March 15, 1949. R. G. VANDERWEIL 2,464,735

COMPOSITE HEAT EXCHANGE FIN

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Fig. 1.

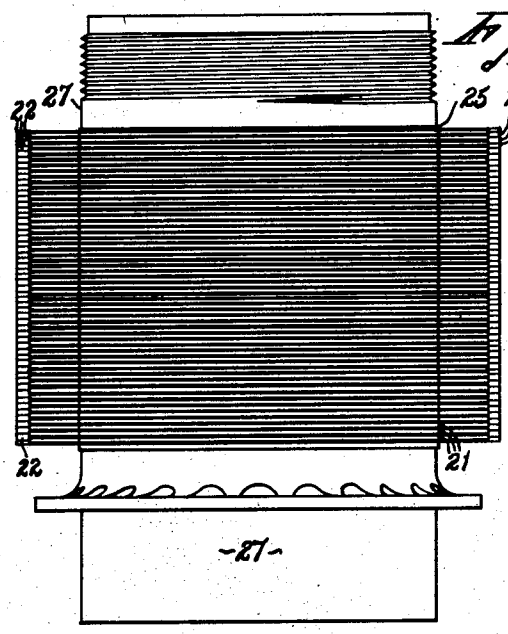



Fig. 2.

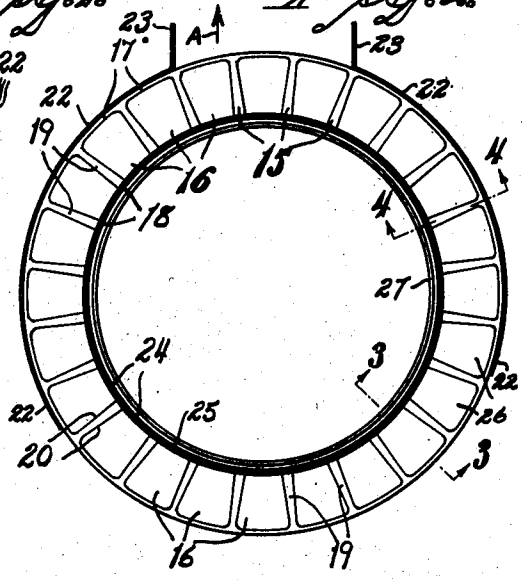



Fig. 3.

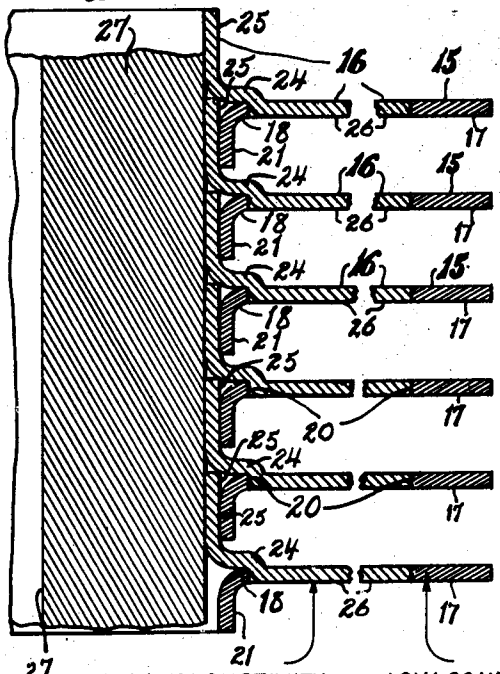
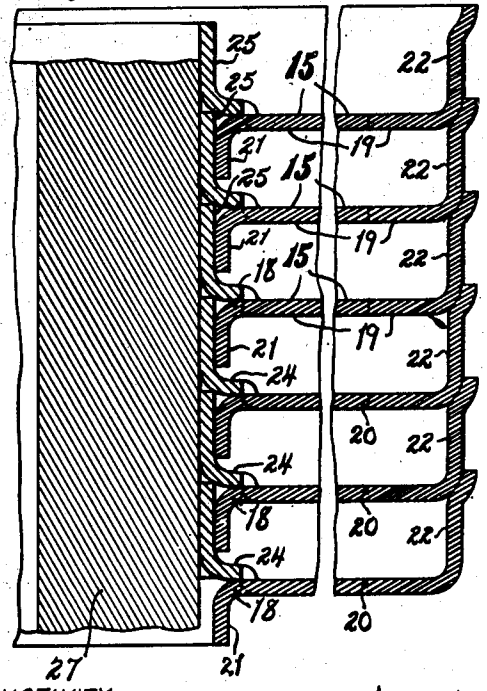



Fig. 4.




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Fig. 5.

