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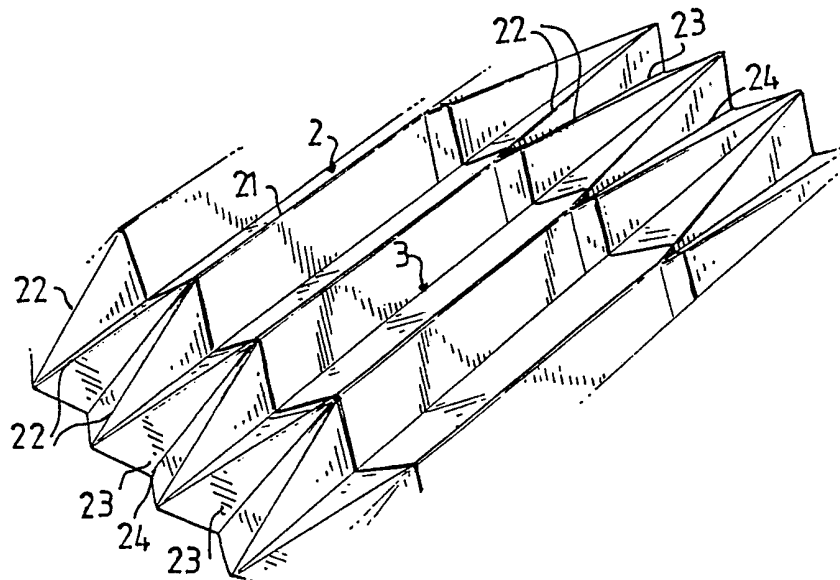
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(54) Aerodynamic covering

(57) A covering having particular application as a skin for the wings of aircraft, including gliders, microlights and ornithopters, and other parts of those and other crafts e.g. sailboards, conventionally using an aerofoil-like section or requiring an increase in surface area.

The covering comprises a plurality of alternating ridges 2 and channels 3 running substantially parallel to the direction of thrust, and having a leading edge adapted to entrain air upwardly to the crowns of the ridges. The crown of each ridge bifurcates (22) fore and aft and each bifurcation slopes to meet the bottom of an adjacent channel to form an awning and a trailing skirt. The region 23 between such bifurcations are identified by a part-channel 24 formed by a reverse fold aligned with the crown of the ridge. The covering is flexible and folds away concertina-fashion to assist in transportation.

