

Feb. 6, 1934.

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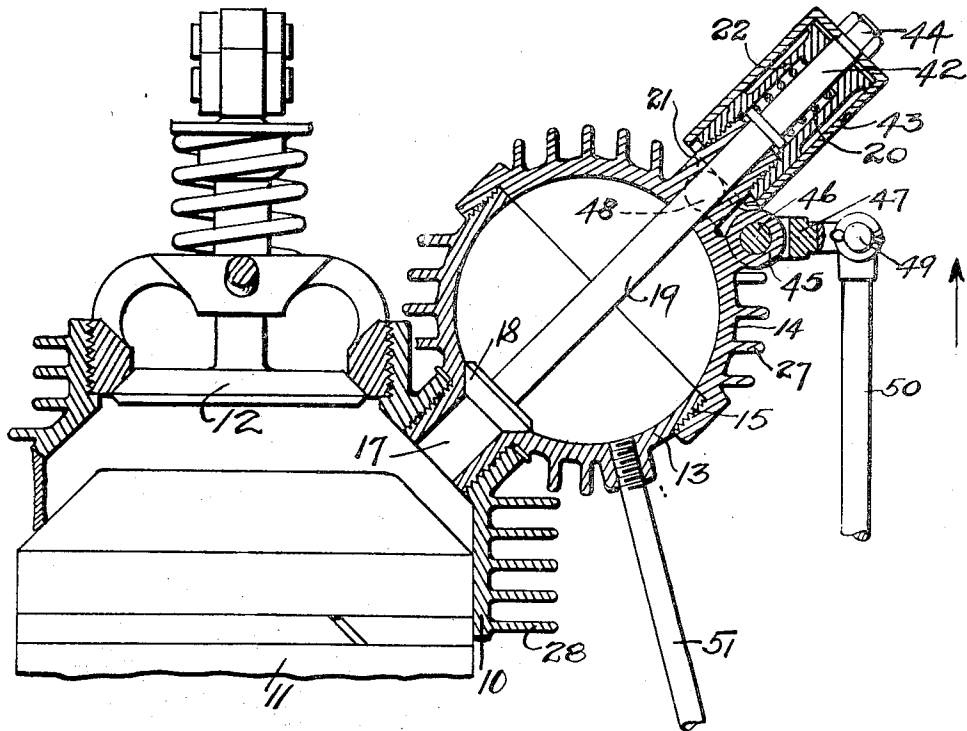
1,945,818

INTERNAL COMBUSTION ENGINE

Filed Dec. 17, 1928

3 Sheets-Sheet 1

Fig. 1.