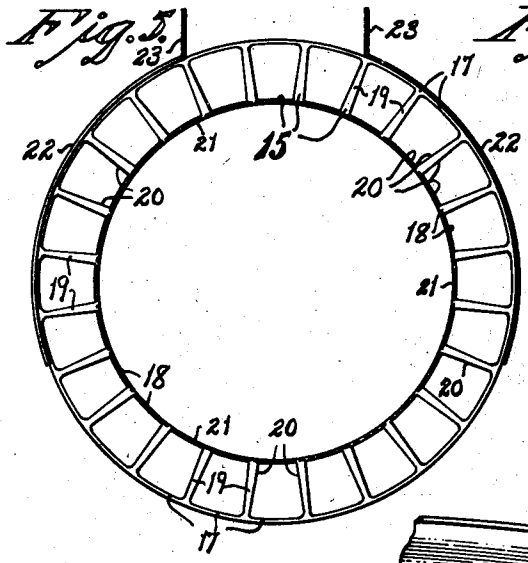



Fig. 6.

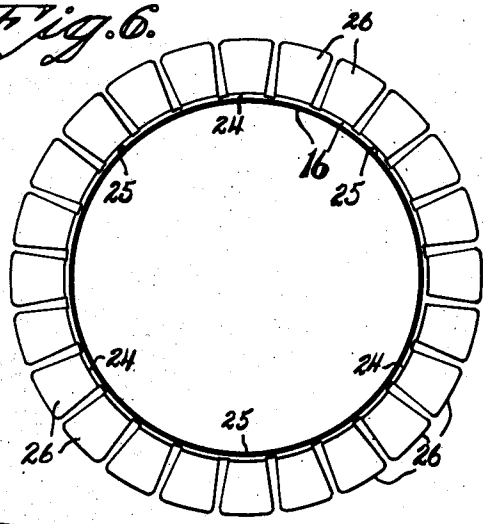



Fig. 7.

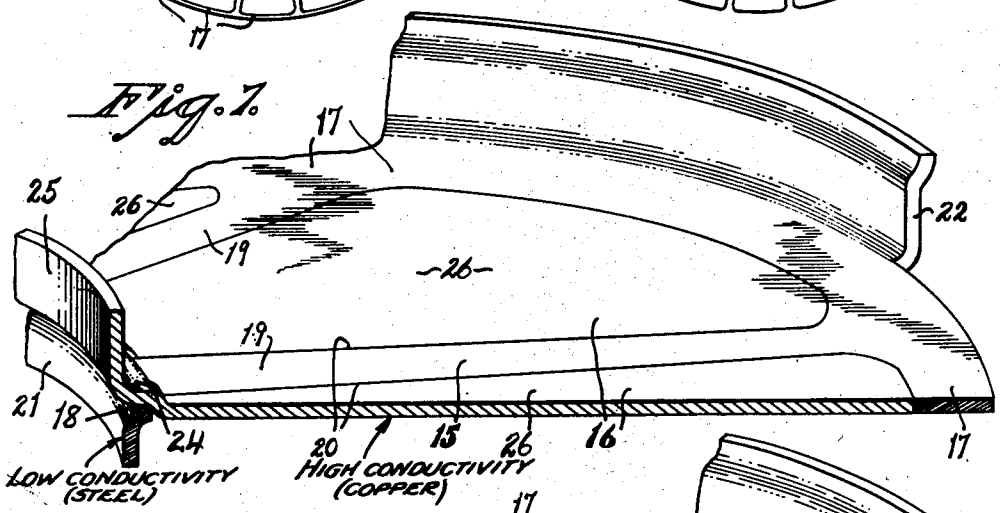
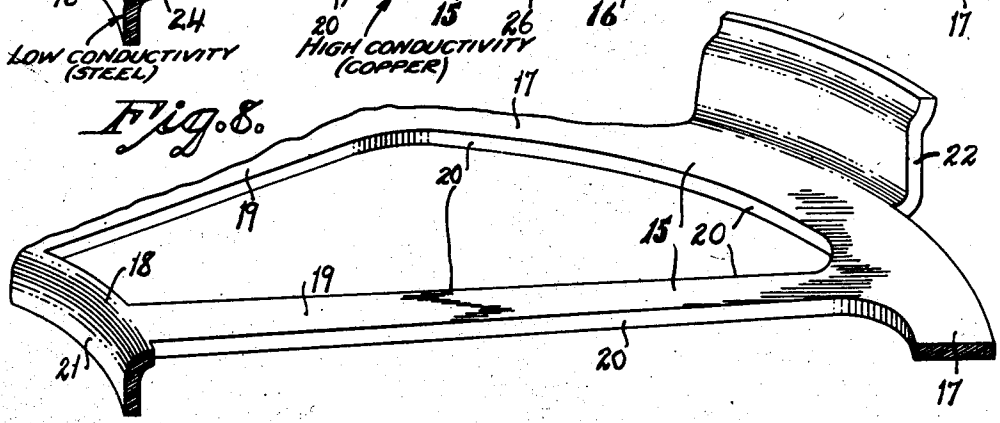



Fig. 8.