FIG 2



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FIG 1

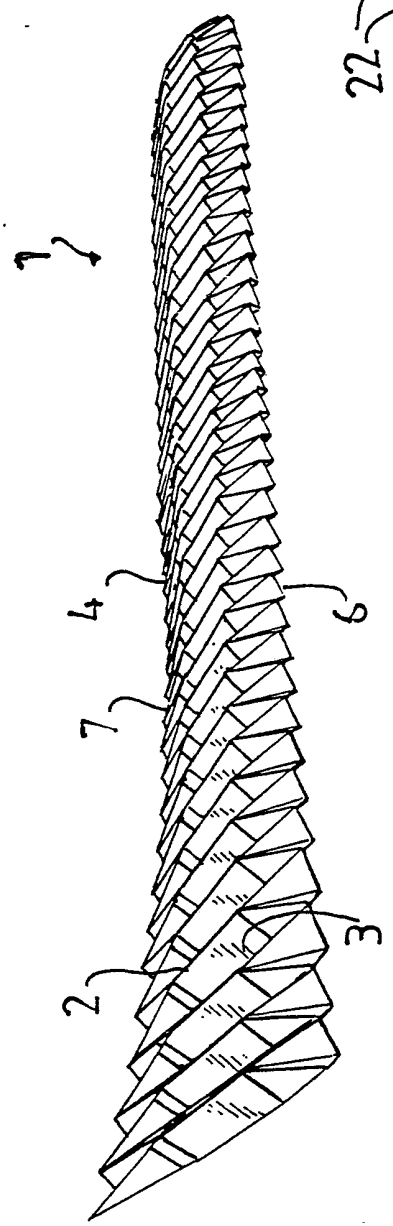


FIG 2

