March 8, 1938. R. J. HORROCKS 2,110,731

DE-ICER FOR AEROPLANES

Filed June 27, 1936

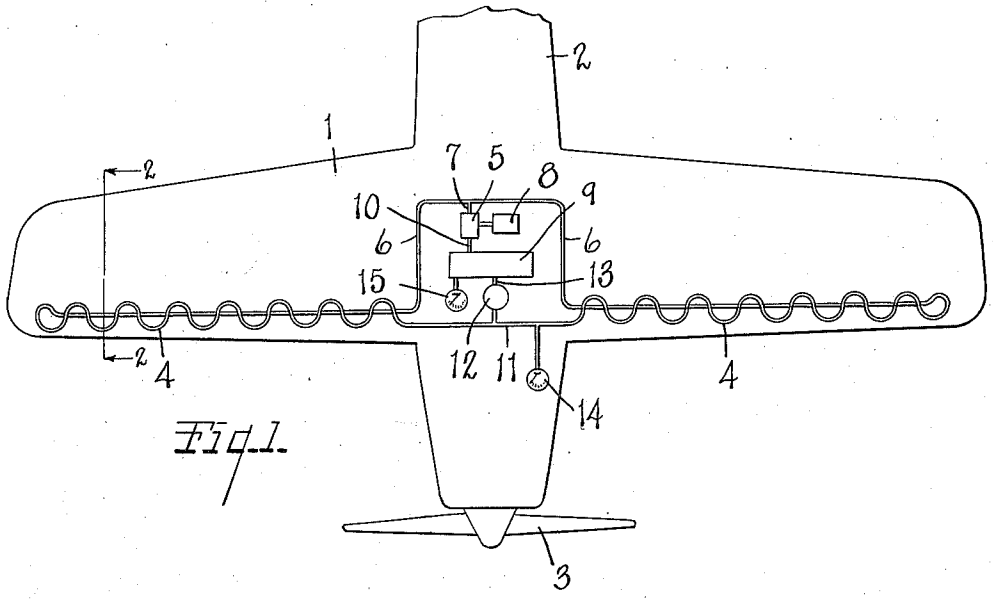


Fig. 1.

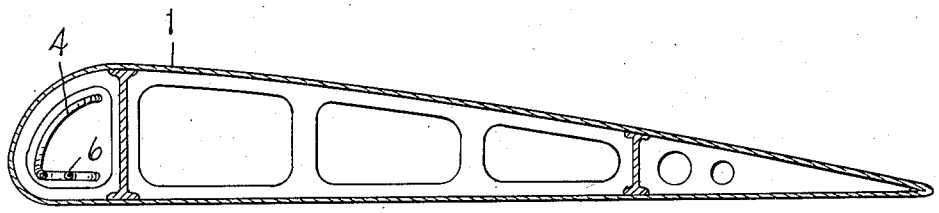


Fig. 2.

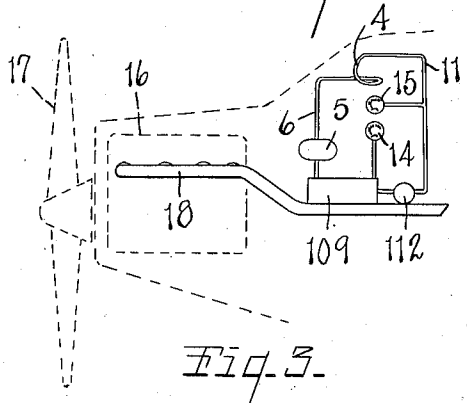


Fig. 3.

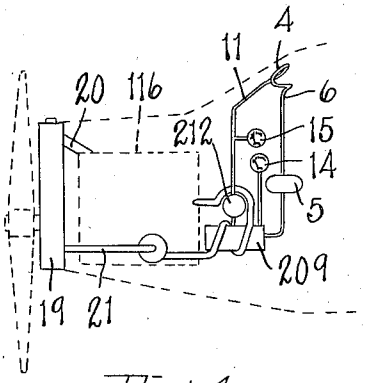


Fig. 4.