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Fig. 9.

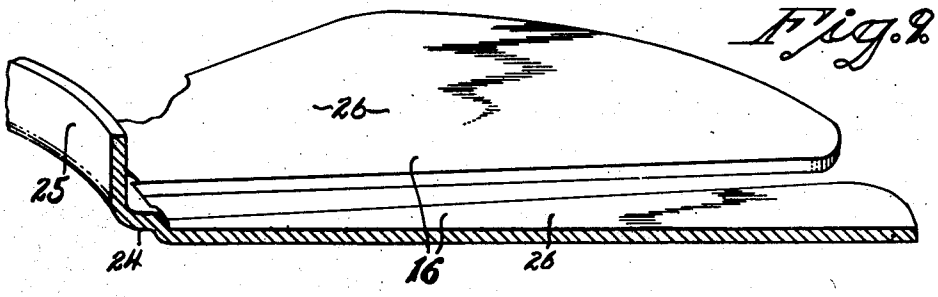



Fig. 10.

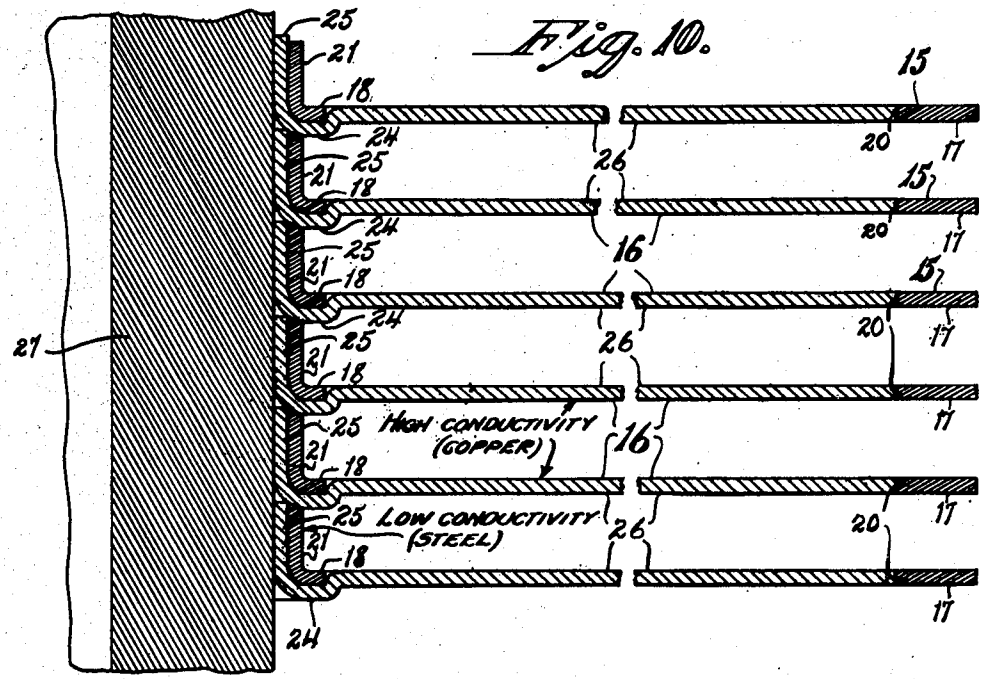
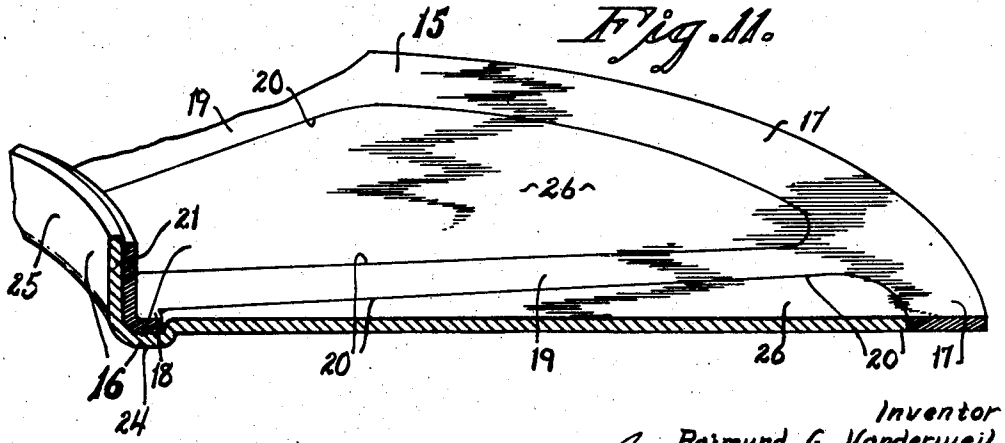



Fig. 11.