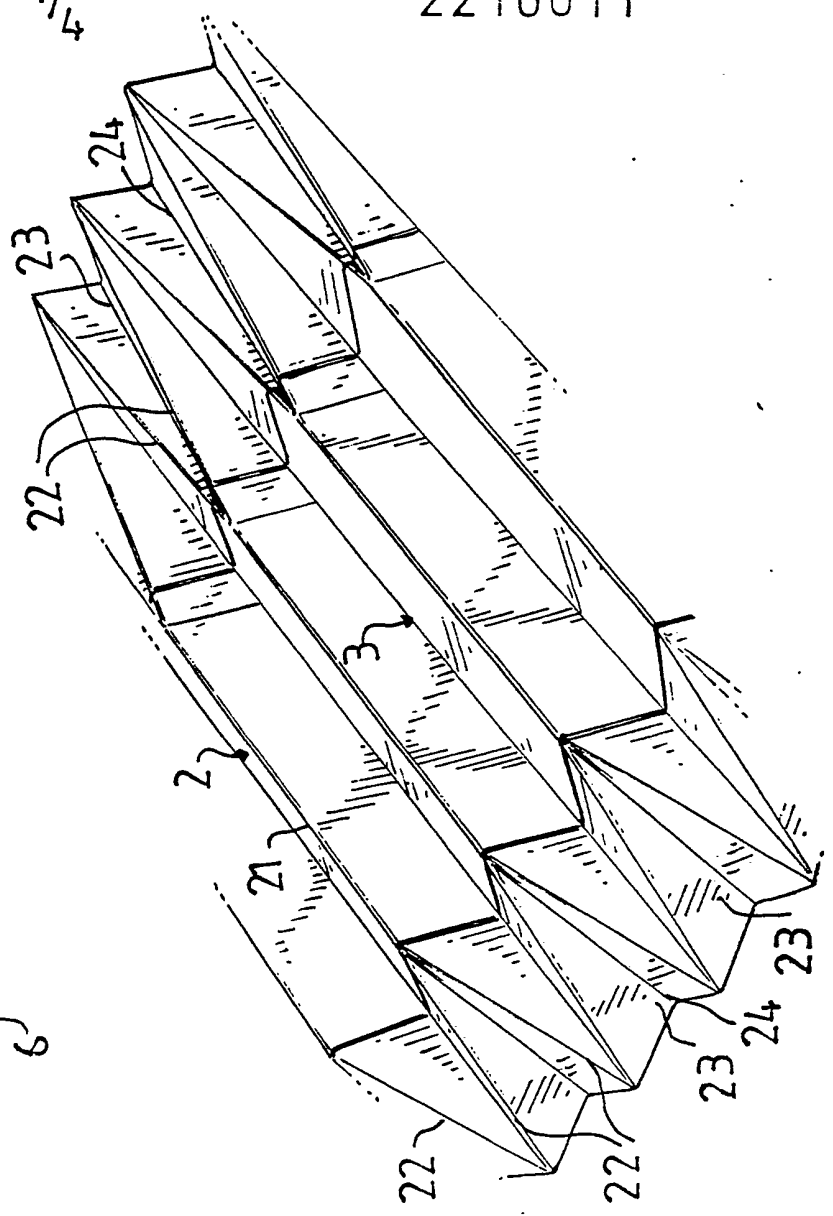


FIG 3

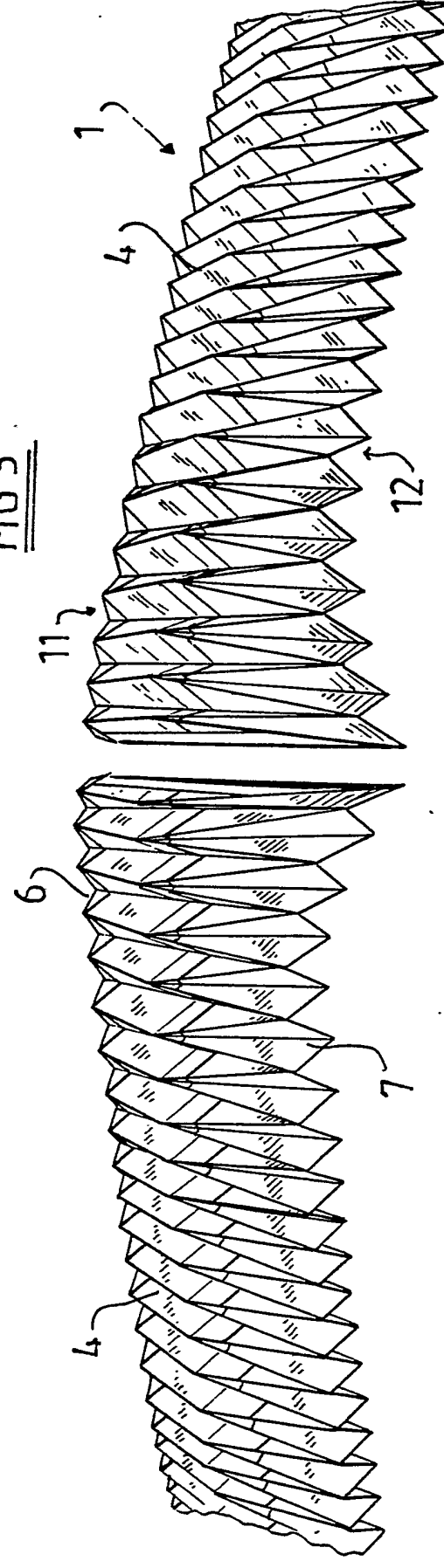
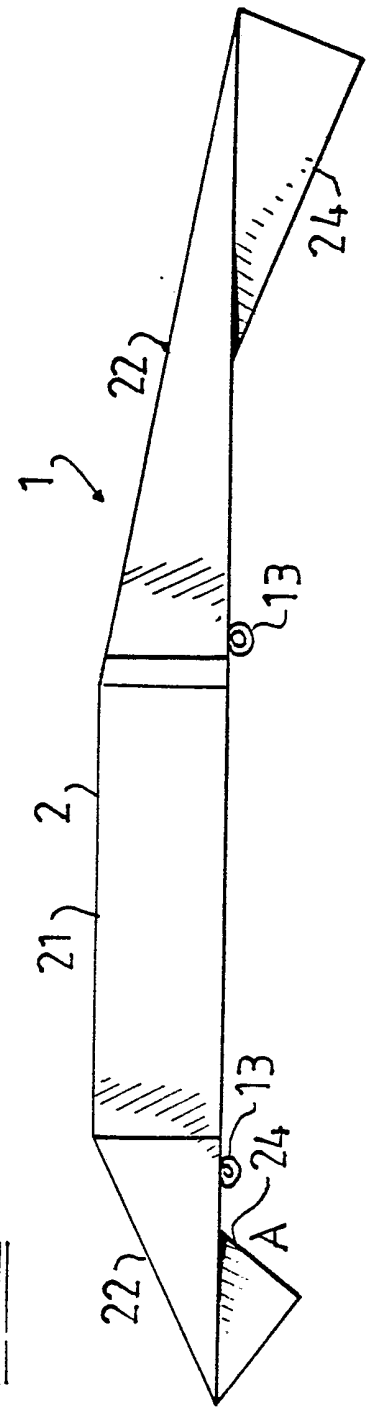