INVENTOR.
Roy J. Horrocks
BY
Chappell, Earl & Chappell
ATTORNEYS

Patented Mar. 8, 1938 2,110,731

UNITED STATES PATENT OFFICE

2,110,731

DE-ICER FOR AEROPLANES

Roy J. Horrocks, Ionia, Mich.

Application June 27, 1936, Serial No. 87,630

7 Claims. (Cl. 244—134)

This invention relates to aeroplanes and particularly to devices for the prevention of the formation of ice on the wings or lifting surface of said aeroplanes. Heretofore many devices have been suggested for this purpose, including inflatable or movable skins of rubber over the surfaces on which ice forms and systems of piping through which exhaust gases from an internal combustion engine used to drive the aeroplane pass. None of these devices have proven satisfactory. The objects of this invention are:

First, to produce a new and improved device for preventing the formation of ice on the wings or lifting surfaces of an aeroplane.

Second, to provide such a device which is simple and inexpensive in construction and which may be simply and easily operated.

Third, to provide such a device which may be operated efficiently at temperatures of between 29 and 34 degrees Fahr. which are the temperatures at which ice forms on the wings or lifting surfaces of aeroplanes.

Fourth, to provide such a device which is safe in operation and free from dangers of explosion and ignition while either the plane or the device is in operation.

Fifth, to provide such a device which is light in weight and may be easily installed in any aeroplane without the necessity for complex changes in design of the plane.

Sixth, to provide such a device in which the heat from the internal combustion engine used to drive the plane is employed to assist in removing ice from the wing without creating any back pressure on the motor.

Seventh, to provide such a device in which the exhaust head from the engine may be employed.

Eighth, to provide such a device in which the heat from a water cooling system for an internal combustion engine may be employed.

Other objects and advantages pertaining to details and economies of construction and operation will appear from the description to follow. A preferred form of my invention is illustrated in the accompanying drawing, in which:

Fig. 1 is a top plan view partly in section showing an aeroplane with my device installed.

Fig. 2 is a sectional view taken on line 2—2 of Fig. 1.

Fig. 3 is a schematic view showing an arrangement whereby the exhaust from the internal combustion engine used to drive the plane is employed to assist in the expansion of the compressed gas.

Fig. 4 is a schematic view showing an arrangement whereby the water cooling system used on an internal combustion engine used to drive the plane may be employed to assist in the expansion of the gas in my device.

The aeroplane shown has a wing 1, fuselage 2 and propeller 3, all of which are conventional in design. Within the wing and along the leading edge thereof and adjacent the lifting surface where ice is prone to form and where the formation of ice is most dangerous is a compression coil 4. This coil is made up of copper or aluminum tubing and is arranged as shown in Fig. 2 in close proximity to the inner surface of the wing. A gas compressor 5 is provided and a pipe connection 6 runs from the high pressure side 7 of the gas compressor to the compression coil 4. The compressor is driven, in the embodiment of the invention shown, by an electric motor 8, but it will be appreciated that the compressor may be driven directly from the internal combustion engine which propels the plane or may be driven by a special wind motor if desired. The motor 8 and the compressor 5 are both conveniently located within the fuselage 2 of the aeroplane.