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Fig. 12.

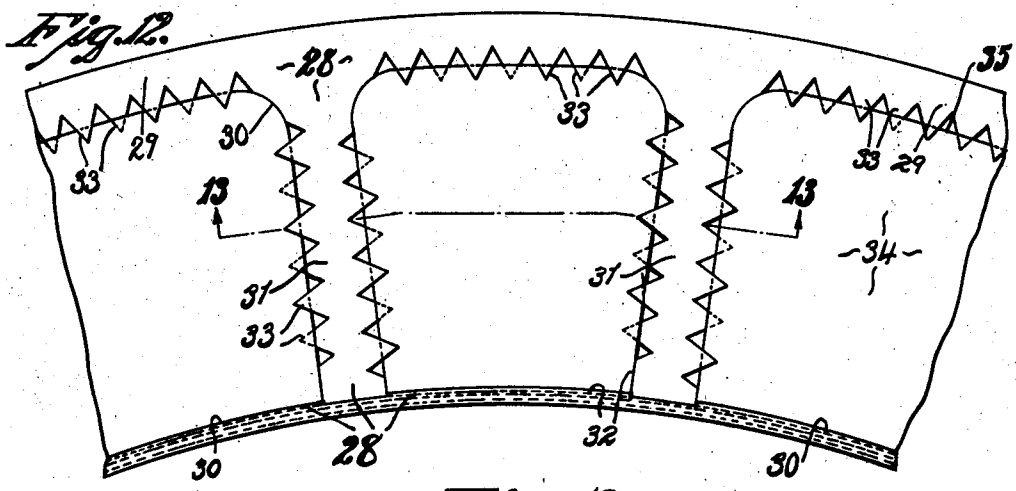



Fig. 13.

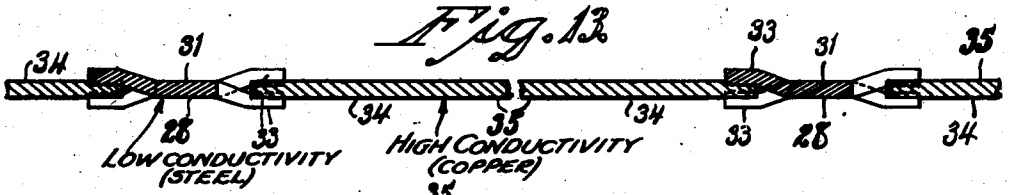



Fig. 14.

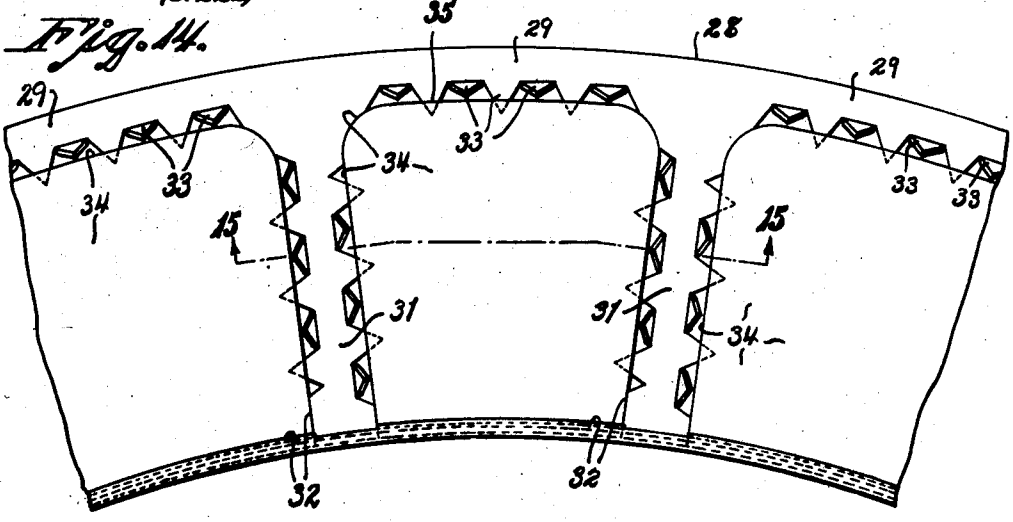
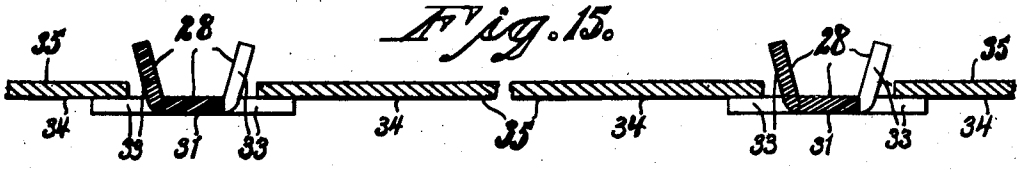



Fig. 15.




