

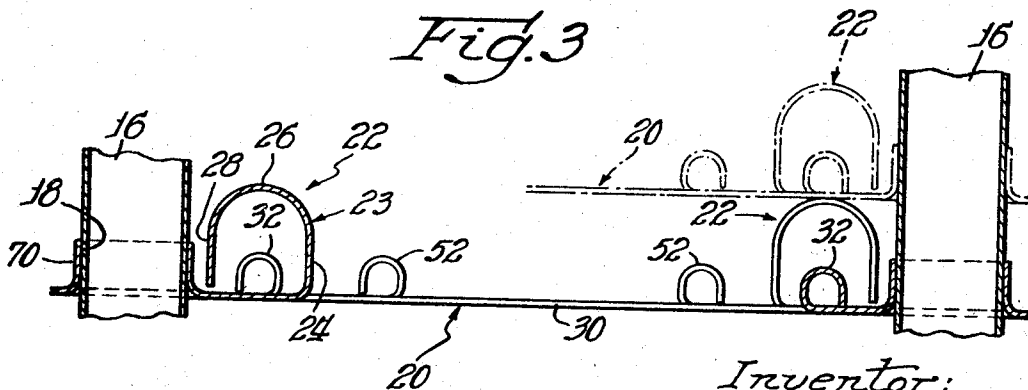
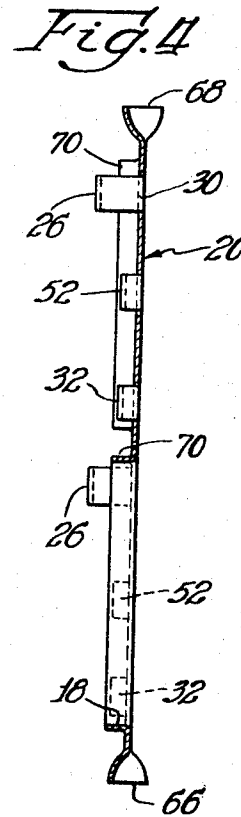
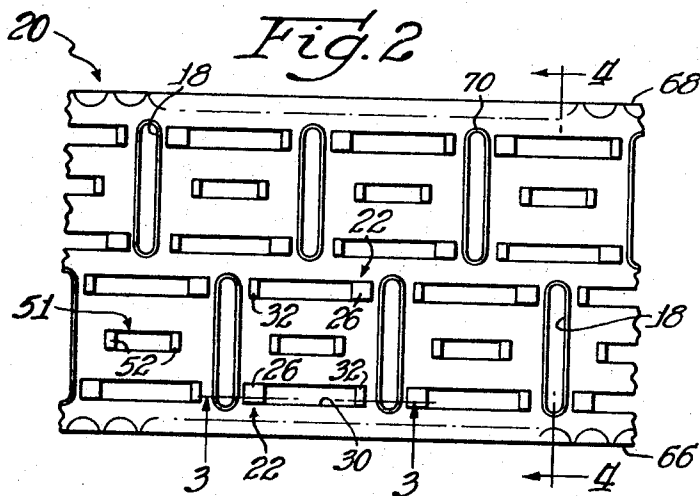
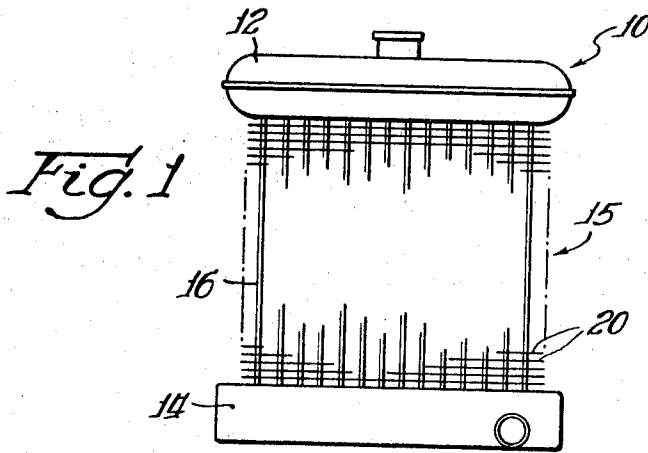
April 8, 1969