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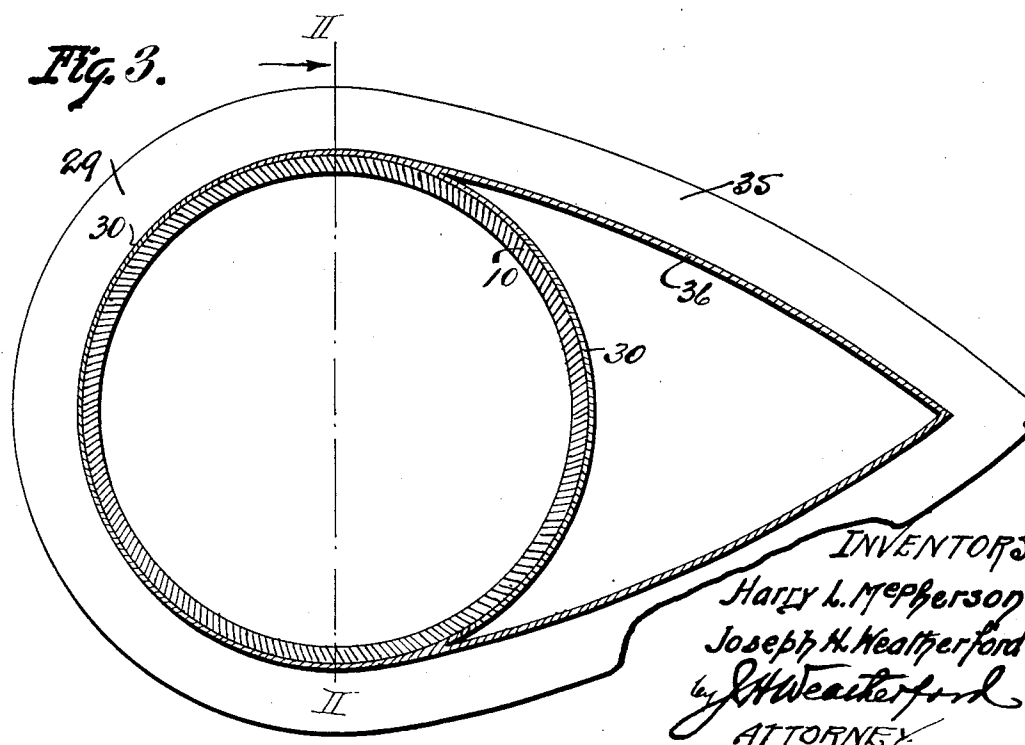
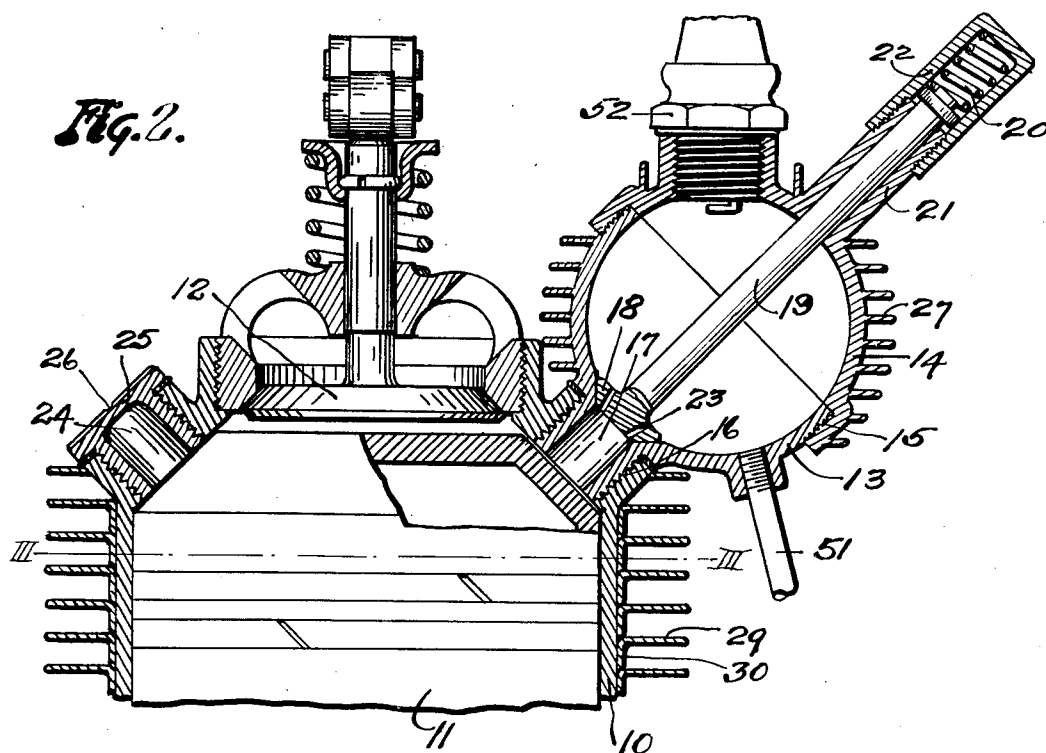
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