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# UNITED STATES PATENT OFFICE

2,464,735

## COMPOSITE HEAT-EXCHANGE FIN

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Application July 7, 1944, Serial No. 543,882

7 Claims. (Cl. 257—261)

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The present invention relates to improvements in heat-exchange fins, and relates more particularly to composite heat-exchange fins, i. e., heat-exchange fins composed of a plurality of sheet materials having different physical characteristics. The heat-exchange fins of the present invention are especially well suited for use in effecting the cooling of the cylinders or other parts of air-cooled internal-combustion airplane engines.

The objects of the present invention are generally similar in character to, though different in mode of attainment from, the objects set forth in my co-pending application filed July 7, 1944 and bearing Ser. No. 543,881, now Patent No. 2,426,536, issued August 26, 1947.

One of the objects of the present invention is to provide a superior composite heat-exchange fin characterized by a combination of high strength and rapid and effective heat-conduction.

Another object of the present invention is to provide an efficient composite heat-exchange fin combining desirable thinness with sufficient strength to withstand stresses imposed by high-velocity air streams or the like.

A further object of the present invention is to provide a superior composite heat-exchange fin having unitary baffle-means whereby air or the like may be deflected in such manner as to effectively utilize a maximum of the surface area of the fin.

Still another object of the present invention is to provide a superior and highly-effective composite heat-exchange fin which will be free of substantial heat-warpage.

A still further object of the present invention is to provide a superior composite heat-exchange fin combining other characteristics herein referred to with moderate cost for manufacture.

Other objects will appear to those skilled in the art from the present disclosure.

In the accompanying drawings, in which certain modes of carrying out the present invention are shown for illustrative purposes:

Fig. 1 is a view in side elevation of the cylinder of an air-cooled aircraft engine equipped with composite heat-exchange fins constructed in accordance with the present invention;

Fig. 2 is a top or plan view thereof;

Fig. 3 is a broken sectional view on an enlarged scale taken on the line 3—3 of Fig. 2;

Fig. 4 is a similar view taken on the line 4—4 of Fig. 2;

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Fig. 5 is a top or plan view of one of the supporting-plates, detached;

Fig. 6 is a similar view of one of the inlay-plates, detached;

Fig. 7 is a fragmentary perspective view of a portion of the composite fins shown in the preceding figures;

Fig. 8 is a similar view of the supporting-plate;

Fig. 9 is a view of the same general character as Figs. 7 and 8 but showing a portion of the inlay-plate, detached;

Fig. 10 is a broken sectional view of the same general nature as Fig. 3 but showing another form of composite heat-exchange fin embodying the present invention;

Fig. 11 is a fragmentary perspective view of a portion of the composite heat-exchange fin shown in Fig. 10;

Fig. 12 is an underside view of a fragment of still another form of composite heat-exchange fin embodying the present invention;

Fig. 13 is a broken sectional view taken on the line 13—13 of Fig. 12;

Fig. 14 is a view similar to Fig. 12 but showing the upper set of anchor-prongs of the supporting-plate in readiness to be pressed into engagement with the inlay-plate; and

Fig. 15 is a broken sectional view taken on the line 15—15 of Fig. 14.

*The structure of Figs. 1 to 9 inclusive*

The particular composite heat-exchange fin shown in the figures just referred to includes what might be aptly termed a "supporting-plate or -member" generally designated by the reference character 15 and an inlay-plate or -member generally designated by the reference character 16.

The supporting-plate 15 above referred to is of ring-like form and is skeletonized and includes, in the instance shown, an outer margin-portion 17 and an inner margin-portion 18 integrally interconnected by a plurality of web-like bridging-portions or arms 19 which latter, in the instance shown, extend substantially radially though not necessarily so. The outer margin-portion 17, the inner margin-portion 18 and the bridging-portions 19 together define a plurality of perforations 20 extending through the supporting-plate from face to face and adapted, as will hereinafter appear, for the reception of portions of the aforesaid inlay-plate 16.

The material at the inner edge of the inner margin-portion 18 of the supporting-plate 15 is turned or bent so as to extend substantially per-

pendicularly with respect to the plane of the said plate to provide a stiffening-flange 21. Portions of the outer perimeter of the outer margin-portion 17 are bent in a direction opposite to the direction of the stiffening-flange 21 to provide a pair of substantially-perpendicular baffle-flanges 22—22, each of which extends about one-quarter-way around the outer perimeter of the supporting-plate 15 and each of which has an end 23 turned outwardly away from the supporting-plate, as is indicated in Figs. 2 and 5.