E. P. ODDY
HEAT EXCHANGER

3,437,134

Filed Oct. 24, 1965

Sheet 1 of 3



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Fig. 5

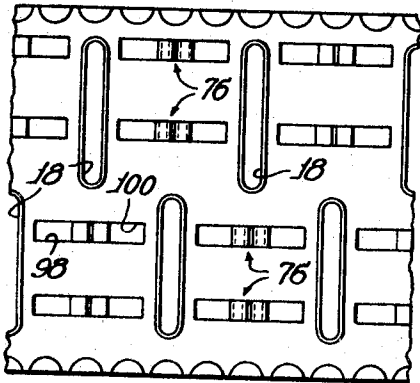


Fig. 6

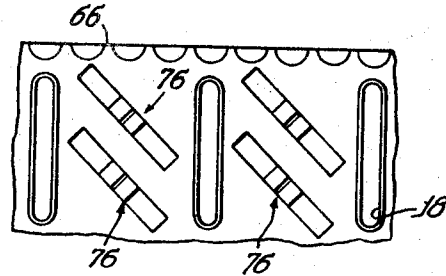


Fig. 7

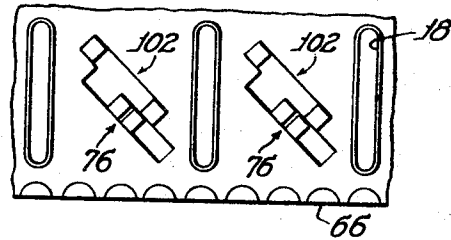


Fig. 5a

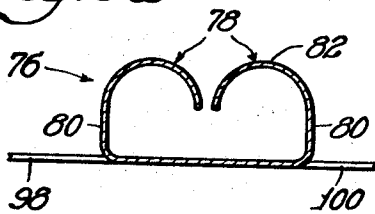


Fig. 8

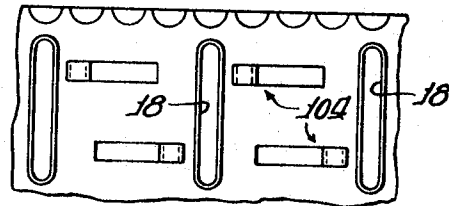
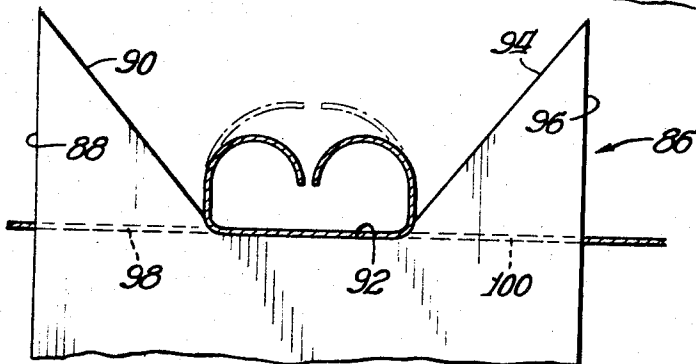


