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HEATING SURFACE

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Fig. 1

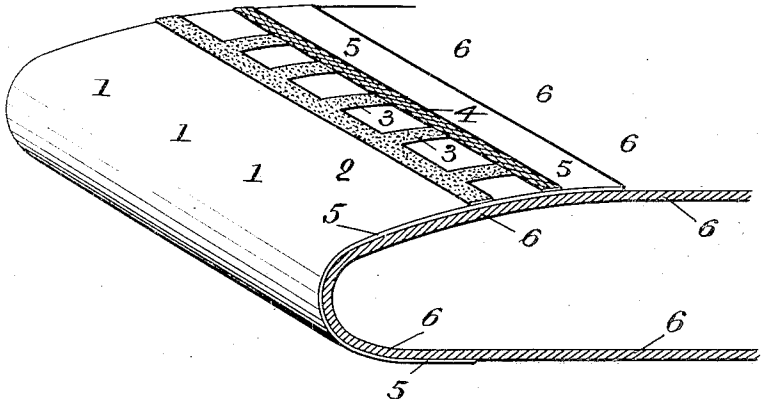


Fig. 2

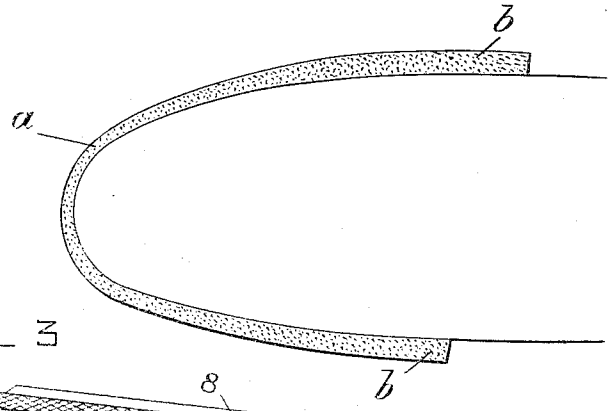
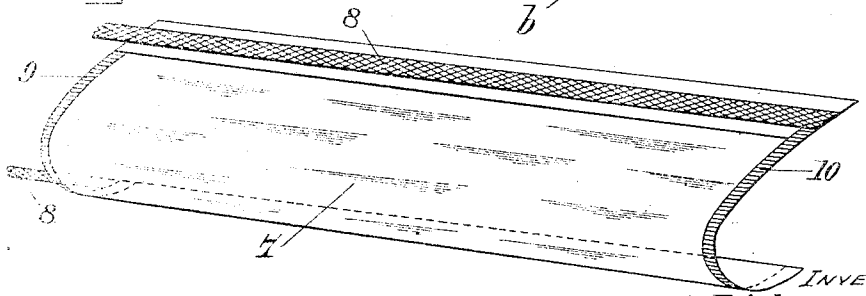


Fig. 3



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HEATING SURFACE

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4 Claims. (Cl. 244—134)

The present invention has for an object the construction of defrosting surfaces for aeroplanes in which a continuous heating layer is disposed at the exterior surface of the part to be defrosted by applying at such exterior surface a continuous resistant layer capable of creating uniform spread out heat such as a resistant metallic sheet.

The application of a current to such metallic sheets may be made by means of metallic strips which may be obtained for example by any metallic process.

Preferably the resistant layers may be supported on an insulating support layer such as asbestos and in such case the metallic strips for leading the current may serve at the same time for fixing the heating layer upon such support.

The heating layer may be divided into various portions connected separately in such manner as to be independently fed with electricity.

By way of example, and to facilitate comprehension of the present description, special forms of application of the invention will now be described with reference to the accompanying drawing.

Figure 1 is a diagrammatic perspective view of a leading edge of a wing.

Figure 2 is a sectional view showing the variations in thickness of the conducting layer.

Figure 3 is a perspective view of a modification.

In the case of aeroplanes, the places where deicing seems to be most needed are the leading edge of the wings, ailerons spars and propellers, and the controls. The process may also be applied to other parts, especially the trailing edge of the wings, ailerons, and spars; and to the upper part of the wings.