Within the fuselage of the plane, I also provide an expansion chamber 9 which is connected by means of tubing 10 to the low pressure side of the compressor 5. Tubing 11 and an expansion valve 12 which discharges into the chamber 9 through a tube 13 are provided to connect the compression coil 4 with the expansion chamber 9 so that a closed circuit is formed of the various elements above mentioned. Within this closed system, I place a gas similar to the gas used in the ordinary refrigerating system. I prefer to use sulphur dioxide because it is non-inflammable and because it may be satisfactorily compressed at low pressures, eliminating any danger from explosion of the system when in operation in the aeroplane. Using sulphur dioxide gas, which is easily compressible and liquefiable by a small gas compressor requires that the system be subjected to a pressure of about 175 pounds to the square inch. This is accomplished by so proportioning the compressor 5 that it will produce this pressure and setting the expansion valve 12 to discharge at 175 pounds to the square inch pressure. Other gases, such as methyl chloride or ammonia gas, could be employed, although these gases are not as satisfactory as the sulphur dioxide. Any gaseous substance which has a boiling point below 29 degrees Fahr. could be employed and it is essential only to provide a gas which will not freeze at a temperature of between 29 and 34 degrees Fahr. under the condi-

tions which would be impressed on the system by the compressor 5.

In the operation of my device, the compressor 5 compresses the gas in the compression coils 4. This physical change of state gives off heat and the coil 4 heats the leading edge of the wing or the adjacent lifting surface so as to prevent the formation of ice. When a pressure of 175 pounds per square inch is set up in the coil 4, the gas discharges into the expansion chamber 9 through the expansion valve 12. The change in state of the gas in the system tends to absorb heat at the valve and the expansion chamber. The gas then passes to the compressor and the cycle is repeated.

As I have pointed out, the formation of ice on the wings of the aeroplane occurs only between 29 and 34 degrees Fahrenheit so it is not essential to employ a gas in the system which would change from the liquid to the gaseous state under the conditions provided by the compressor at a temperature below 29 degrees Fahrenheit. It is thus possible for the plane to pick up the necessary heat for changing the gas from liquid to gaseous phase from the atmosphere at this pressure using a gas such as I have described.

A pressure gauge 14 mounted on the dash indicates the pressure in the coil 4 and a similar pressure gauge 15 mounted on the dash indicates the pressure in the expansion tank or at the low side of the compressor 5.

In Fig. 3, I show an arrangement whereby the exhaust from the internal combustion engine used to drive the plane may be employed. Heretofore in devices using the exhaust gas, the exhaust pipes have been branched out to pass through the wing. This creates objectionable back pressure and condensation in the pipes. By using my system, it is possible to employ this heat without creating the objectionable back pressure.

In carrying out the invention, I provide an expansion tank 109 connected in a circuit similar to the circuit shown in Figs. 1 and 2, in place of the expansion tank 9. An expansion valve 112 similar to the expansion valve 12 is also employed and in the same circuit. 16 represents the internal combustion engine used for driving the propeller 17. 18 is the exhaust from the internal combustion engine 16 and this exhaust pipe is arranged to pass in heat exchange relationship with the expansion chamber 109 and the expansion valve 112. It is thus possible to utilize the heat from the exhaust gases to assist in the expansion of the gas in expansion valve 112 and in the expansion chamber 109 which may be of particular advantage in a plane having an unheated cockpit or fuselage. With this arrangement excessive back pressure is avoided because the exhaust gases may pass in a straight flight back from the engine.

In Fig. 4, I show a similar arrangement in which the expansion chamber 209 is identical in all material respects with expansion chamber 9 and is connected in the same circuit. The expansion valve 212 is similar to the expansion valve 12 and connected in the same circuit. 116 is the internal combustion engine provided with a water circulating cooling system comprising a radiator 19, connection 20 leading to the engine 116 and a pipe 21 which is coiled in heat exchange relationship with the expansion tank 209 and the expansion valve 212 so that the warm water passing from the engine 116 heats the expansion chamber 209 and the expansion valve 212 to assist in the expansion of the gas therein.

