Aug. 31, 1943. J. GOODMAN 2,328,079

MEANS FOR PREVENTING ICE FORMATION ON AIR-CRAFT WINGS

Filed March 26, 1941

Fig. 1

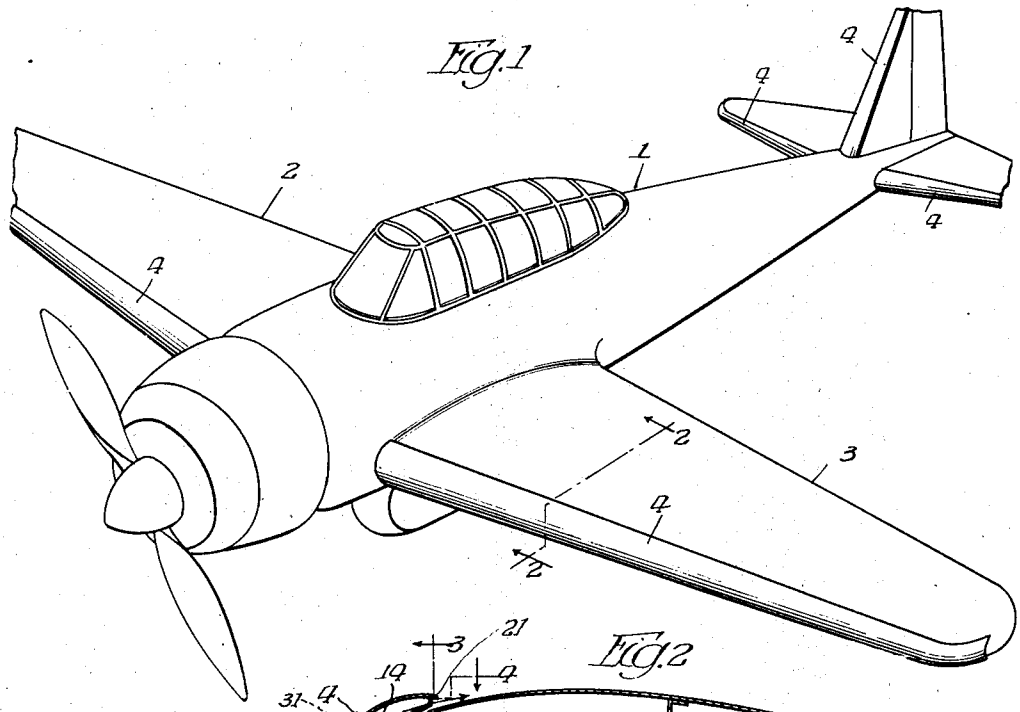


Fig. 2

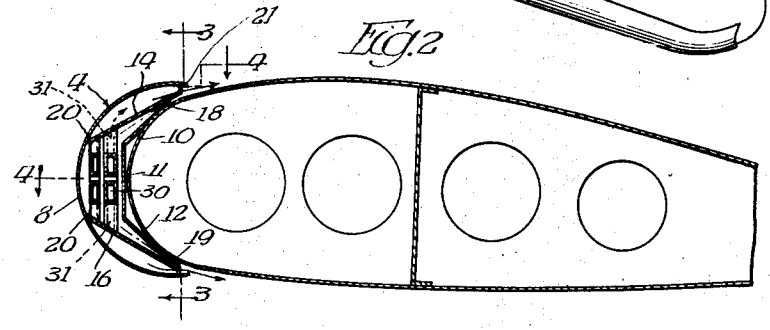


Fig. 3

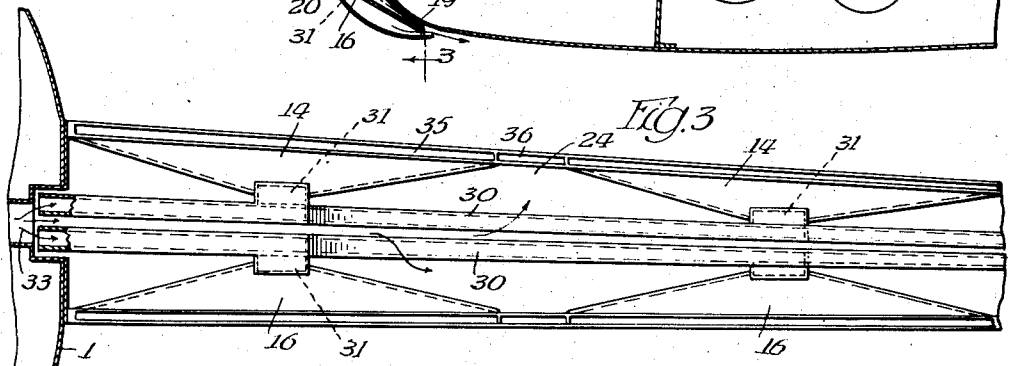
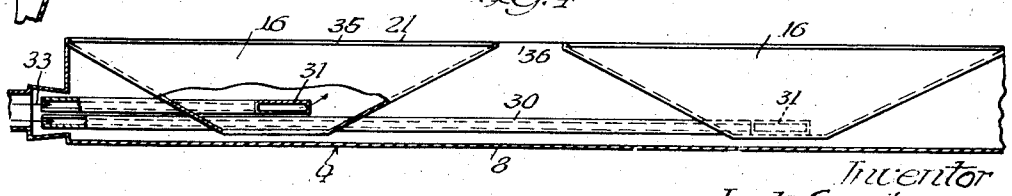