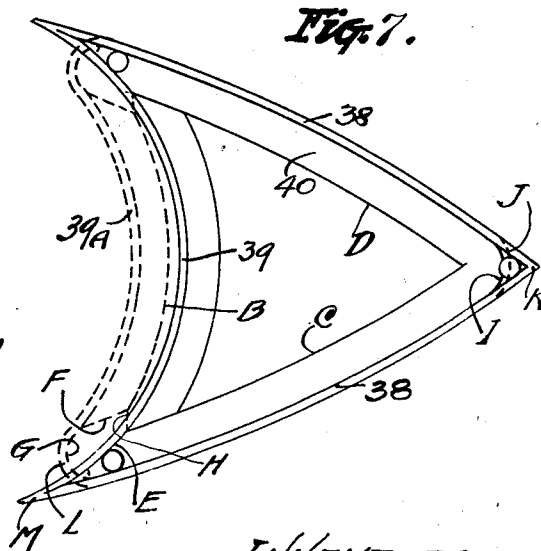
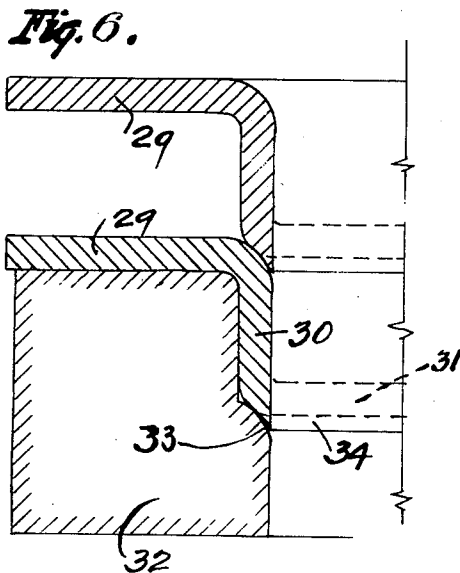
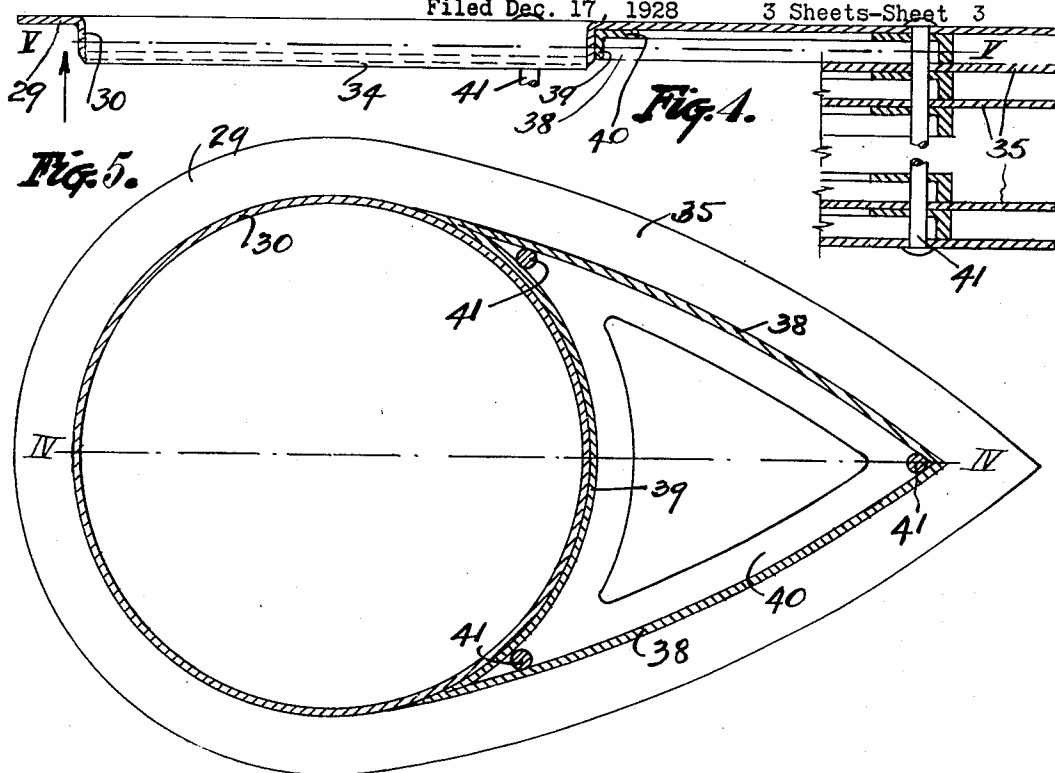
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1,945,818

