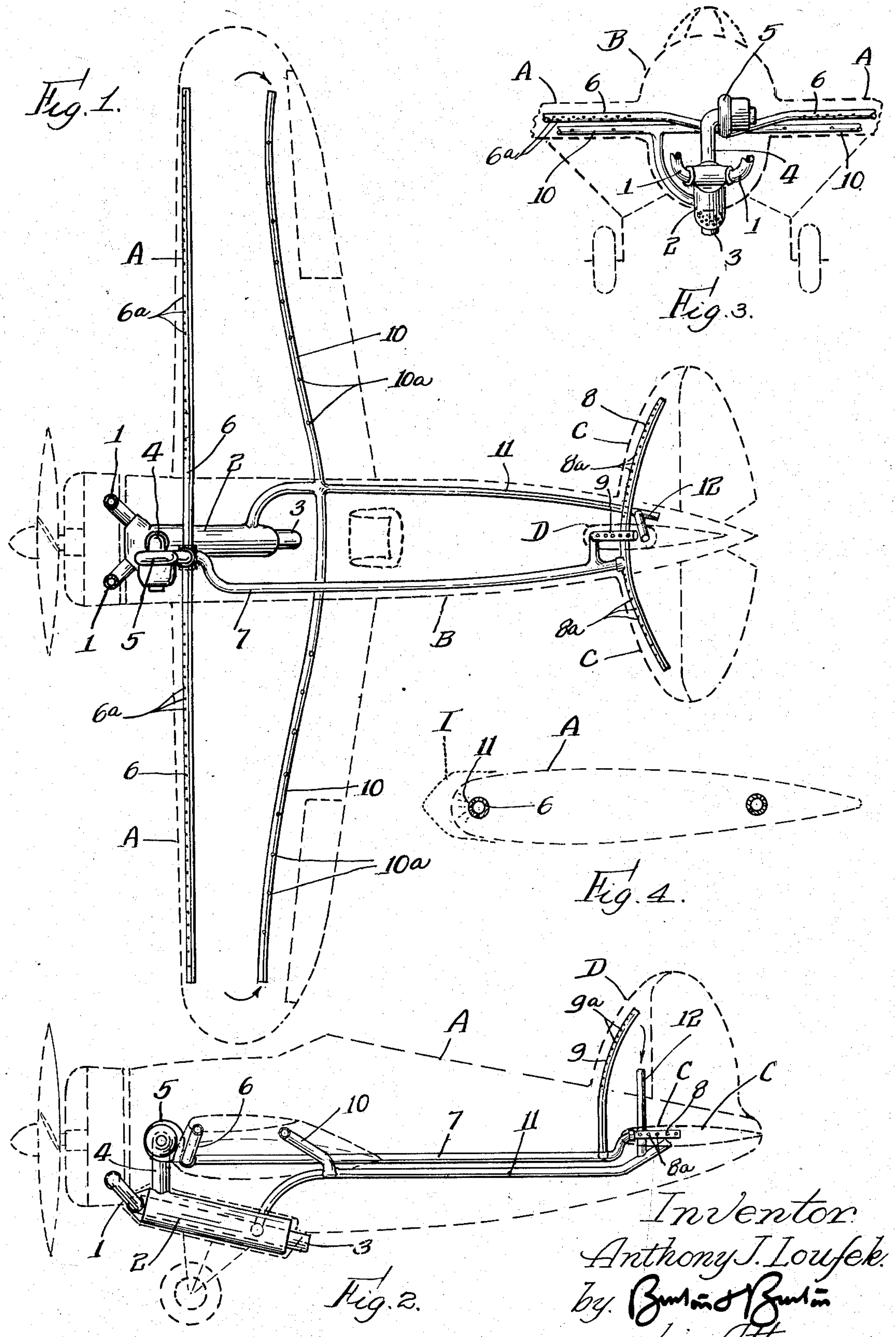
April 24, 1945. A. J. LOUFEK 2,374,441

ICE PREVENTION MEANS FOR AIRCRAFT

Filed Feb. 3, 1942



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UNITED STATES PATENT OFFICE

2,374,441

ICE PREVENTION MEANS FOR AIRCRAFT

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Application February 3, 1942, Serial No. 429,365

2 Claims. (Cl. 244—134)

This invention relates to means for heating certain critical portions of an aircraft, particularly an aeroplane, to forestall and prevent the formation of ice thereon. It is well understood that under certain weather conditions the wings, struts, elevators and rudders of aeroplanes tend to accumulate ice, which not only overloads the machine, but which also breaks the streamlined contour of these parts, causing excessive drag of the covered parts through the air and materially reducing the lifting efficiency of the wings. Frequently, this results in forced landings or in serious accidents.