The aforesaid supporting-plate 15 may be formed of any suitable sheet material having the characteristics at elevated temperatures of relatively-high modulus of elasticity, high tensile strength (and hence flexural strength) combined with relatively-low heat-conductivity as compared to the material of which the aforesaid inlay-plate 16 or its equivalent is formed. Among the many sheet materials suitable for producing the supporting-plate may be mentioned high-carbon steel (about .95% C.), silicon bronze, nickel and nickel alloys, stainless steel etc.

The sheet material from which the inlay-plate 16 or its equivalent may be formed is characterized when at elevated temperatures, by having a relatively-low modulus of elasticity and a relatively-high heat-conductivity as compared to the material of which the aforesaid supporting-plate 15 is formed. Suitable materials for the said inlay-plate are numerous, among which may be mentioned copper, silver and aluminum.

The inlay-plate 16, in the instance shown, includes an inner margin-portion 24 having an integral and substantially-perpendicular stiffening-flange or contact-flange 25. Extending outwardly from the margin-portion 24 just referred to, is an annular series of inlay-panels or leaves 26 each of which is spaced and shaped to closely conform to and to fit into the perforations 20 in the supporting-plate 15.

When the inlay-plate 16 is assembled with the supporting-plate 15, as is particularly shown in Figs. 3, 4 and 7, the stiffening-flange 25 of the said inlay-plate extends in a direction opposite to the direction in which the stiffening-flange 21 of the supporting-plate 15 extends. Furthermore, the stiffening-flange 25 is positioned inwardly with respect to the stiffening-flange 21 so that the outer face of the stiffening-flange 25 of one composite fin is overlapped by the stiffening-flange 21 of the next adjacent composite fin, as is especially well shown in Figs. 3 and 4. The inner margin-portion 24 of the inlay-plate 16 engages with the adjacent face of the inner margin-portion 18 of the supporting-plate 15.

Throughout the major portion of their extent, each of the inlay-panels 26 of the inlay-plate 16 are flush with the surrounding portions of the supporting-plate 15. The contacting edges of the inlay-panels 26 and the supporting-plate 15 may be anchored together in any suitable manner such, for instance, as by silver solder, welding, brazing or, in some instances where the temperatures encountered are not unduly high, by a synthetic resin or the like. The said edge-portions may also be secured together by mechanical means such, for instance, as is shown in Figs. 12 to 15 inclusive and as will be more fully hereinafter described.

When a group of composite heat-exchange fins such as have been above described are assembled onto an engine cylinder 27 or the like, the baffle-flanges 22 thereof will nest together, if desired, in a manner such as is shown in Fig. 4. The stiffening-flanges 25 will serve to determine the spacings between adjacent fins.



It will be noted by reference to Figs. 3 and 4, in particular, that in each of the instances shown, an inner portion of the inlay-plate 16 is in direct heat-exchange engagement with the object from which or to which heat is to be transferred such, for instance, as the cylinder 27. By this arrangement, in instances where heat is to be dissipated from an object such as a cylinder 27, the inlay-plate 16 will rapidly transfer such heat from its inner margin-portion to the inlay-panels or leaves 26 for dissipation into the air or other fluid stream flowing between the various fins. In instances where it is desired to employ integral baffle-flanges such as 22, such baffle-flanges will serve to deflect air or other fluid around the rear side of the cylinder 27 or its equivalent when the said fluid is flowing in the direction of the arrow A in Fig. 2. The cooling fluid, under these conditions, will emerge at the rear of the structure through the passage formed between the opposed but laterally spaced-apart ends 23 of such baffle-flanges.

Each composite heat-exchange fin of the present invention may be provided after assembly with an allover coating or plating of corrosion-resistant material, preferably nickel though silver, tin, chrome and other materials may be used which resist deep corrosion and scaling at elevated temperatures.

*The structure of Figs. 10 and 11*

The composite heat-exchange fins illustrated in Figs. 10 and 11, are in substance the same as the composite heat-exchange fins illustrated in the preceding figures and the parts bear like reference characters. The differences are those of form, especially with respect to the fact that the stiffening-flange 21 of the supporting-plate 15 extends in the same direction as the contact- or stiffening-flange 25 of the inlay-plate 16 and bears against the outer face of the latter.

Thus when a series of heat-exchange fins of the character just referred to are assembled onto a structure such as the engine-cylinder 27 (Fig. 10), the stiffening-flanges 25 of the highly-conductive inlay-plates 16 engage directly with the surface of the said engine-cylinder.