I have shown and described my invention in the embodiments preferred by me and wish to claim the same specifically and broadly as pointed out in the appended claims.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is:

1. Means for preventing the formation of ice on the wing of an aeroplane having an internal combustion engine and an exhaust pipe therefor, comprising in a closed circuit a compression coil disposed within the wing, a gas compressor, means connecting the high pressure side of said compressor to said compression coil, an expansion chamber, means connecting said expansion chamber with said compression coil, means connecting said compression coil to said expansion chamber including an expansion valve discharging into said expansion chamber, a substance in said system, said substance being one normally gaseous at the lowest pressure in said system, and means for driving said compressor to compress said substance, said expansion chamber being disposed in heat exchange relationship with the exhaust pipe of said internal combustion engine.

2. Means for preventing the formation of ice on the wing of an aeroplane having an internal combustion engine and an exhaust pipe therefor, comprising in a closed circuit a compression coil disposed within the wing, a gas compressor, means connecting the high pressure side of said compressor to said compression coil, an expansion chamber, means connecting said expansion chamber with said compression coil, means connecting said compression coil to said expansion chamber including an expansion valve discharging into said expansion chamber, a substance in said system, said substance being one normally gaseous at the lowest pressure in said system, and means for driving said compressor to compress said substance, said expansion chamber and said expansion valve being disposed in heat exchange relationship with the exhaust pipe of said internal combustion engine.

3. Means for preventing the formation of ice on the wing of an aeroplane having an internal combustion engine and a circulating cooling system therefor, comprising in a closed circuit a compression coil disposed within the wing, a gas compressor, means connecting the high pressure side of said compressor to said compression coil, an expansion chamber, means connecting said expansion chamber with the low pressure side of said compressor, means connecting said compression coil to said expansion chamber including an expansion valve discharging into said expansion chamber, a gas in said system, and means for driving said compressor, said expansion chamber and expansion valve being disposed in heat exchanging relationship with said circulating cooling system of said engine.

4. Means for preventing the formation of ice on the wing of an aeroplane having an internal combustion engine and a circulating cooling system therefor, comprising in a closed circuit a compression coil disposed within the wing, a gas compressor, means connecting the high pressure side of said compressor to said compression coil, an expansion chamber, means connecting said expansion chamber with the low pressure side of said compressor, means connecting said compression coil to said expansion valve discharging into said expansion chamber, a gas in said system, and means for driving said compressor, said expan-

sion chamber being disposed in heat exchanging relationship with said circulating cooling system of said engine.

5. Means for preventing the formation of ice on the wing of an aeroplane having an internal combustion engine and an exhaust pipe therefor, comprising in a closed circuit a compression coil disposed within the wing, a gas compressor, means connecting the high pressure side of said compressor to said compression coil, an expansion chamber, means connecting said expansion chamber with said compression coil, means connecting said compression coil to said expansion chamber including an expansion valve discharging into said expansion chamber, a substance in said system, said substance being one normally gaseous at the lowest pressure in said system, and means for driving said compressor to compress said substance, said exhaust pipe being disposed to heat the expanding gas in said system.

6. Means for preventing the formation of ice on the wing of an aeroplane having an internal combustion engine and a circulating cooling system therefor, comprising in a closed circuit a compression coil disposed within the wing, a gas compressor, means connecting the high pressure side of said compressor to said compression coil, an expansion chamber, means connecting said expansion chamber with the low pressure side of said compressor, means connecting said compression coil to said expansion chamber including an expansion valve discharging into said expansion chamber, a gas in said system, and means for driving said compressor, said circulating cooling system being disposed to heat the expanding gas in said system.

7. Means for preventing the formation of ice on the wing of an aeroplane having an internal combustion engine, comprising in a closed circuit a compression coil disposed within the wing, a gas compressor, means connecting the high pressure side of said compressor to said compression coil, an expansion chamber, means connecting said expansion chamber with the low pressure side of said compressor, means connecting said compression coil to said expansion chamber including an expansion valve discharging into said expansion chamber, a gas in said system, means for driving said compressor, and means for conveying heat from said internal combustion engine to said closed circuit to heat the expanding gas therein.

ROY J. HORROCKS.