Jan. 9, 1934. C. W. LEGUILLON 1,942,867

DEICER FOR AEROPLANES

Filed May 17, 1932

Fig-1

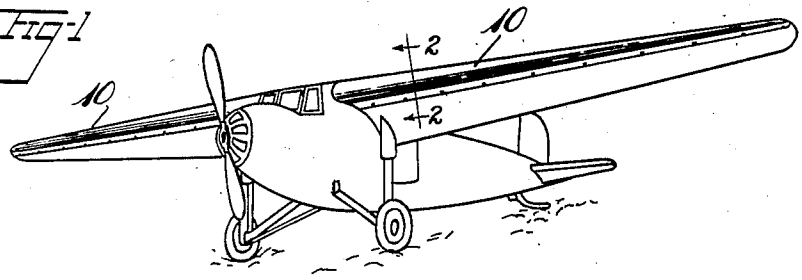


Fig-2

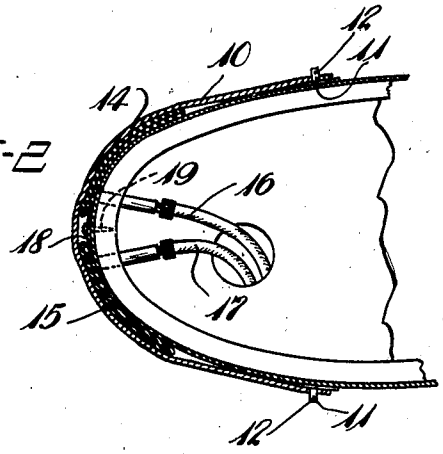
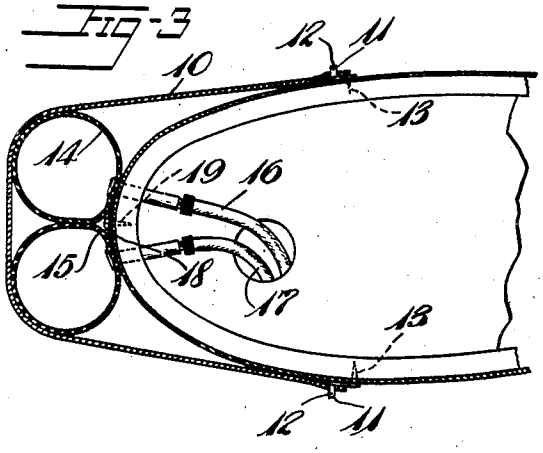


Fig-3



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DEICER FOR AEROPLANES

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3 Claims. (Cl. 244—31)

This invention relates to devices for preventing accumulation of ice upon aeroplanes or the like and its chief objects are effectiveness and economy and simplicity of construction and operation.

Of the accompanying drawing:

Fig. 1 is a perspective view of an aeroplane equipped with an embodiment of my invention in its preferred form.

Fig. 2 is a section on line 2—2 of Fig. 1, with certain air-bags constituting parts of the embodiment in collapsed condition.

Fig. 3 is a section on line 2—2 of Fig. 1 with the air-bags in distended condition.

Referring to the drawing, the device in the preferred form here shown comprises an extensible sheet 10 of material such as vulcanized rubber or rubberized, stretchable fabric extending about the leading edge of the wing or part to be protected and having its margins anchored to the upper and lower faces of the wing respectively as by stud members 11, 11 extending through apertures in the sheet 10, provided with respective cotter pins 12, 12, and secured to the wing by screws 13, 13 (Fig. 3).

Underlying the sheet 10 just above and below the middle horizontal line of the leading edge of the wing, between the sheet 10 and the wing, are respective bags 14, 15 extending lengthwise of the wing and having communication through conduits 16, 17 with fluid-pressure and evacuating means adapted to distend the bags periodically, either in alternation or simultaneously, and to exhaust them to permit them to collapse. For simplicity and economy of construction and effectiveness in operation the bags preferably are not adhered to the sheet 10.

The bags preferably are formed of rubber and reinforced with fabric to prevent them from "ballooning" locally and they preferably are mounted upon and vulcanized to a rubberized fabric base 18 common to them and secured to the wing along its middle line by screws such as the screw 19.

In the operation of the device the distension and collapsing of the tubes 14, 15 causes a stretching and retraction of the sheet 10 and consequent breaking up and dislodgment of ice forming thereon, and by various timing of alternate and simultaneous distension of the bags varying and highly effective stretching of the sheet 10 may be obtained.

Preferably the sheet 10 has mixed therein or applied thereto a substance adapted to exude from the pores of the rubber, especially at low temperature, and form a surface film thereon adapted to lessen the adhesion of ice to the surface of the sheet.

The water-repellent material to be used for impregnating the rubber preferably is a liquid and the liquid to be used for this purpose should be one which has a freezing point below the ice-forming temperatures and which is fluid at these temperatures. It should be of low viscosity at these temperatures and should not be sticky, and hence adhesive toward ice. It should also be material which will be absorbed into the rubber, but which will not swell or weaken the rubber to such an extent that it would have insufficient tensile strength for the use to which it is applied. It is also important that the liquid be of relatively high boiling point in order that it may not evaporate from the surface at the high temperature to which it may be subjected.

It is desirable that the liquid be such that it may be applied to the rubber without substantially deteriorating the rubber surface; that it will reduce the adhesion of the ice to the surface and yet will not evaporate from the surface at ordinary temperatures; that the rubber will have a substantially dry surface at ordinary temperatures; and that it will exude from the rubber at ice-forming temperatures.