INTERNAL COMBUSTION ENGINE

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Application December 17, 1928
Serial No. 326,608

8 Claims. (Cl. 123—171)

This invention relates to internal combustion engines, and more especially to the cooling fins therefor.

The objects of this invention are:

First, to provide means for efficiently air cooling the cylinders or other parts;

Second, to provide means for reducing the resistance of the cylinders or other parts subjected to high speed air currents, as in airplane engines;

Third, to provide means for reducing the cost and increasing the strength of engine cylinders of given weight, while providing efficient air cooling therefor;

The means by which these objects are accomplished includes;

(a) Providing cooling fins for the cylinder, which fins are independently formed and placed around the exterior of the cylinder;

(b) Providing cooling fins for the cylinder, which fins are independently formed and placed around the exterior of the cylinder and which fins have flanges substantially covering the entire cylindrical area of the cylinder;

(c) Providing a method for forming cooling fins of thin sheet metal for the cylinders which consists in drawing a shallow flanged cup of interior diameter adapted to be forced over the surface of the cylinder, so removing the bottom of the cup as to leave a sharp cylindrical edge adapted to register snugly with an adjacent fin when the fins are assembled on the cylinder, and shaping the exterior of the flange to desired contour;

(d) Providing cooling fins having a portion of their peripheral edges shaped to substantially stream line contours;

(e) Providing a plurality of cooling fins having portions of their exterior contours shaped to substantially stream lines, and having intermediate spacing flanges shaped to similar stream lines, between the stream line portions of said fins;

(f) To provide for the cylinders a plurality of independent sheet metal cooling fins shaped to stream line contours, and assembled on the cylinders, and a plurality of sheet metal spacing members, adapted to be disposed between the stream line portions of said fins and against said cylinders to form stream line members between said fins;

(g) To provide for the cylinders a plurality of independent sheet metal fins shaped to stream line contours and assembled on the cylinders, a plurality of hollow sheet metal wall, spacing members, adapted to be disposed between the

stream line portions of said fins and against said cylinders to form stream line members between said fins, and means for securing the stream line portions of said fins and said spacing members together;

(h) Finishing the exterior wall surface of the cylinder to a true surface concentric with the bore thereof, and forcing or shrinking on such exterior surface independent sheet metal cooling fins;

The means by which the foregoing and other objects are accomplished and the manner of their accomplishment will readily be understood from the following specification on reference to the accompanying drawings, in which:

Fig. 1 is a sectional elevation of the upper portion of an engine cylinder showing integral fins thereon.

Fig. 2 is a sectional elevation on the line II—II of Fig. 3, with the preferred form of fin construction.

Fig. 3 is a sectional plan of the cylinder taken on the line III—III of Fig. 2.

Fig. 4 is a sectional elevation taken on the line IV—IV of Fig. 5 showing a modification of the fin construction.

Fig. 5 is a sectional plan taken on the line V—V of Fig. 4, being substantially the same as the line III—III of Fig. 2, showing the same modification of the fin structure set out in Fig. 4.

Fig. 6 is an enlarged fragmentary sectional elevation through a portion of one of the fins and also showing a portion of the die in which the fin-flange is completed.

Fig. 7 is a plan view of an independent fin spacing member showing in dotted lines, the original shape of this member as drawn and punched, and the finished shape thereof.

Referring now to the drawings in which the various parts are indicated by numerals; 10 designates cylinders, 11 pistons therein and 12 combined inlet and outlet valves therefor, all typical only. 13 and 14 are two halves of substantially spherical combustion chambers, which halves may be secured together in desired manner, such for instance, as by the threads 15. The halves 13 may be integral with the cylinders, but preferably are attachable to and detachable therefrom as by the threaded connection 16. 17 are openings or passage-ways between the cylinders and the compression chambers. 18 are valves preferably of the ordinary poppet or mushroom type having complementary seats formed in the halves 13, which valves have guiding stems 19 and are held against their seats by compression springs

20. Preferably the halves 14, of the compression chambers are provided with elongated projecting hubs 21 which are bored out to a close working fit with the valve stems 19, and the springs 20 are enclosed and held against the stems by covers 22 which are threaded on the hubs 21 and sealed tightly thereto. 42 are extensions of the stems 19 which project through the covers 22, and through the bottom of cups 43, which cups are secured and sealed to the stem extensions 42 by nuts 44. The cups 43 enclose the covers 22 and make close sliding fits therewith. 45 are brackets projecting from the exterior of the compression chamber halves 14, through which brackets, pins 46 are passed. 47 are forked bell crank levers which are pivoted on the pins 46. One end of these levers have cam ends 48, which engage against the ends of the cups 43 at diametrically opposite points, and the other ends are provided with pin connections 49, to cam rods 50, which lead to the usual type of cams (not shown) ordinarily employed in internal combustion engines.