Fig. 12



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Fig. 9

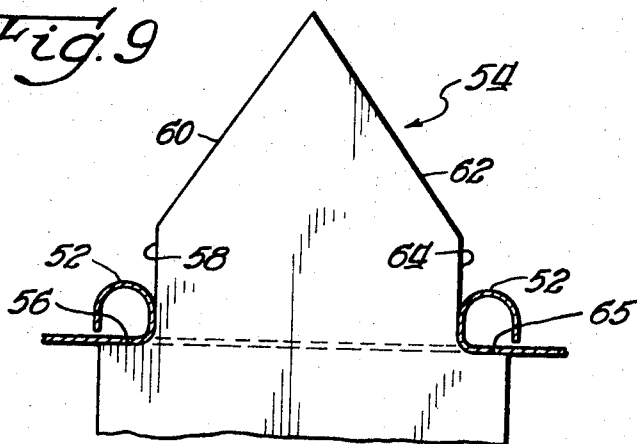


Fig. 10

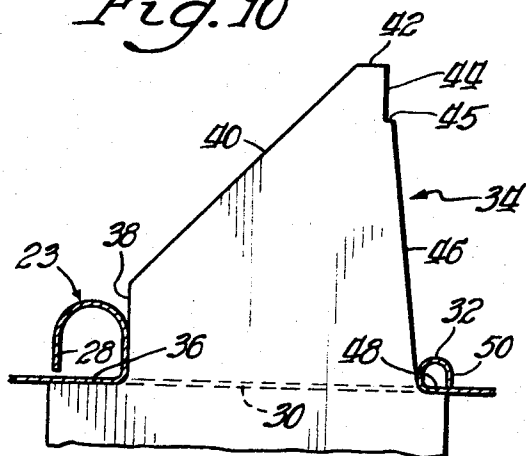
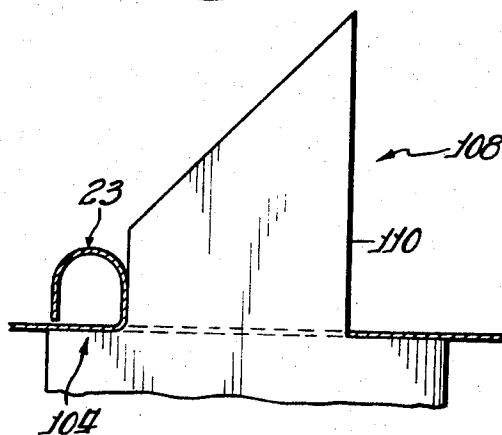


Fig. 11



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3,437,134

HEAT EXCHANGER

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U.S. Cl. 165—151

7 Claims

ABSTRACT OF THE DISCLOSURE

A heat exchanger core comprised of parallel stacked fins which include tube receiving openings and spacer means, the spacer means being struck out of the body of the fin to form spacer loops.

This invention relates to heat exchangers and more particularly to a self-spacing type of fin used therein which lends itself to rapid hand assembly or automatic assembly prior to automatic insertion of the liquid carrying tubes and to a method and apparatus for manufacturing the fin.

Self-spacing fins have heretofore been devised for use in cores for vehicle cooling radiators and other heat exchangers. These cores are formed by stacking fins uniformly spaced from each other and inserting a plurality of coolant tubes through previously formed apertures in the fins. The tube ends interconnect a supply header and a receiving header. It is known that some manufacturers of radiators presently use self-spacing fins. However, those devised in the past and those used at present have certain shortcomings which make it questionable whether the gains obtained by automatic or rapid hand assembly offset the losses.

Some self-spacer means for fins required the fins to be made of thicker material in order to provide strength to resist distortion by the frictional force of the tubes being pushed through the holes in the fins. This resulted in increased weight and cost of the heat exchanger. By making the holes larger, thinner material could again be used but the larger holes caused loss of contact between the tubes and the fins and subsequently lowered performance. The shape of some spacer means was such that prior to stacking the loose fins would become interlocked requiring separation by hand and thus increasing labor cost. Other spacer means have provided the necessary stiffness and strength for stacking purposes but were of such shape as to cause too much interference with air flow through the core with a resultant loss in performance.

The present invention overcomes all of the aforesaid shortcomings and provides a fin that is easy to manufacture and stack either by hand or automatically with the end result being a heat exchanger of better performance at less cost.

A primary object of the invention is to provide a heat exchanger of the fin and tube type in which struck-out lugs or spacer elements of a unique shape are provided between adjacent tube openings which tend to minimize damage to the fins as the tubes are inserted.

Another object of the invention is to provide a heat exchanger of the stated type wherein struck-out flow deflectors of similar unique shape are formed in the fin which, together with the spacers, minimize laminar flow of the secondary heat exchange media across the fin element.

Another object of the invention is to provide a heat exchanger structure in which the spacers or the flow deflectors are disposed at an angle to the leading edge of the fin so as to enhance heat dissipation.

Another object of the invention is to provide a heat exchange fin in which the spacers or the flow detectors provide additional secondary heat exchanger areas.