One object of this invention is to provide heating apparatus so disposed in relation to the critical parts and areas as to maintain them at a temperature which will prevent the formation of ice thereon.

Another object of the invention is to provide heating apparatus for the purpose indicated which shall be of relatively light weight and simple in construction and operation.

A further object of the invention is to provide, in combination with the internal combustion motor of an aeroplane, a heat exchanger for transferring heat from the exhaust gases to a quantity of air in a heating system through which the air is recirculated so as to conserve its heat and utilize it most efficiently in maintaining safe temperatures at the wings and other critical portions of the aeroplane.

More specifically, it is an object of the invention to provide a system of air circulating pipes or conduits leading from a heat exchanger in which the air can absorb heat from the exhaust gases of the engine of the aeroplane and a system of return conduits, together with an air circulating fan or blower coupled to said conduits for forcing the heated air outwardly into the hollow spaces of the wings and other parts and creating suction to draw the air from said space through the return conduits for reheating and recirculation through the system.

Other objects and advantages of the invention will appear from the following description taken in connection with the accompanying drawing in which:

Figure 1 is a top plan view indicating diagrammatically the outlines of the aeroplane in broken line, and showing the arrangement of a heating system relative thereto in accordance with this invention.

Figure 2 is a side elevation of the aeroplane in broken outline, with the elements of the heating system shown in full lines therein.

Figure 3 is a front elevation of the heating system with portions broken away and with portions of the aeroplane shown in dotted outline.

Figure 4 is a diagrammatic outline view of the cross-sectional contour of an aeroplane wing with heating conduits of my system disposed therein and also indicating the approximate form of ice on the leading edge of the wing.

While there is shown and described herein certain specific structure embodying the invention, it will be manifest to those skilled in the art that various modifications and re-arrangements of the parts may be made without departing from the spirit and scope of the invention and that the same is not limited to the particular form herein shown and described except in so far as indicated by the appended claims.

Within the general outlines of an aeroplane, indicated diagrammatically in the drawing, there are shown exhaust pipes 1, 1 which may be understood as leading from the exhaust manifold of the usual internal combustion engine which drives the plane. The pipes 1, 1 extend into and through a jacket 2 which operates as a heat exchanger, and the exhaust gases are discharged from an exhaust pipe 3, preferably at the rear end of the jacket 2. Within the jacket 2 the exhaust pipe and the interior of the jacket may be provided with ribs, fins, corrugations or other well understood structural features adapted to absorb heat from the exhaust gases and to transfer it to air within the jacket, it being understood that the exhaust gases are confined within passages so that they do not come into actual contact with the air. The heated air leaves the heat exchanger 2 by way of a pipe 4, shown leading upwardly to the intake of a rotary fan or blower 5, and the outlet of the blower is connected to distribution pipes or conduits 6, 6 extending in opposite directions therefrom to the respective wings A, A of the aeroplane. An additional distribution pipe 7 extends rearwardly in the fuselage B to a curved conduit 8 disposed adjacent the leading edges of the elevators C, C, and a branch pipe 9 extends upwardly adjacent the leading edge of the rudder D of the plane.

The forward sides of the ppes 6, 6 are formed with slits or perforations 6^a disposed adjacent the leading edges of the wings A, A so as to discharge heated air directly against the inner surfaces of the hollow wings. These structures are usually made of sheet metal such as thin steel, Duralumin or aluminum alloy, which will operate to transmit the heat rapidly to the outer surfaces while the air thus released within the hollow wing structures will be more or less distributed over the remaining areas of the wings and will serve to warm them.

Experience shows that the principal formation of ice, and that which most seriously impairs the efficiency of an aeroplane, occurs at the leading edges of the wings, as denoted in dotted outline at I in Figure 4; hence, it is of primary importance to keep these surfaces heated above freezing temperature, and, accordingly, I direct the hottest air against these areas. The forwardly exposed edges of the elevators C also subject to ice formation, and I therefore provide the hot air supply pipe 7 extending from the outlet of the blower 5 to the arcuate distribution pipe 8 which is mounted within the hollow structure of the elevators C and adjacent their forward edges, and which is provided with slits or perforations 8ª disposed at frequent intervals in the length of the pipe 8 for discharging heated air against the inner surfaces of the leading edges of the elevator C. The leading edge of the rudder D also requires protection against ice formation, and for this purpose I provide a branch pipe 9 extending upwardly from the feed pipe 7 and formed with slits or openings 9ª for directing the heated air against the inner surface of this portion of the rudder. The rudder structure, and also that of the elevators C, are usually hollow, or, at least, include intercommunicating spaces through which the air discharged from the ports 8ª and 9ª will flow and distribute some of its heat so as to warm the remaining exposed outer surfaces of the tail structure.

