A process for producing a corrugated heat exchanger dissipator for a tube and dissipator core, comprises forming in an elongate metal sheet material a plurality of longitudinally spaced sets of longitudinally extending slots with the slots of successive sets longitudinally aligned to form a plurality of parallel straps with the straps of successive sets in alignment, bending the straps of each set and the corresponding straps of successive sets alternately in opposite directions relative to the plane of the sheet, and bending the solid areas between the sets transversely in alternate opposite directions to corrugate the sheet and interfit the straps of adjacent sets.
1

PROCESS FOR MANUFACTURING EXPANDED AND CORRUGATED HEAT EXCHANGER CORES FROM METAL STRIP MATERIAL

This is a division of application Ser. No. 94,238, filed Dec. 1, 1970.

BACKGROUND OF THE INVENTION

This invention relates to radiators for cooling fluids, and radiators provided particularly for vehicles with a core of tubes between which are placed dissipators constituted of corrugated intercalaries.

It is known that the main quantity of the heat which is dissipated by a radiator of that type is dissipated through dissipators. In the radiator manufacturing technics, which have already reached a high degree of perfection, an attempt is made to form, in the sections of the dissipators which are located, between the consecutive tubes wall or row of a core, disturbers with punctures, whereby the air passing through the core has to follow complex passages which improve the heat dissipation.

The invention has come from the surprising facts which have been found that the heat dissipation of a corrugated intercalary is at a maximum at the level of the leading edge of said dissipators and then decreases rapidly. Besides, it has become apparent that it would be possible to substantially reduce the dissipator thickness if it was possible to multiply the leading edges but without restricting the contact surface between the dissipator and the tube wall. It has also become apparent that the disturbers formed up to now into the dissipators, excessively increased the loss of the air load passing through the core, whereby the air volume, that is the air mass, passing through the core is thus reduced of course to the prejudice of the quantity of the dissipated heat.

SUMMARY OF THE INVENTION

This invention embodies a new disturber in taking the above conditions into consideration and allowing to appreciably increase, the heat dissipation for a radiator having a specified weight of metal constituting the dissipators, or to appreciably reduce the weight of metal constituting said dissipators for a same heat dissipation capacity of the radiator.

According to the invention, the dissipator has continuous supporting areas on the tube wall between which it is placed, said continuous areas being connected to each other by folded straps, alternately bent in one way and in the other way, the straps of same bend of each fold stretching in parallel to each others whereby the straps coming next are respectively imbricated by each other.

The invention also relates to a process for manufacturing the above mentioned dissipator. According to this second arrangement, parallel and lengthwise set of slots are made, said slots being separated by a continuous section, in the lengthwise way of a thin strip to delimit parallel straps, the delimited straps are performed by a same lot of slots to fold them alternately one way and to the other, the strips, in line, made from two successive sets of slots having their curve opposite, the strip is corrugated at the level of each continuous section separating each set of straps and the so-corrugated strip advances while being retained in the undulated section thereof, which causes the strips of successive set of straps to become imbricated between each other.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a front view of a radiator of which the core is provided with dissipators of the present invention.

FIG. 2 is a diagrammatic perspective view illustrating a manufacturing step for the intercalaries of the present invention.

FIG. 3 is a diagrammatic elevation view at a smaller scale than FIG. 2 and illustrating another manufacturing step.

FIG. 4 is a sectional perspective view of the finished dissipator.

FIGS. 5 and 54 are lengthwise sectional views of same dissipator section, FIG. 5a showing a modification.

FIG. 6 is a end view partly in section along line VI—VI of FIG. 5.

FIG. 7 is a slightly enlarged sectional view and shown along line VII—VII of FIG. 5.

FIG. 8 is a diagrammatic view illustrating a development of the invention.

DETAILED DESCRIPTION OF THE INVENTION

FIG. 1 shows a radiator in which 1 and 2 designate two water boxes provided with connection tubes 3 and a filling flange 4. The water boxes overlap collectors 5 and 6 in which run the ends of the core tubes 7. Dissipators 8 are placed between each tube or row of tubes 7 to form exchange secondary surfaces between the fluid circulating into tubes 7 and the fluid passing through the core.

To form the dissipators 8, a very thin metallic strip 9 is utilized, as thin as some hundredths of millimeters, for instance made of copper, brass or aluminum, and sets of slots 10, 10a, etc. of a similar length are made in the lengthwise way on said strip. Each set of slots is separated by a solid portion 11 designed to form the supporting surface for the dissipator on the wall of the tubes 7 of the core, this supporting surface being continuous from one to the other lateral edges of strip 9, as shown in FIG. 2.

The slots 10, 10a, etc. are for instance made with roller 12 FIG. 3 but said slots could also be made by a press or by any other means.

Upon completion of slots, the strip 9 is prefomed for example with a second set of rollers 13 (FIG. 3) working successively on two pre-slotted sections of strip, that is, with reference to FIG. 2 on the two pre-slotted sections 10 and 10a. This preforming causes the lengthwise pre-corrugations of successive strips delimited by slots 10, 10a. Thus, two successive strips, such as 14 and 14a are respectively preformed to turn their concavity up and down, and the two next strips such as 15 and 15a are formed in the opposite direction, while the space 11, separating the two slots 10, 10a, is not preformed. Thus, are delimit, with the successive strips, approximately alternate sinusoids all along the strip 9. The bend of strips can be not continuous, said strips being then folded at a median section and thus deforming two sections obviously linear on each side of the folding line.