Fig. 4



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MEANS FOR PREVENTING ICE FORMATION ON AIRCRAFT WINGS

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3 Claims. (Cl. 244—134)

This invention relates to means for preventing the formation of ice on the leading edge of the wing of aircraft such as, for instance, airplanes.

One of the bothersome problems in aviation is the formation of ice at the leading edge of the wing of the plane. Such ice is formed by droplets of super cooled water, in the atmosphere, striking the surface of the plane and instantly freezing on contact therewith. As the ice builds up on the leading edge of the wing, or corresponding part of the body of an airplane, the pressure of the air against the forwardly moving airplane surface tends to hold the ice in position so that the ice builds up in thickness very very rapidly. One method of dealing with this problem is by providing inflatable and collapsible rubber tubes along the leading edge of the wing. The tubes are alternately inflated and deflated to break the ice coating which can than be swept away by the wind. Such method of preventing ice formation is sometimes satisfactory but not always so, and in many instances has exceedingly serious drawbacks.

It is one of the objects of the present invention to provide an apparatus which will utilize the heat of the exhaust gases of the engine for maintaining the leading edge of the wing at a temperature sufficiently elevated to prevent ice formation. In accordance with the principles of the present invention the leading edge of the plane wing is provided with a hollow scover or similar member which extends preferably the full length of the wing. This hollow cover strip is, in the preferred embodiment of the present invention, divided into a plurality of compartments. Each compartment receives hot engine exhaust gases to maintain the forward exposed surface of that compartment sufficiently warm to prevent condensation and freezing thereon of water globules from the surrounding atmosphere. The exhaust gases are moved through the hollow compartment and then exhausted therefrom in a direction rearwardly along the wing surface. This prevents ice formation immediately rearward of the cover strip. This de-icing or ice formation preventing strip may be applied to airplanes already made, in a simple and expedient manner.

The attainment of the above and further objects of the present invention will be apparent from the following specification taken in conjunction with the accompanying drawing forming a part thereof.

In the drawing:

Figure 1 is a fragmentary perspective view of an airplane, to the wings of which a de-icing device of the present invention has been applied;

Figure 2 is a fragmentary sectional view taken along the line 2—2 of Figure 1;

Figure 3 is a rear view of the de-icing device with the back cover plate thereof removed, said view being taken along the dotted line 3—3 of Figure 2; and

Figure 4 is a sectional view taken along the line 4—4 of Figure 2.

Reference may now be had more particularly to Figure 1. In this figure I have illustrated, diagrammatically, one conventional type of airplane 1 having wings 2—3 of any preferred construction. A hollow boot or covering 4 of the present invention is applied to the leading edge of each wing. The boot extends the full length of the wing to the very tip thereof. A similar boot or cover 4 is applied to the rudder and to other similar parts of the plane where ice may form. Figures 2, 3 and 4 illustrate the construction of the boot or cover. The boot comprises a front semi-tubular sheet 8, which may be of any desired curvature, preferably such curvature as offers the least impediment to air flow. The rear of the boot consists of three plate members 10, 11 and 12 which extend the full length of the boot, to-wit, the length of the airplane wing, and are secured to the airplane wing to secure the boot 4 to the wing. The plate members are welded or otherwise secured together so that there is no air leakage at the joints between the plate 11 and the plates 10 and 12. The plates 10, 11 and 12 are secured in spaced relationship to the front semi-tubular sheet 8 by a number of plate-like vanes 14 and 16. The vanes 14 and 16 are welded or otherwise secured to the plates 10 and 12 at 18 and 19 and are secured to the front semi-tubular sheet 8 either at the points 20—20 or at the ends 21—21, or both, thus forming a rigid structure. Each plate 14 and 16 is of a generally triangular shape, the apex of which terminates at 20 and the base of which terminates at 21. A series of plates 14 and a series of plates 16 are provided, together to extend the full length of the wing. Adjacent plates 14—14 are spaced apart by a space 24. A similar space is provided between adjacent plates 16.