The invention can be applied to the leading edges of aeroplane wings in the following manner.

If the wing is covered with fabric—the latter being preferably coated with an insulating paint or varnish—said fabric is, itself, sufficient to assure adequate electrical insulation.

In the case of a metal wing, the surface should then be made as even as possible, in order, particularly, to prevent projecting parts—such as the heads of the rivets serving for the assembling of the plates—from adversely affecting the de-icing unit. This result can be obtained by cementing strips of stout paper, or fabric, over the rows of rivets.

The parts to be de-iced may be thermally insulated from the metal mass of the wing, by means of an insulating covering of cork, felt, rubber, asbestos, fabric, paper cardboard, fibre, etc. They may be electrically insulated by means of the aforesaid non-conductors, or by being covered with an electrical insulating material such as varnish, paint, paper, asbestos fabric, etc.

Asbestos paper is preferred, as possessing both thermal and electrical properties.

The electric contacts with the heating layer are formed of metallised strips produced, for example, by spraying the asbestos paper, or the like, with a metal which is a good conductor, such as copper. To ensure perfect contact between said metallised strips and the heating layer, it is advisable, in the first place, to provide a metallised strip of asbestos paper on the zone bordering the heating layer, and then apply the carbon layer so as to cover—at least partially—the said metallised strip, and finally to apply a second metallised strip, covering the same surface as the first. In this way, the edge of the heating layer is located between two metallised layers, one below and the other above.

Fig. 1 shows how the metallised strips may be arranged.

The longitudinal strips 2, bordering the heating layer 1, are supplied with current by a series of connecting strips 3, which are also metallised and branch from a metallic current lead 4 which is also mounted on the asbestos paper (or fabric) covering the wing.

The current leads 4 are preferably constructed of thin flexible braided metal strips (aluminium, copper, tinned copper, etc.) laid parallel with the metallised contact strips.

An excellent method of mounting said braided strips on the asbestos paper consists in placing screening pieces on either side of the strip, and then spraying the strip with metallic particles, which penetrate the interstices of the strip and adhere to the asbestos on the one hand, and to the strip on the other, and thus fix the two firmly together.

At the same time, suitable stencils enable metallised connecting strips to be formed which ensure uniform distribution of current to the metallised contact strips.

This arrangement enables an excellent distribution of the current to be attained, without the wing being pierced at any point of its surface.

The heating layer will preferably extend further over the upper surface of the wing than over the under surface of the latter.

The heating layer will preferably be constituted by a metallic layer produced by spraying, spreading or otherwise, a colloidal coating consisting of a resistance metal (preferably unox-

idisable) suspended in a liquid solution. For this purpose, resistance alloys, such as constantin, nickel silver, nickel-chromium, copper-manganese, bismuth, etc. in a colloidal state, may be employed.

Finally, the unit composed of the heating layer and the strips supplying the current is advantageously protected by a coating of varnish providing an exterior electrical insulation. This may be black or of a brown shade, to facilitate the dissipation of heat.

The device de-icing the wing may be subdivided into two or more sectional units, adapted to be supplied with current in series, or parallel, or in combined series and parallel arrangement, to enable their de-icing function to be varied.

According to another embodiment of the present invention (see Figure 3) a very fine mesh wire cloth will be used as a resistance conducting layer, for instance a wire cloth of 100 to 250 mesh per square centimeter. The said wire cloth affords the advantage of securing a very uniform heat distribution and of having a very high mechanical resistance.

In the particular case of the leading edge of an aircraft wing, the part of the wing concerned with or a removable surface of corresponding form will first of all be covered by sizing a lagging material which should also be a good electric insulating material, such as cork in the form of a layer of 2 to 3 m/m. in thickness.

Upon said cork is subsequently sized a thin and white asbestos paper which simultaneously constitutes a screen and a thermal insulation as well as an electric insulting material.

If the leading edge is of uniform profile over all its length between the cabin and the tip of the wing, as shown in Figure 3 a wire cloth 7 having a width corresponding to the iced surface is cemented (to this end a caseine base cement is advantageously applied).

