

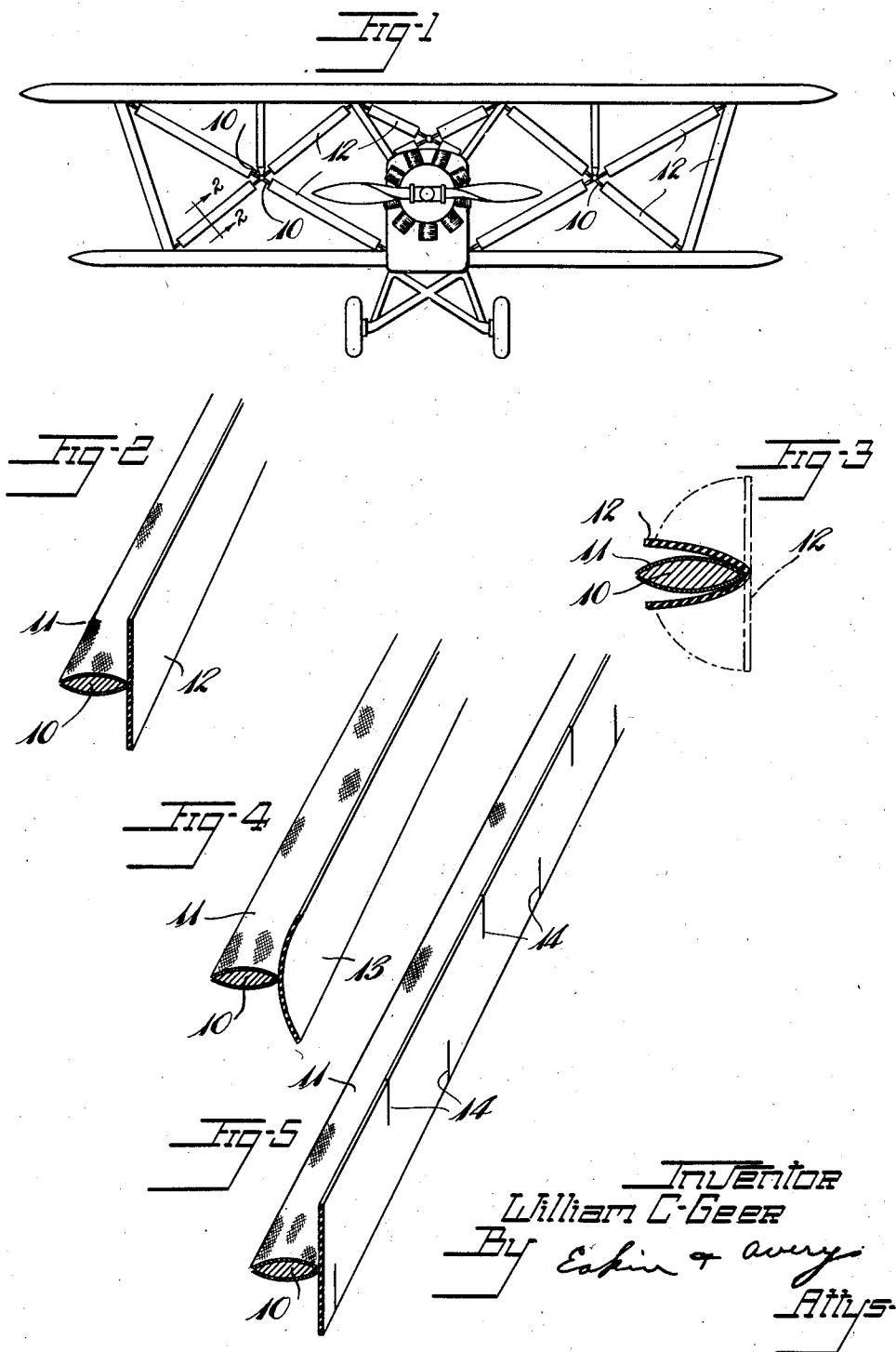
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DEICER FOR AEROPLANES AND THE LIKE

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UNITED STATES PATENT OFFICE

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DE-ICER FOR AEROPLANES AND THE LIKE

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This invention relates to devices for preventing accumulation of ice upon parts of aeroplanes or the like, especially parts of small cross-section such as struts and wires, and its chief objects are lightness, simplicity and economy of construction, and automatic operation.