A number of pipes 30 extend lengthwise within the boot 4 and open at 31 into the various compartments formed between the plates 14 and the sheet 8 and between the plate 16 and the sheet 8. Exhaust engine gases are delivered through the tubes 30 to the outlets 31. Likewise exhaust engine gases are delivered, as indicated by the arrow 33, into the space between adjacent tubes

30 to fill the space between adjacent plates 14 and the adjacent plates 16. The exhaust gases escape at the periphery of the boot, indicated at 35 and 36, and flow rearwardly along the upper and lower wing surfaces. The hot exhaust gases thus keep the forward leading edge of the wing (which is the surface 8) sufficiently warm to prevent condensation and freezing of water droplets from the atmosphere. Furthermore, the exhaust gases flow along the upper and lower wing surfaces and likewise prevent condensation and freezing of water droplets at the portions of the wing surface adjacent the outlets of the exhaust gases.

While I have herein spoken of using the heat of exhaust gases for warming the leading edges of the plane wing, it is to be understood that any other available source of heat may be used. For instance, atmospheric air may be circulated around the engine, or through a radiator, whereby it is heated by the engine, or by the hot water of the engine in the case of a water cooled engine, and that hot air may then be blown through the covering or boot 4. Likewise, any other available source of heat may be used.

The plate-like vanes 14 and 16 which divide the boot or covering 4 into a number of compartments are useful in that they prevent the concentration of a major part of the heat at the part of the wing immediately adjacent the airplane body, with a resulting diminution of heat at the tips of the wings. By providing the vanes which divide the boot or covering into a number of compartments, the hot gases are delivered into the deicing device at a plurality of places and flow therefrom out through the covering 4 at a plurality of outlets. Otherwise the hot gases might be excessively cooled at the part of the boot adjacent the plane body, with a resulting shortage of heat by the time the gases reach the wing tips. The plates or vanes 14 and 16 may be omitted, if desired, because even if they are omitted the plurality of inlets 31 which are spaced from one another lengthwise of the wing assure the delivery of hot gases, whether exhaust gases or heated air, into the wing at a plurality of places spaced lengthwise thereof. This prevents any one part of the wing covering from receiving an excessive amount of heat at the expense of another part of the wing.

In compliance with the requirements of the patent statutes I have here shown and described a preferred embodiment of my invention. It is, however, to be understood that the invention is not limited to the precise construction here shown, the same being merely illustrative of the principles of the invention. What I consider new and desire to secure by Letters Patent is:

1. Means for inhibiting ice formation along the leading edge of an airplane wing which comprises, a boot covering the leading edge of the wing and extending from the body of the plane to the tip of the wing but spaced from the wing to provide a space for heated gases, means within the boot and extending lengthwise of the wing and having a plurality of gas outlets spaced from one another lengthwise of the wing for delivering hot gases into the space between the boot and the leading edge of the wing, and means within the boot dividing it into a plurality of separate compartments spaced from one another lengthwise of the wing and each compartment including a gas receiving inlet and a gas outlet.

2. Means for inhibiting ice formation along the leading edge of an airplane wing which comprises, a boot covering the leading edge of the wing and extending from the body of the plane to the tip of the wing but spaced from the wing to provide a space for heated gases, means within the space and having a plurality of gas outlets spaced from one another lengthwise of the wing for delivering hot gases into the space between the boot and the leading edge of the wing, a plurality of gas discharge outlets to the atmosphere at the trailing edge of the boot and spaced from one another lengthwise of the wing, and means within the boot dividing it into a plurality of compartments spaced from one another lengthwise of the wing and each compartment including a gas receiving inlet and a gas discharging outlet.

3. Means for inhibiting ice formation along the leading edge of an airplane wing which comprises, a boot covering the leading edge of the wing and extending from the body of the plane to the tip of the wing but spaced from the wing to provide a space for heated gases, means within the boot dividing it into a plurality of compartments spaced from one another lengthwise of the wing and each compartment having an air outlet to the atmosphere on the trailing side of the foot, the boot constituting one wall of each of said compartments so that heating of said compartments results in heating of the outer surface of the boot, and separate adjacent hot gas conveying conduits extending lengthwise of the boot to the respective compartments and delivering heated gases thereto so that the rupture of any compartment wall and an associated conduit does not disable the delivery of hot gases to all of the remaining compartments.

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