A large number of oils are absorbed into vulcanized rubber, but ordinarily with the result that the rubber is thereby caused to swell to a greater or less extent and consequently its tensile strength and other physical properties are more or less weakened. Because of this effect it has been generally considered to be undesirable to use most oils in contact with rubber.

I have found that by mixing with an oil which will be absorbed into the rubber surface and give the desired lubricating or non-adhesive characteristics, a liquid which is insoluble in the rubber and which will prevent swelling thereof, a composition will be produced which will give the desired surface and which will not substantially swell or otherwise deteriorate the rubber.

One of the following liquids of low freezing point and relatively high boiling point may be added to a rubber surface and will substantially decrease the adhesion of ice to the surface.

	Freezing point	Boiling point
	C	C
Tetrahydronaphthalene	−25°	206°
Dekahydronaphthalene	−125°	193.3°
Pine oil	−25°	150–185°
Ethyl benzoate	−34.6°	213.2°
p-cymene	−73.5°	176.5°
Castor oil	−12°	Above 300°
Lubricating oil from petroleum selected for low freezing point.	−15°	Above 250°

The addition of one of these liquids to vulcanized rubber will, however, cause the rubber to swell and will decrease its tensile strength. By adding a liquid such as diethyl phthalate or butyl tartrate to one of the above oils, the swelling of the rubber and the decrease in tensile

strength will be greatly reduced. If the two liquids to be mixed are not miscible with each other, they may be brought into common solution by adding a liquid capable of dissolving both of them. For example, diethyl phthalate and pine oil, which are mutually immiscible, may be brought into solution by adding castor oil, which in itself is insoluble in rubber and therefore further reduces the swelling of the rubber.

As an example of a suitable composition to be applied to a rubber surface, and which will reduce the adhesion of ice to the rubber surface, the following substances may be mixed in the proportions stated:

	Parts by volume
Pine oil	4
Diethyl phthalate	4
Castor oil	1

This particular mixture has the added advantage that its solubility in rubber is reduced at the ice forming temperatures, so that at these temperatures it will exude from and render the surface well lubricated while it will produce a substantially dry surface in the rubber at ordinary temperatures.

When this mixture is applied to a vulcanized rubber of the composition hereinafter described for use in preventing the accumulation of ice upon aircrafts, the oil will exude from the surface at the ice forming temperature and replace any oil which may be removed from the surface by the air forces, by vaporization or by removal with the ice. Additional oil may be applied from time to time as the supply is exhausted. When a neutral oil which does not radically alter the physical properties of the rubber is absorbed in rubber the rubber is actually preserved against oxidation.

Any rubber mixture, capable of satisfactory vulcanization, may be used for producing the rubber surface, the following typical mixture being given as an example of such a composition:

	Parts
Smoked sheet	100
Zinc oxide	10
Sulfur	3
Accelerator	1

When the oil is added to the vulcanized rubber to reduce the adhesion of ice to the surface, the rubber mixture should be one, such as the above, with little or no oil soluble sticky material that would render the surface adhesive to ice. Some other colloidal surface may be used in place of rubber, if the surface is to be one that is devoid of irregularities into which water might penetrate and, upon freezing, anchor itself.

When a vulcanized rubber of the above described composition is soaked in pure pine oil for 24 hours, its average increase in volume will be greater than 50%, and its average decrease in tensile strength will be greater than 75%. However, when a vulcanized rubber of the same composition is soaked for 24 hours in the mixture of oils referred to above, it was found to have an increase in weight of about 19%, an increase in gauge or volume of about 7½% and an average decrease in tensile strength of about 12½%. It is apparent, therefore, that although an appreciable weight of oil had been absorbed into the rubber, the volume had been only relatively slightly increased and the tensile strength had been but moderately affected.

Although I have described a particular mixture of liquids, it is not intended to thereby limit the invention to the specific liquids or proportions mentioned. Other vegetable, mineral or synthetic oils may be used to give the desired lubricating or reduced adhesion characteristics. Other liquids than those described may also be added to such oils to reduce the swelling of the rubber and the resultant decrease in tensile strength and deterioration of other physical properties. Such liquids may be alcohols, ketones and other esters which possess the property of mixing with nitrocellulose or, as hereinbefore indicated, castor oil. The boiling point and freezing point may be unimportant in the particular use to which the liquids may be applied, in which event a wide range of selection may be had. Furthermore the particular oil added for this purpose may not come within the range of temperatures desired, although the resultant mixture may be within that range.

Modifications are possible within the scope of the invention as defined by the appended claims.

I claim:

1. In combination with a member exposed to ice-forming conditions, a stretchable sheet and a flexible bag so associated therewith as to stretch the sheet to a greater extent than the wall of the bag is stretched when the bag is distended from a flattened to a more rounded form, and means for modifying the pressure of fluid within the bag.

2. In combination with an aerofoil, a stretchable sheet of material extending about the leading edge of the aerofoil, and secured thereto at positions rearward of the leading edge, a flexible bag mounted between the aerofoil and the said stretchable sheet, and means for modifying the pressure of fluid within the bag for changing its shape, the sheet having unattached zones and the construction and association of the sheet and the bag being such that the sheet is stretched to a greater extent than the wall of the bag when the bag is changed from a flattened to a more rounded form.

3. A combination as defined in claim 2 including a plurality of the bags for non-symmetrical, alternating distortion of the sheet and defining more than two freely stretchable zones of the sheet.

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