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Other and more particular objects of the invention will be apparent from the following detailed description and the appended drawings, wherein:

FIGURE 1 is an elevational view of a heat exchanger constructed in accordance with the principles of the present invention;

FIGURE 2 is a plan view of a portion of a heat exchange fin used in the heat exchanger illustrated in FIGURE 1;

FIGURE 3 is a greatly enlarged sectional view taken substantially on line 3—3 of FIGURE 2;

FIGURE 4 is an elevational sectional view taken substantially on line 4—4 of FIGURE 2;

FIGURE 5 is a plan view of a fin made in accordance with a modified form of the present invention;

FIGURE 5a is a greatly enlarged elevational view of a spacing unit of the fin illustrated in FIGURE 5;

FIGURE 6 is a fragmentary plan view of another modified form of the present invention;

FIGURE 7 is a fragmentary plan view of another modified form of the present invention;

FIGURE 8 is a fragmentary plan view of a still further modified form of the present invention;

FIGURE 9 is a greatly enlarged elevational view of a punch used in forming the flow deflectors of FIGURES 2, 3 and 4 and the spacing units of FIGURE 7;

FIGURE 10 is an elevational view illustrating a punch utilized in forming the spacers and simultaneously forming the associated flow deflectors shown in FIGURES 2, 3 and 4;

FIGURE 11 is an elevational view illustrating a punch utilized in forming the spacers of FIGURE 8; and

FIGURE 12 is an elevational view of a punch utilized for forming the spacing units of FIGURES 5, 6 and 7.

Referring to the drawings, and more particularly to FIGURES 1 and 2, the heat exchanger of the present invention is indicated generally by reference numeral 10 and includes a top tank or supply header 12 and a bottom tank 14 which are interconnected by a core 15 comprising a plurality of water tubes 16 received in a plurality of registering openings 18 in a plurality of stacked fins 20 which are secured to the tubes 16 in heat conductive relation. Coolant flow from the tank 12 to the tank 14 through the tubes 16 in which dissipation of heat occurs with the passage of air across the fins 20. The fins 20 are made from relatively thin metal stock, such as copper or the like, in the order of .0025—.003", and thus are easily deformed.

According to an important feature of the present invention, means are provided for effectively preventing deformation of the fins as the tubes 16 are inserted through the registering openings 18. FIGURES 2, 3 and 4 illustrate one form of the present invention in which each fin 20 is formed with a plurality of spacing units 22. Each of the spacing units 22 is struck from the body of the fin stock and comprises a lug, in the form of a loop 23 having a leg portion 24, a substantially U-shaped portion 26 and an end portion 28 substantially parallel to the leg portion 24. The leg portion 24 and the end portion 28 are substantially perpendicular to the plane of the fin 20. This factor, together with the arcuate configuration of the U-shaped portion 26 provides relatively great compressive strength to the loop and prevents compressing of the stack as the tubes are inserted in the tube apertures of the fin stock.

Stamping of the fin stock to form U-shaped spacing unit 22 produces an elongated opening 30. Formed in each of the spacing units 22 simultaneously with each of the loops 23 is a flow deflector loop 32 of substantially less height than loops 23 which provides both additional secondary heat exchange surface and means to deflect the flow of air as it passes across the surface of the fin.

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FIGURE 10 illustrates a punch for forming the openings 30 and the loops 23 and 32. This punch is indicated by reference numeral 34, is substantially rectangular in cross section, and includes a ledge 36, a surface 38 perpendicular to the ledge 36, an angular surface 44 substantially parallel to the surface 38, a shoulder 45, a surface 46 disposed at a relatively great angle with respect to the plane of the ledge 36, and a ledge 48 coplanar with the ledge 36. As the punch 34 pierces the fin stock to form the opening 30, a portion of the metal, corresponding to the area of the top surface 42, is forced outwardly to form the end portion 28. The metal at the left side of this area, as viewed in FIGURE 10, is then curled by the surface 40. The fin stock at the right side of the area is not punched until the shoulder 45 is reached and the surface 46 protrudes through the stock. Then this material is curled until the punch 34 reaches the position illustrated in FIGURE 10 in which the flow deflector curl 32, having an end section 50 perpendicular to the plane of the same stock, is formed.