The current supply to the wire cloth will for instance be secured by welding flat conductors or braided strips of highly conducting metals at the longitudinal ends of said wire cloth. The circulation of current in the wire cloth will consequently proceed lengthwise with respect to the wing; a current lead 9 being provided near the cabin, the other lead 10 at the end of the wing. In order to avoid the wing being pierced the conductors 8 which provide the distribution of current to the wing tips will be preferably secured parallel with the wire cloth strip, as is shown in Figure 3. The said conductor will be sized onto the asbesto paper or onto the cork.

It may be formed by an aluminium or tinned copper strip or a braided strip of tinned copper having a thickness of: 5:10 to 1 m/m. and a width of 2 to 10 centimeters for instance.

The unit thus constituted may be covered with a usual protecting varnish.

When the profile of the wing is not regular, i. e. when its section is decreasing from the cabin up to its tip, the width of the surface to be de-iced not being regular, in order to make up for the decrease in width of the wire cloth and the resulting increase in heating, it is advantageous to vary progressively the thickness, the character or the grade of the wire cloth. To this end different sorts of wire cloth will be welded endwise, the most resistant being laid towards the cabin.

The character and the size of the wire-cloth used vary according to the surfaces to be de-iced; in many cases, nickel, Monel metal, nickel silver and nickel chromium are perfectly convenient; their specific resistances being comprised between 10 and 120 microhms per cm./cm^2.

According to another embodiment the resistance conducting layer will be obtained by means of a very thin metal sheet, of one of the above mentioned metals.

According to another embodiment, the resistance conducting layer will be constituted by a continuous metal layer forming a thin fil n obtained by projection by means of a pistol which sprays the particles of some metals being molten. The collection of said particles over the surface to be de-iced forms an electric current conducting metal film. For instance aluminium may be used, since its conductivity is considerably decreased by the strong oxidation of its particles during its projection.

The said thin metal film may also be obtained by a galvanoplastic process. For forming the film also metals such as nickel-chromium, constantin, tin and the like may be used.

In the case of a heating layer formed of metal of relatively high conductivity, the in-and-out current leads will be preferably arranged so that the current, passes lengthwise through the resistance layer.

The electro-thermic de-icing device forming, the object of the present invention ensures the melting of the superficial contacting layer of rime, and thus producing a liquid film which almost completely prevents the adhesion of the rime. The thrusts exerted by the air then dislodge the rime covering the wing. The rime covering the device forms an excellent heat insulation against the cooling action of the air. Given an adequate electrical combination, the subdivision of the heating units enables to utilise the whole as a de-icing device, with a greatly reduced consumption of current.

According to another embodiment of the invention, the above-described device, when mounted on rigid supports (of metal, light-metal alloys, moulded materials, etc.) shaped to conform with the surface to be de-iced, may take the form of independent, portable standard panels, adapted to be mechanically attached to the part to be protected.

Having now particularly described and ascertained the nature of our invention and in what manner the same is to be performed, we declare that what we claim is:

1. A heating and defrosting surface for airplanes comprising an insulating supporting layer applied upon the surface of the airplane to be heated and defrosted, an electric conducting resistant layer in direct contact with the atmosphere positioned upon said supporting layer and means for leading and passing an electric current through said resistant layer.

2. A heating and defrosting surface for airplanes comprising an insulating supporting layer applied upon the surface of the airplane to be heated and defrosted, a sprayed metallic resistant layer in direct contact with the atmosphere positioned upon said supporting layer and means for leading and passing an electric current through said resistant layer.

3. A heating and defrosting surface for airplanes comprising an insulating supporting layer applied upon the surface of the airplane to be heated and defrosted, a carbon resistant layer in direct contact with the atmosphere positioned upon said supporting layer and means for lead-

ing and passing an electric current through said resistant layer.

4. A heating and defrosting surface for airplanes comprising an insulating supporting layer applied upon the surface of the airplane to be heated and defrosted, a thin wire cloth resistant layer in direct contact with the atmosphere positioned upon said supporting layer and means for leading and passing an electric current through said resistant layer.

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