Further to forming these pre-corrugations, it has been found advantageous to curve each strap in the cross-section way, for example by forming a median fold 16a which can be easily obtained by the same rollers as those performing the above described preform-
ing or before this operation, with the rollers making the slots 10, 10a. The transversal curve given to each strap is also alternated. As an example, with reference to FIG. 7, we see that the strap 14 is curved in a way opposite to the one of the adjacent strap 15. The result of said curve is first to slightly operate the adjacent lateral edges of two successive straps as shown for edges a and b of straps 14 and 15. Said curve also makes possible a folding of the straps more important than the one shown on FIG. 2 but only in one way. The curve also makes the straps more rigid and finally is designed to create a turbulence in the fluid flow running through the core in the direction of the arrow f₁ of FIG. 7 and consequently to increase the quantity of the dissipated heat for a same surface of metal.

An additional operation consists of corrugating the pre-formed strip, exactly as it is made upon the manufacturing of corrugated dissipators, which is most of the time performed with a set of rollers, such as rollers 16. Said corrugation has the effect to alternately bend in opposite directions the solid portions 11 separating each set of pre-corrugated straps.

When the corrugated strap is discharged from rollers 16 and because the preforming of straps 14 and 15 between portions 11, each section has bowed portions 17 defined said straps. The so-corrugated strap passes on a guide 18 and is directed under a block 19 which reduces the advance thereof in the way indicated by the arrow f₂, said advance being caused thereto by the rollers. The height of block 19 is adjusted in such a way that the successive folds formed by the strap be partly crushed as the advance of the strip is reduced. Thus the pre-corrugation of the straps is increased, said straps being folded in the way they are pre-corrugated or pre-folded and the straps of a fold being imbricated by those of next fold. For example, the strap 15 of FIG. 2 is thus brought between the straps 14a and 14b as well shown in drawing of FIGS. 4 and 5. On FIG. 4 it is shown that straps 14 and 14a which were oppositely folded are set in parallel to each other, it is the same for straps 15, 15a which are folded in the other way. It is also noticed that two continuous sections are respectively set on one and the other of the two sides of the formed dissipator, which is especially noticed for sections 11 and 11, of FIG. 2 which respectively appear at upper and lower sections of two successive folds of the dissipator shown on FIG. 4.

FIG. 5a shows a case where the straps, instead of presenting a continuous bend are pre-folded substantially at their median section, to form angles 20, thus each of them defining appreciably linear segments 21, 22.

The way the straps overlap each other depends on the height of the free passage between guide 18 and block 19 of FIG. 3. By sufficiently reducing this passage, it becomes possible that each strap corresponds to more than two successive folds of the constituted corrugated dissipator. When the friction made by the block is substantially the same as the one made by the guide 18, it can then be obtained that the section 11 be shifted by half-a-pitch in comparison with section 11₁, that is be placed just at the median section of the space separating the two sections 11₁ and 11₂ of FIG. 5.

On the contrary, if the friction made by block 19 is different of the one made by the guide 18, it is then obtained, as shown in FIG. 8, an additional deformation which can be set as desired and which can allow if desired that the section 11₁ be strictly in line with the section 11₁₁, whereby said solid surfaces of the dissipators can rest on sections, in line, of two consecutive tubes or rows of tubes 7.

The invention is not restricted to the embodiment shown and described in detail for various modifications thereof can moreover be applied to it without departing the scope of the invention. More particularly the length of the straps can be different according to needs, for example it can progressively change in the direction of the air circulation, whereby the convection coefficient is modified depending on the air heating.

1. Method for manufacturing an elongated member of heat conducting material having a generally zigzag configuration, comprising the steps of:

- slitting successive portions of a metal strip with spaced groups of parallel longitudinal slots defining spaced groups of parallel longitudinal straps;
- bending the straps of each group alternately in opposite directions from said strip with aligned straps of successive groups bent in opposite directions;
- bending said strip transversely thereof in opposite directions alternately between successive groups of straps in zig-zag configuration, and
- interfitting the bent straps of successive groups.

2. Method according to claim 1 comprising compressing the adjacent zig-zag portions of said strip to increase the interfitting of said straps.

3. Method according to claim 1 wherein said straps are accurately bent longitudinally.

4. Method according to claim 1 wherein said straps are angularly bent longitudinally.

5. Method according to claim 1 comprising the step of uniformly spacing the solid areas between said strap groups on two opposite sides of the member so that each area on one side is intermediatedly spaced between two adjacent areas on the other side.

6. Method according to claim 1 comprising the step of uniformly spacing the solid areas so that corresponding areas on the opposite sides are aligned transversely of the member.

7. Method according to claim 1 wherein the slitting step produces equally spaced longitudinal slots so that the straps are equal in width.

8. Method according to claim 1 wherein the slitting step produces variably spaced parallel longitudinal slots so that the straps have different widths.