fin surface is subject to the air stream than is possible by a flat fin. The improved fin is more effective as a heat-exchange unit because more fin area is exposed to the air stream per lineal feet of surface; the exposed edges of the vanes provide additional exchange surface, being effective in their obstructive function; and as there is no air film on the surface effective heat exchange may be accomplished with a lower pressure drop in the flow of the air.

In the particular construction of the spacer strips, it will be apparent that if the strip had its root directly at the margin of the tube opening 3, such root would present an obstruction to the free embedding of the margin in the tube in the mechanical bonding. Thus effective bonding would be difficult preventing not only proper contact of the tube and fin, but proper fixing of the fin in place. By the improved spacer-strip formation the margin of the tube opening 2 is completely unobstructed presenting a uniform edge which, under expansion of the tube under any usual or preferred method, may be evenly and correctly embedded into the material of the tube to insure a proper holding of the fin and also a proper metallic contact between the tube and fin.

In the embodiment of the invention as illustrated in Figures 9 and 10, the fin body 12 is initially produced with the spacer strips 14 extending inwardly and radially of the central opening 15. However, as the body 12 is placed upon the tube 16, the spacer strips 14 flex outwardly, as indicated by broken lines in Figure 10. It is believed to be obvious that these strips 14 are of such length to provide the required spacing between adjacent bodies. It is believed to be obvious that the body as illustrated in Figures 9 and 10 can be initially stamped and in a manner whereby there is but a minimum of waste material.

While the present invention is more particularly designed for use in cooling air, it is to be understood that the improved fin is equally effective in other heat-exchange requirements, and that any and all such additional uses are contemplated as within the spirit of the present invention.

Having thus described the invention, what is claimed as new, is:

1. A heat-exchange fin comprising, a central annular fin body having an opening therethrough defined by a substantially uninterrupted inner margin which is adapted to receive snugly an expansible metal tube, and a heat-exchange vane assembly formed by an even number of radial vanes each attached at one end to said body and projecting radially from said body, said vanes being offset axially with respect to said central body with the vanes being in two groups offset in opposite directions and with the vanes in the two groups alternately positioned whereby each vane is offset in the opposite direction from the two next adjacent vanes, said body being substantially in a single plane and with the vanes of the two groups being substantially in single planes respectively on opposite sides of the plane of said body.

2. A heat-exchange fin as described in claim 1, wherein the outer contour of the fin is substantially rectangular and wherein the vanes are separated by radial slits which extend inwardly from the fin periphery.

3. A rectangular heat-exchange fin comprising, a central fin body having an opening therethrough

defined by a substantially uninterrupted inner margin which is adapted to receive snugly an expansible metal tube, and a heat-exchange vane assembly formed by an even number of peripherally positioned vanes each attached at one end to said central fin body and projecting from said central fin body, said vanes being separated by slits which extend inwardly from the periphery of the fin to said central body and with the vanes being offset with respect to said central body and being in two groups which are offset in opposite directions with the vanes in the two groups alternately positioned whereby each two adjacent fins are offset in the opposite directions, said central fin body being substantially in a single plane and said fins of the two groups being respectively in two parallel planes which are offset with respect to each other and also on opposite sides of and offset with respect to the plane of said central body.

4. A heat-exchange fin as described in claim 3 which includes a plurality of integral spacing members which are attached to said central fin body at points spaced from said central body and which project from said central body and act as spacer members and heat-exchange fin portions.

CLEVELAND A. SEWELL.