Referring more particularly to FIGURE 2, it will be noted that the openings 18 are arranged in two transversely spaced, longitudinally offset series in order to provide desirable turbulence. Between each pair of openings 18 there are provided two spacer units 22 oppositely disposed with respect to each other. In the lower series, as illustrated in FIGURE 2, the lowermost spacer unit has a spacer curl 23 on the left side and a flow deflector curl 32 on the right side. The uppermost of the spacing units 22 has a spacing curl 23 on the right side and a flow deflector curl 32 on the left side.

Between each pair of these spacing units is formed a flow deflector unit 52 having curls 52 which are similar to the flow deflector and are of substantially less height than spacing curl 23.

The curls 52 are formed by a punch 54 illustrated in FIGURE 9. The punch 54 comprises two ledges 56 and 65, two perpendicular surfaces 58 and 64 perpendicular to the ledges and two surfaces 60 and 62 which intersect the surfaces 58 and 64. The apex 61 of the tool is preferably disposed midway between the surfaces 58 and 64.

Both the leading edge 66 and the trailing edge 68 of the fin 20 (FIGURE 2) are preferably crinkled or undulated to increase turbulence and impart rigidity to the fin section. Each of the openings 18 includes a peripheral flange 70 formed by the punch operation.

In FIGURE 5 is illustrated a modified form of the present invention in which like reference numerals denote like parts. In this form of the invention, however, a plurality of spacer units 76 are disposed between each pair of openings 18. Each of the spacing units 76, as shown clearly in FIGURE 5a, includes a pair of adjacent loops 78 each having a leg portion 80, a U-shaped portion 82 and an end portion 84.

The portions 80 and 84 are substantially perpendicular to the plane of the fin stock.

Each spacer unit 76 is formed by means of a punch illustrated in FIGURE 12 and indicated by reference numeral 86. The punch 86 has a vertical surface 88, as viewed in that figure, a downwardly sloping surface 90, a flat surface 92 perpendicular to the surface 88, a surface 94 sloping upwardly at the same angle as that of surface 90 and a surface 96 parallel to the surface 88. As the punch 86 pierces the fin stock, a pair of spaced openings 98 and 100 are formed. The metal is curled as illustrated until the loops 78 are formed. If it is desired to decrease the number of fins per inch, the penetration of the punch 86 may be limited so that the height of the spacer loop 78 above the plane of the fin stock is increased and the spacers assume the position illustrated in dot and dash lines. It will be appreciated that the size of the spacers may be varied as desired merely by the degree of penetration of the punch 86.

FIGURE 6 shows another modified form of the inven-

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tion in which the spacer units 76 are disposed in parallel relation each to the other and at an angle to the leading edge 66. In this form of the invention, the spacer units 76 are in spaced relation each to the other. In FIGURE 7 is illustrated another modified form of the present invention which is similar to that shown in FIGURE 6 with the exception that a spacer unit 76 is disposed in contiguous relation to a spacer unit 102 which is similar to the flow deflector unit 52 but on a larger scale. As illustrated in that figure, spacer units 76 and 102 are disposed at an angle to the leading edge 66.

FIGURE 8 illustrates another modified form of the present invention which includes a plurality of spacer units 104 each of which have a spacer loop similar to loop 23 at one end thereof. The units 104 are oppositely disposed so that the spacing loops are adjacent opposite openings 18 of a pair of openings. The spacer units 104 may be formed by a punch 108 illustrated in FIGURE 11. The punch 108 is similar to the punch 34 of FIGURE 10 but has a surface 110 in lieu of the surfaces 42, 44 and 46. By this arrangement curling is effected on only one side.

The method includes the steps of providing punches of the type set forth in FIGURES 9, 10, 11 or 12. The present method also includes limiting the depths of penetration of any of the punches illustrated to vary the configuration of the loops and thus control the height of the spacing elements above the plane of the fin stock.

The above described heat exchanger exhibits important advantages over heat exchangers heretofore known. For instance, the formation of the several types of spacer units illustrated provides the rigidity necessary perpendicular to the surface of the fin and parallel to the tubes so one fin supports the other and distortion of the fins is minimized when the tubes are inserted. The spacing units are struck from the body of the fin stock and thus do not require additional metal. In fact, the ability of this fin to provide an increase in turbulence over previous fins, and the consequent increase in its ability to dissipate heat, permits the use of fewer fins per inch in a core of given dimensions.