51 are fuel pipes.

24 is a safety plug providing a closure for an opening through the wall of the cylinder. This plug is provided with a comparatively thin portion 25 having fillets at its juncture with the plug body and which thin portion may have grooves or notches 26 thereacross so that in case of excessive pressures being set up such thin portion of the plug will rupture without danger from flying fragments occasioned by such rupture, and where scored will rupture along such lines.

The compression chambers may be provided with fins 27 for the purpose of radiating heat therefrom, which fins would preferably be integral therewith. The cylinder walls may also be provided with integral fins 28 as shown in Fig. 1, but it is preferable that independently formed cooling fins 29 as shown in Fig. 2, of thin metal be used instead. In such case these fins are provided with flanges 30, which are integral with the fin proper and which flanges are forced or shrunk over the exterior surface of the cylinder walls, which necessarily must be accurately finished, so that intimate contact is made between the fin-flanges and the walls. When the first flange has been forced on any cylinder, additional ones are forced on each seating tightly against the preceding one. In order that the contact between adjacent fin-flanges be as intimate as possible we prefer to first draw the flange in the shape of a shallow cup, a fragmentary portion of which is shown in Fig. 6, in which view the bottom of the cup 31 is shown in dash lines, and to then place each cup in succession in a die 32, which has a seat 33 rounded to substantially the same curvature as the top of the cup, against which the bottom of the cup rests. The bottom of the cup is then punched out, resulting in the lower portion of the flange 30 being drawn down to a sharp edge 34, and in its being conformed substantially to the curvature of the die seat 33. In Fig. 6 one fin and its flange is shown in position in the die, and a second fin and flange is shown seated thereon in order to more clearly show the manner in which such punching shapes the flange edge to conform with the rounded edge of the adjacent fin-flange which seats thereagainst.

The fins 29 may be of the usual uniform depth, around the cylinder in which case they would be substantially as shown in the left half of Fig. 5, but it is deemed preferable to shape the trailing portion 35 of the fin, that is the portion behind

the cylinder from the air current, as shown in the right half of Fig. 3, along stream lines. In such case the flange 30 extends continuously around the cylinder wall and ordinarily the fin extends continuously from the flange 30 to the exterior edges thereof. 36 is a spacing flange or member disposed between the stream line portions of the fin, which member is shaped to a contour substantially parallel to that of the fin.

The spacing member 36 may be integral with the flange 30 and the fin 35, but where the fins and flanges are made of aluminum, which metal possesses many inherent advantages, such construction is exceedingly difficult. It is desirable therefore in such cases to make the spacing member an independent member such as is shown in Fig. 7, and to assemble such member between the stream line fins 35 as shown in Figs. 4 and 5. Such a member preferably has flanges 38 which substantially parallel the exterior lines of the fins 35 and a flange 39 which conforms to the exterior of the cylindrical flange 30, preferably also a stiffening web 40 integral with the flanges 38 and 39 is disposed within these flanges. One of these spacing members is disposed between each pair of fins 35, and the assembled fins and spacers may be secured together as by rivets 41. It will be especially noted that these rivets are entirely enclosed within the structure thus formed so that only the heads present air resistance.

Referring to Fig. 7, it will be seen that a spacing member of this type may be drawn in the shape of a shallow cup substantially conforming to the dotted lines, in which case 39A would be the initial shape of the flange 39. The central portion lying between the dotted line "B" and the lines "C" and "D" is then punched out, two similar portions lying between the line "E" and the dotted lines "F", "G" and "H" are also punched out, and flange 38 is sheared from the web 40 along the curved line "I". The rounded end "J" is then shaped to a point "K", the rounded portions "L" shaped into the pointed portions "M", and the flange 39 is drawn inward to its finished shape 39.