*The structure of Figs. 12 to 15 inclusive*

In the structure now being described, a skeletonized supporting-plate 28 is employed having the same general characteristics as the supporting-plate 15 before described. The said supporting-plate 28 includes an outer margin-portion 29 and an inner margin-portion 30 integrally interconnected by a plurality of web-like bridging-portions or arms 31.

The outer margin-portion 29, the inner margin-portion 30 and the bridging-portions 31 together define a plurality of perforations 32 extending through the supporting-plate from face to face.

The inner edge of the outer margin-portion 29 and the respective opposite side-edges of the bridging-portions 31 of the aforesaid supporting-plate 28 are formed with a plurality of anchor-prongs 33 alternately extending in engagement with the opposite faces of the inlay-panels 34 of an inlay-plate generally designated by the reference character 35, and corresponding basically to the inlay-plate 16.

Preferably, and as illustrated in Figs. 14 and

15, alternate ones of the anchor-prongs 33 are initially bent into near-perpendicularity with respect to the plane of the supporting-plate 28 to permit the inlay-panels 34 of the inlay-plate 35 to be positioned on top of the remaining alternate anchor-prongs (as viewed in the drawings). After the parts have been assembled, the alternate upstanding anchor-prongs 33 may be forcibly bent downwardly upon the upper surface of the inlay-panels 34 so as to cause the anchor-prongs 33 to bite into the respective opposite surfaces of the said inlay-panels and thereby couple or anchor the same in place.

The fins may be attached to a cylinder or the like by a shrinking or pressing process, or by fusing with silver-solder or preferably with alloys of lower fusion temperatures.

The invention may be carried out in other specific ways than those herein set forth without departing from the spirit and essential characteristics of the invention, and the present embodiments are, therefore, to be considered in all respects as illustrative and not restrictive, and all changes coming within the meaning and equivalency range of the appended claims are intended to be embraced therein.

I claim:

1. A thin sheet-like composite heat-exchange fin for a heat-radiating body, the said fin comprising a skeletonized supporting-plate formed of sheet metal of relatively-high strength and relatively-low heat-conductivity as compared to the sheet metal of the hereinafter-mentioned inlay-plate means, the said skeletonized supporting-plate having a plurality of segregated perforations extending therethrough from face to face; and inlay-plate means comprising segregated elements held in segregated relationship by a common contact-member arranged to engage said heat-radiating body thereby to conduct heat therefrom to said segregated elements, the said segregated elements being arranged to fit into the respective segregated perforations of said skeletonized supporting-plate with opposite sides of each segregated element exposed to the air and its edges substantially flush with and anchored to the peripheral edges of its respective segregated perforation, the said inlay-plate means being formed of sheet metal of relatively-low strength and relatively-high heat-conductivity as compared to the aforesaid supporting-plate.

2. A thin sheet-like composite heat-exchange fin for a heat-radiating body, the said fin comprising a skeletonized supporting-plate formed of sheet metal of relatively-high strength and relatively-low heat-conductivity as compared to the sheet metal of the hereinafter-mentioned inlay-plate means, the said skeletonized supporting-plate having a plurality of segregated perforations extending therethrough from face to face; and inlay-plate means comprising segregated elements held in segregated relationship by a common contact-member constituting an integral extension of each segregated element arranged to engage said heat-radiating body thereby to conduct heat therefrom to said segregated elements, the said segregated elements being arranged to fit into the respective segregated perforations of said skeletonized supporting-plate with opposite sides of each segregated element exposed to the air and its edges substantially flush with and anchored to the peripheral edges of its respective segregated perforation, the said inlay-plate means being



formed of sheet metal of relatively-low strength and relatively-high heat-conductivity as compared to the aforesaid supporting-plate.

3. A thin sheet-like composite heat-exchange fin for a heat-radiating body, the said fin comprising a skeletonized supporting-plate having an inner margin-portion, an outer margin-portion, and a plurality of web-like bridge-portions integrally connecting the two said margin-portions and together therewith defining a plurality of segregated perforations extending from face to face through the said supporting-plate, the said skeletonized supporting-plate being formed of sheet metal of relatively-high strength and relatively-low heat-conductivity as compared to the sheet metal of the hereinafter-mentioned inlay-plate means; and inlay-plate means comprising segregated elements held in segregated relationship by a common contact-member constituting an integral extension of each segregated element arranged to interlock with the inner margin-portion of said skeletonized supporting-plate and to engage said heat-radiating body thereby to conduct heat therefrom to said segregated elements, said segregated elements being arranged to fit into the respective segregated perforations of said skeletonized supporting-plate with opposite sides of each segregated element exposed to the air and its edges substantially flush with and anchored to the peripheral edges of its respective segregated perforation, the said inlay-plate means being formed of sheet metal of relatively-low strength and relatively-high heat-conductivity as compared to the aforesaid supporting-plate.