Applicant does not intend to be limited by the disclosures of the above described forms of the invention, but rather intends to be limited only by the scope of the appended claims.

I claim:

1. A heat exchanger core comprising a plurality of substantially parallel stacked fins of relatively limited thickness; each of said fins having a series of tube-receiving openings in limited spaced relation to one edge thereof; said tube-receiving openings extending transversely of said fins and being spaced longitudinally thereof; spacer means formed integrally with said fin between adjacent tube openings; said spacer means comprising a plurality of spacer loops integrally formed on said fin; each of said loops including a leg portion extending generally perpendicular to said fin, a generally U-shaped section, and an end portion extending generally perpendicular to said fins said spacer means further comprising a plurality of spacer units disposed in normal relation to the adjacent tubes, each of said spacer units comprising one of said spacer loops and a turbulizer loop of substantially less height than said spacer loop, said turbulizer loop effective to provide a secondary heat exchange surface and to deflect the flow of air as it passes across the surface of the fin, said turbulizer loop struck out of the body of said fin.

2. A core in accordance with claim 1, wherein said spacer units are oppositely disposed with respect to the adjacent tubes so that the spacer loops of some of the units is adjacent one of the tubes while the spacer loop of the other spacer units is adjacent the next tube.

3. A core in accordance with claim 2, where a turbulizer unit is struck out from the body of said fin between and parallel to said spacing units, each of said

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turbulizing units comprising a pair of spaced turbulizing loops spaced inwardly of the loops of said spacing units.

4. A heat exchanger core comprising a plurality of stacked fins of relatively limited thickness, each of said fins having a series of tube-receiving openings in limited spaced relation to one edge thereof, said tube-receiving openings extending transversely of said fins and being spaced longitudinally thereof, a second series of longitudinally spaced tube-receiving openings in said fin, said second series being transversely extending, longitudinally spaced, and in limited spaced relation to the other edge of said fin, said second series being offset with respect to said first series, spacer means formed integrally with said fin between adjacent tube openings, said spacer means comprising a plurality of spacer units disposed in perpendicular relation to adjacent tubes, each of said units comprising a pair of adjacent spacer loops struck out of the plane of said fins, each of said loops having an axis parallel to the plane of the fin and having a leg portion extending generally perpendicular to the plane of the fin, a substantially U-shaped section and an end portion extending parallel to said leg portion and generally perpendicular to said fin.

5. A heat exchanger core comprising a plurality of stacked fins of relatively limited thickness, each of said fins having a series of tube-receiving openings in limited spaced relation to one edge thereof, said tube receiving openings extending transversely of said fins and being spaced longitudinally thereof, a second series of longitudinally spaced tube-receiving openings in said fin, said second series being transversely extending, longitudinally spaced, and in limited spaced relation to the other edge of said fin, said second series being offset with respect to said first series, spacer means formed integrally with said fin between adjacent tube openings, said spacer means struck out of the plane of said fin comprising a first spacer unit having a pair of adjacent spacer loops and a second spacer unit having spacer loops at each end thereof.

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6. A core in accordance with claim 5, wherein said first spacer unit and said second spacer unit are contiguous and offset with respect to each other, each of said units disposed at an angle to the leading edge of said fin.

7. A heat exchanger core comprising a plurality of stacked fins of relatively limited thickness, each of said fins having a series of tube-receiving openings in limited spaced relation to one edge thereof, said tube-receiving openings extending transversely of said fins and being spaced longitudinally thereof, a second series of longitudinally spaced tube-receiving openings in said fin, said second series being transversely extending, longitudinally spaced, and in limited spaced relation to the other edge of said fin, said second series being offset with respect to said first series, spacer means formed integrally with said fin between adjacent tube openings, said spacer means comprising a plurality of spacer units angularly disposed with respect to adjacent tubes, each of said units comprising a pair of adjacent spacer loops struck out of the plane of said fins, each of said loops having an axis parallel to the plane of the fin and having a leg portion extending generally perpendicular to the plane of the fin, a substantially U-shaped section and an end portion extending parallel to said leg portion and generally perpendicular to said fin.

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U.S. Cl. X.R.

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