In building an engine with independent fins assembled on the cylinders, the cylinders are first turned or ground to a uniform outside dimension which permits the use of an extremely thin wall since the strength may be calculated with exactness. Where lightness is an object, as in air plane engines, sheet aluminum or aluminum alloy is ordinarily used for the fins. Shallow cups are drawn in these sheets usually one quarter to three-eighths of an inch in depth with the interior cup diameter such that a tight fit may be had with the exterior of the cylinder wall. Each cup is then placed in a die which has an annular seat conforming approximately to the upper rounded edge of the cup, and the bottom of the cup sheared out. This shearing will flow the end of the flange thus formed to substantially the curvature of the die seat. If it has not previously been done, the exterior of the fin is then shaped to the desired contour. These fins are then forced over the exterior of the cylinder or if preferred are heated and placed thereover, each successive fin being forced solidly against the preceding fin-flange so that the rounded juncture of the fin and flange is brought into the correspondingly rounded flange end of the preceding flange and the assembly becomes substantially a monolithic unit covering the cylindrical portion of the cylinder wall. These fins resist with the cylinder walls stresses within the cylinder, and by

virtue of the intimate contact of the fin flanges with the cylinder walls provide an efficient means for radiating the heat of the cylinder. Should the fins be of usual cylindrical form this would complete the assembly operation; however, should the fins be of stream line type it is preferable to insert between them spacing members which abut against the fin flange and which enclose a space conforming in contour to the fin contour but of less area, and substantially parallel with the fin edges. These members may be short, hollow, thin wall spacers, but preferably in order to give them proper stiffness and assist in transfer of heat they are usually provided with a web portion as shown. Such spacing members may be made in conformity with the description of Fig. 7, or of substantially the same shape but without the flange 39, and after being made to conform exactly with the spacing of the fins they are inserted between the stream line portion of the fins and are drawn as closely as possible against the fin flanges by means of rivets, which rivets are thereafter headed to clamp the fins and spacers into a rigid structure.

In Fig. 4, a spark plug 52 is shown, though such plug is not ordinarily used with this type of engine and is introduced for the purpose only of indicating the point at which combustion takes place, and as illustrating how a spark plug could be used with this type of compression chamber.

Having described our invention, what we claim is:

1. In an internal combustion engine, a cylinder having a plurality of fins extending therefrom, each having the periphery of their forward halves substantially cylindrical and of their rear halves substantially stream line and spacers disposed between the stream line portions of said fins, each spacer comprising a hollow member having the forward portion conforming closely to a portion of the exterior of said cylinder, and the rear portion substantially stream line paralleling but inward from said fin periphery.

2. In an internal combustion engine, a cylinder having a smooth external wall surface, independently formed fins, each having the periphery of their forward halves substantially cylindrical and of their rear halves substantially stream line and each having an integral flanged portion, assembled on such cylinder surface in intimate contact therewith, and spacers disposed between the

stream line portions of said fins, each comprising a flange member and integral web, said flange member having the forward portion conforming closely to a portion of the exterior of said fin-flanges, and the rear portion substantially stream line paralleling said fin periphery and means for securing said fins together with said spacers therebetween.

3. In an internal combustion engine, a cylinder having cooling fins extending therefrom, said fins having portions thereof, shaped to stream line contour, and fairings between said fins, extending from opposite sides of said cylinder to form a stream line continuation of the wall of said cylinder between said fins and fins extending outward from said fairings.

4. In an internal combustion engine, a cylinder, metal fairings extending from opposite sides of said cylinder and forming stream line continuations of the walls thereof, thin metal fins extending from said cylinder to said fairings and fins extending outward from said fairings.

5. In an internal combustion engine, a cylinder having cooling fins extending therefrom, said fins having their rear portions shaped to stream line contour, and spacers of thin metal between said fins, extending rearwardly from the walls of said cylinders and lying substantially parallel to but inward from said fin peripheries.

6. In an internal combustion engine, a hollow engine part, metal fairings extending from opposite sides of said part and forming stream line continuations of the walls thereof, fins extending from the walls of said part to said fairing and fins extending outward from said fairings.

7. In an internal combustion engine, a hollow engine part, metal fairings extending from opposite sides of said part and forming stream line continuations of the walls thereof, and fins extending from the walls of said part to said fairings.

8. In an internal combustion engine, a hollow engine part, metal fairings extending from opposite sides of said part and forming stream line continuations of the walls thereof, and a plurality of metal bridges spaced apart and extending from the walls of said part to said fairings.

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