Of the accompanying drawing:

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

Fig. 2 is a perspective sectional view of one of the elements of the embodiment, in an unstrained condition.

Fig. 3 is a cross-section of the same in operation, the unstrained position of a part of the structure being shown in broken lines.

Fig. 4 is a perspective sectional view of one of the elements of a modification, in an unstrained condition.

Fig. 5 is a similar view of an element of another modification.

Referring to the drawing, stream-line brace wires of an aeroplane are shown at 10, 10. Embracing each wire is a rubberized fabric sheath 11 serving as an anchorage for a transverse flexible or vibrator sheet of deformable material such as vulcanized rubber composition, which along its middle line is vulcanized or otherwise secured to the sheath 11, on the forward side of the latter, and adapted to vary its shape under the force of the air-stream when the aeroplane is in flight, to break up the ice and dislodge it from its surface, and also to shield the sheath behind it from the formation of ice thereon.

The flexible sheet, in unstrained condition, may be of the plane form shown at 12 in Fig. 2, of the forwardly concave form shown at 13 in Fig. 4, or may be of plane or other form and slotted inward from each side at intervals as shown at 14, 14 in Fig. 5.

In flight the transverse sheet is flexed by the air-stream as shown in Fig. 3, its flexure varying as the air speed of the aeroplane varies, so that ice forming upon its surface is broken up and dislodged, and a fluttering or periodic vibration of the sheet also may be produced with very effective dislodgement of the ice as the result.

The rubber sheet preferably has mixed therein or applied thereto a substance adapted to lessen its adhesion to the ice.

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
	Degrees C.	Degrees 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.

Various modifications are possible within the scope of the invention as defined in the appended claims.

I claim:

1. In combination with a member exposed to ice-forming conditions in an air-stream, a transversely disposed sheet of deformable ma-

terial secured along its middle line only to the said member.

2. In combination with a member exposed to ice-forming conditions in an air-stream, a sheath embracing the member and a transversely disposed strip of deformable material anchored along a longitudinal zone thereof to the sheath in position to be agitated by the air-stream.

3. In combination with a member exposed to ice-forming conditions in an air-stream, a strip of vulcanized rubber composition extending along the said member and having a portion freely projecting laterally from said member when in an unstrained condition and thus so disposed as to be agitated by the air-stream.

4. In combination with a member exposed to ice-forming conditions in an air-stream, a sheath embracing the member and a transversely disposed strip of deformable material anchored along a longitudinal zone thereof to the sheath in position to be agitated by the air-stream and a surface film of adhesion-preventing material on said strip.

5. In combination with a brace-wire of an aeroplane a strip of deformable material extending along the wire and having a portion freely projecting laterally from the wire when in an unstrained condition and thus adapted to be deformed to dislodge ice therefrom.

6. In combination with a brace-wire of an aeroplane a strip of deformable material extending along the wire and having a portion freely projecting laterally from the wire when in an unstrained condition and thus adapted to be deformed by the air-stream to dislodge ice therefrom.

7. In combination with a brace-wire of an aeroplane a strip of deformable material extending along the wire and adapted to be deformed by the air-stream to dislodge ice therefrom, the said strip being concave on its forward side when in an unstrained condition.

8. In combination with a brace-wire of an aeroplane a strip of deformable material extending along the wire and adapted to be deformed by the air-stream to dislodge ice therefrom, the said strip being slit inwardly from its margins at intervals.

In witness whereof I have hereunto set my hand this 9th day of May, 1932.

WILLIAM C. GEER.