4. In a finned heat-radiating body, a plurality of thin sheet-like composite heat-exchange fins arranged in juxtaposition on said heat-radiating body, each fin comprising a skeletonized supporting-plate having an inner margin-portion provided with a substantially-perpendicular stiffening-flange, an outer margin-portion, and a plurality of web-like bridge-portions integrally connecting the two said margin-portions and together therewith defining a plurality of segregated perforations extending from face to face through the said supporting-plate, the said skeletonized supporting-plate being formed of sheet metal of relatively-high strength and relatively-low heat-conductivity as compared to the sheet metal of the hereinafter-mentioned inlay-plate means; and inlay-plate means comprising segregated elements held in segregated relationship by a common contact-member constituting an integral flange formed on the inner margins of said segregated elements substantially perpendicular thereto and arranged to engage said heat-radiating body thereby to conduct heat therefrom to said segregated elements, the said integral flange of each inlay-plate extending in a direction opposite to that of the stiffening-flange of its respective supporting-plate and arranged to be engaged by the stiffening-flange of an adjacent composite fin on said radiating body to form a footing for the supporting-plate of said adjacent composite fin, said segregated elements being arranged to fit into the respective segregated perforations of said skeletonized supporting-plate with opposite sides of each segregated element exposed to the air and its edges substantially flush with and anchored to the peripheral edges of its respective segregated perforation, the said inlay-plate means being formed of sheet metal of relatively-low strength and relatively-high heat-

conductivity as compared to the aforesaid supporting-plate.

5. A thin sheet-like composite heat-exchange fin for a heat-radiating body, the said fin comprising a skeletonized supporting-plate having an inner margin-portion provided with a substantially-perpendicular stiffening-flange, an outer margin-portion, and a plurality of web-like bridge-portions integrally connecting the two said margin-portions and together therewith defining a plurality of segregated perforations extending from face to face through the said supporting-plate, the said skeletonized supporting-plate being formed of sheet metal of relatively-high strength and relatively-low heat-conductivity as compared to the sheet metal of the hereinafter-mentioned inlay-plate means; and inlay-plate means comprising segregated elements held in segregated relationship by a common contact-member constituting an integral flange formed on the inner margins of said segregated elements substantially perpendicular thereto and extending in the direction of said stiffening-flange so as to nest therewith and provide a footing for the stiffening-flange of said supporting-plate, said integral flange being arranged also to engage said heat-radiating body thereby to conduct heat therefrom to said segregated elements, said segregated elements being arranged to fit into the respective segregated perforations of said skeletonized supporting-plate with opposite sides of each segregated element exposed to the air and its edges substantially flush with and anchored to the peripheral edges of its respective segregated perforation, the said inlay-plate means being formed of sheet metal of relatively-low strength and relatively-high heat-conductivity as compared to the aforesaid supporting-plate.

6. A thin sheet-like composite heat-exchange fin for a heat-radiating body, the said fin comprising a skeletonized supporting-plate formed of ferrous sheet metal of relatively-high strength and relatively-low heat-conductivity as compared to the non-ferrous sheet metal of the hereinafter-mentioned inlay-plate means, the said skeletonized supporting-plate having a plurality of segregated perforations extending therethrough from face to face; and inlay-plate means comprising segregated elements held in segregated relationship by a common contact-member arranged to engage said heat-radiating body thereby to conduct heat therefrom to said segregated elements, the said segregated elements being arranged to fit into the respective segregated perforations of said skeletonized supporting-plate with opposite sides of each segregated element exposed to the air and its edges substantially flush with and anchored to the peripheral edges of its respective segregated perforation, the said inlay-plate means being formed of non-ferrous sheet metal of relatively-low strength and relatively-high heat-conductivity as compared to the aforesaid ferrous metal supporting-plate.



7. A thin sheet-like composite heat-exchange fin for a heat-radiating body, the said fin comprising a skeletonized supporting-plate formed of sheet steel of relatively-high strength and relatively-low heat-conductivity as compared to the copper-base sheet metal of the hereinafter-mentioned inlay-plate means, the said skeletonized supporting-plate having a plurality of segregated perforations extending therethrough from face to face; and inlay-plate means comprising segregated elements held in segregated relationship by a common contact-member arranged to engage said heat-radiating body thereby to conduct heat therefrom to said segregated elements, the said segregated elements being arranged to fit into the respective segregated perforations of said skeletonized supporting-plate with opposite sides of each segregated element exposed to the air and its edges substantially flush with and anchored to the peripheral edges of its respective segregated perforation, the said inlay-plate means being formed of a copper-base sheet metal of relatively-low strength and relatively-high heat-conductivity as compared to the aforesaid sheet steel supporting-plate.

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