Preferably, the air employed for conveying the heat of the exhaust gases to the wings and tail portions of the aeroplane is not taken directly from the outside atmosphere, since, particularly under conditions at which ice may form on the aeroplane, the temperature of the outer air is relatively low. Therefore, I provide in the hollow spaces of the wings A, elevators C and rudder D, a system of return pipes by which the warm air, after having given up a portion of its heat to the external walls of these parts, can be drawn back to the heat exchanger 2 for reheating. In this way I am able to maintain a relatively high temperature in the air which is thus repeatedly recirculated through the aeroplane, and the heat absorbed by this air from the exhaust gases is not wasted or dissipated. The return pipes include the pipes 10 leading inwardly from the wings A, A, and the return pipe 11 extending from the hollow spaces in the elevators C and provided with a branch 12 which leads from the rudder, as seen in Figure 4. These return pipes may be open at the ends, and may also have additional inlet openings, as noted at 10ª, so as to pick up the air from all the spaces to which it is distributed. The suction of the blower 5, acting through the connecting conduit 4 and through the space within the heat exchanger 2, insures that the air will be drawn into the return conduits and delivered to the heat exchanger, since there is no other source from which the suction applied to the jacket 2 can be satisfied.

In most aeroplane construction the outer walls of the hollow wings and other parts are reasonably air-tight, so that there will be relatively little tendency for the air of the heating system to leak from the spaces in which it is employed, and the system is substantially a closed one in which the same air is recirculated repeatedly and serves merely as a vehicle for transferring heat from the exhaust gases to the portions of the plane which require safeguarding against ice formation.

The fan or blower 5 will be of the rotary type which, if desired, can run continuously, even when the heating system is not needed. Any suitable thermostatic control devices may be employed to regulate the quantity of heated air delivered by the blower, as, for example, by means of a suitable control valve in the passage 4 by which the supply of heated air to the blower may be shut off or reduced in accordance with requirements. These devices and expedients are not shown in detail in the drawing, since they may be of any familiar construction, with the thermally responsive devices located either in the air conduits themselves or in the hollow spaces in the wings so as to control the operation directly in relation to the temperatures maintained in the wings. If preferred, the control of the heating system may be arranged for manual operation by the pilot so that the heating means may be employed or dispensed with, in accordance with his discretion.

I claim as my invention:

1. In an airplane which is powered by an internal combustion engine and includes a hollow wing structure, the combination of heating means for said wing comprising a heat exchanger connected to receive the exhaust gases from the engine and having a separate passage for air by which heat from said gases is absorbed, a conduit of relatively small cross section as compared with said hollow wing, said conduit extending within the wing from the air passage of the heat exchanger and substantially throughout the length thereof and having a plurality of longitudinally distributed outlets discharging closely adjacent the inner surface of the wing at its leading edge, the air being then free to flow through the adjacent space in the wing, and a return conduit of relatively small cross section as compared with said hollow wing, said return conduit extending within the wing and substantially throughout the length thereof into connection with said air passage of the heat exchanger and having a plurality of longitudinally distributed inlets exposed in the rear portion of the space within said hollow wing, providing for the recirculation of the heated air through the heat exchanger and through the wing, together with a fan device included in the circuit of the heat exchanger and said conduits for forcibly circulating the air therethrough.

2. In an airplane which is powered by an internal combustion engine and includes a hollow structure having external surfaces exposed to the outer air, the combination of heating means for said hollow structure comprising a heat exchanger connected to receive the exhaust gases from the engine and having a separate passage for air by which heat from said gases is absorbed, a distributing conduit of relatively small cross section as compared with said hollow structure, said conduit extending within said structure from the air passage of the heat exchanger and substantially throughout the length of the hollow structure and having a plurality of longitudinally distributed outlets discharging closely adjacent an inner surface of the wall of said hollow structure at the portion thereof which is the leading portion with respect to the direction of travel of the airplane, the air being then free to flow through the adjacent space in the hollow structure, and a return conduit of relatively small cross section as compared with said hollow structure, said return conduit extending within said structure and sub-

stantially throughout the length thereof into connection with said air passage of the heat exchanger and having a plurality of longitudinally distributed inlets exposed in a portion of the space substantially opposite that in which the distributing conduit is located within said hollow structure, providing for the recirculation of the heated air through the heat exchanger and through said hollow structure of the airplane, together with a fan device included in the circuit of the heat exchanger and said conduits for forcibly circulating the air therethrough.

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