FIG 4



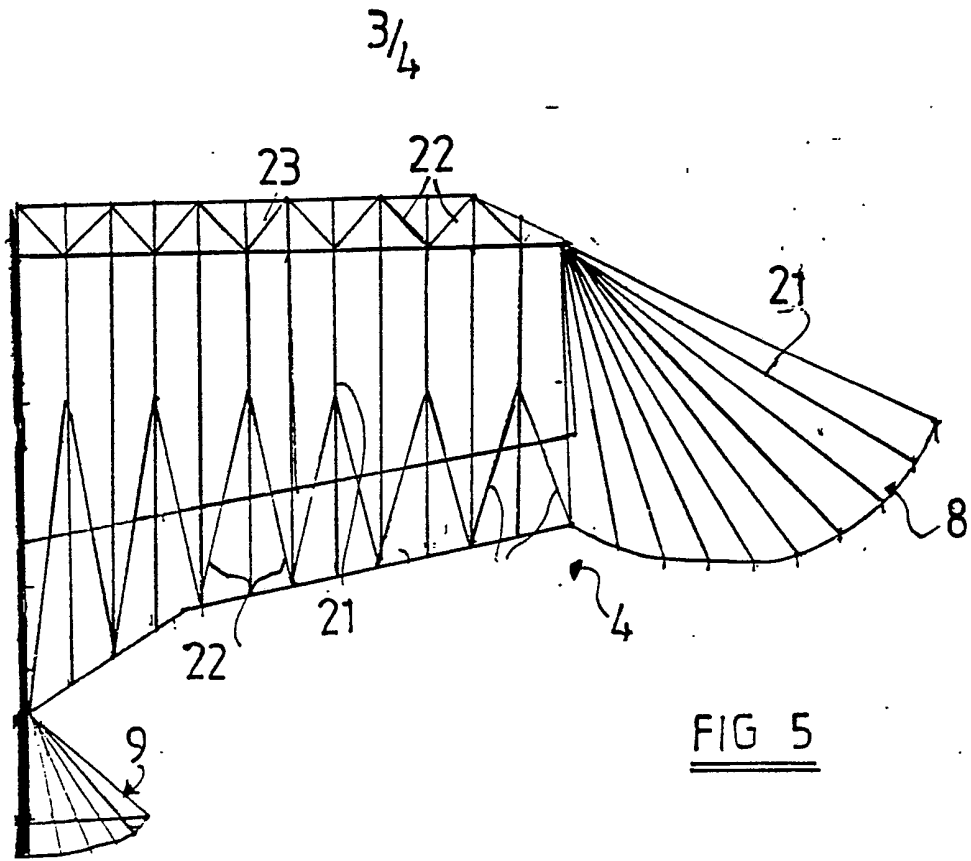


FIG 5

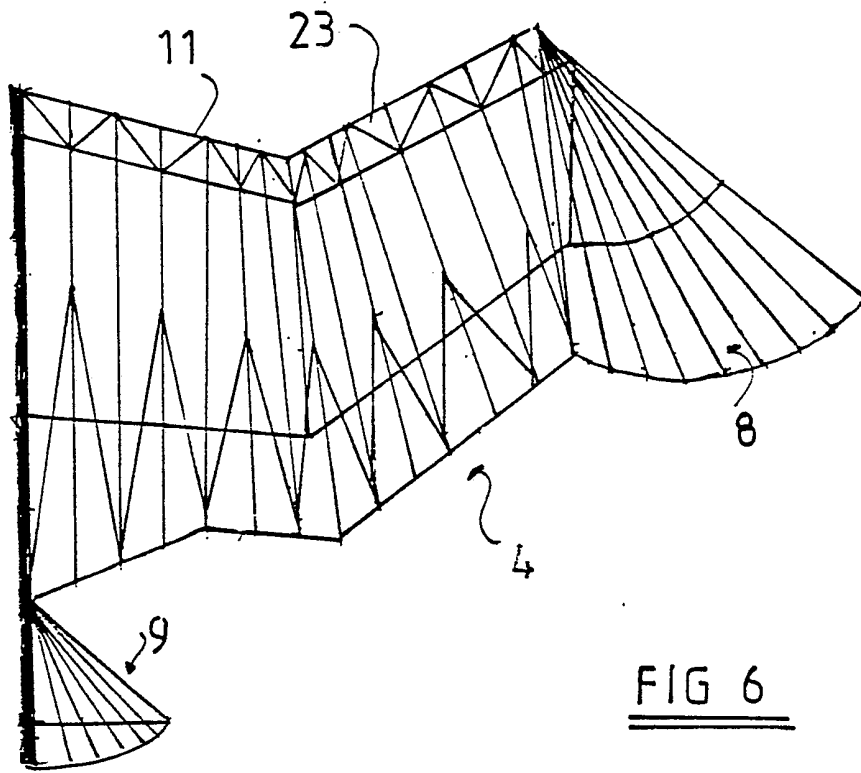


FIG 6

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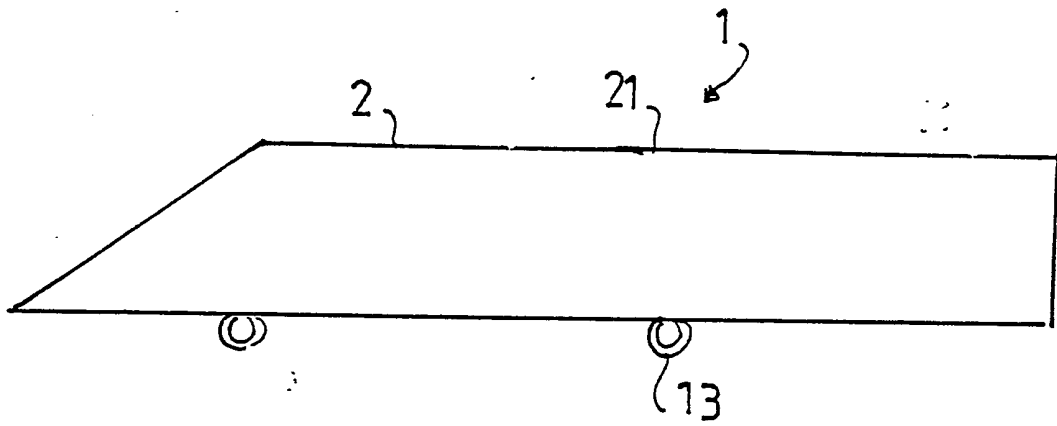


FIG 7

Aerodynamic Covering

This invention relates to an aerodynamic covering.

More specifically, this invention relates to a covering that has particular application as a skin for the wings of aircraft, including gliders, microlights and ornithopters, and other parts of those and other crafts conventionally using an aerofoil-like section or requiring an increase in surface area so as to travel more efficiently, such as rudders and tail elevators of racing cars, the sails of surfing boards, and even kites. As an aircraft wing is a particularly well-known use of the aerofoil-like section, the term wing shall hereinafter be used on the understanding that the application of the covering relates not only to limbs such as wings but to all parts such as aforementioned having similar requirements.

According to the present invention there is provided an aerodynamic covering, the covering comprising a plurality of alternating ridges and channels running substantially parallel to the direction of thrust, and having a leading edge adapted to entrain air upwardly to the crowns of the ridges.

Preferably, the crown of each ridge bifurcates fore and aft and each bifurcation slopes to meet the bottom of an adjacent channel to form an awning and a trailing skirt.

Preferably, the region between such bifurcations is indented by a part-channel formed by a reverse fold aligned with the crown of the ridge.

Preferably, when attached to a wing the ridges and channels run substantially orthogonally to the length of the wing.

Preferably, the covering is attached by tags to the leading edge and the trailing edge of the wing, the covering extending beyond the points of attachment, in front of the wing as the awning and behind the wing as the trailing skirt.

Preferably, on a wing the covering covers the proximal region of the wing and is accompanied by a distal covering of alternating channels and ridges which diverge fan-like from an area of the leading edge, the covering being attached at the leading edge and trailing edge, projecting to the front to meet at the point of ridge convergence and projecting backwards as a trailing skirt.

Preferably, the covering is flexible and folds away concertina-fashion to assist in transportation.

Preferably, the covering is made of a waterproof material, such as plastics or stiffened wax paper.

An embodiment of the present invention will now be described, by way of example, with reference to the accompanying drawings, in which:

Fig. 1 is a perspective view from the front of an aerodynamic covering according to the present invention, attached to aircraft wing;
Fig. 2 is an enlarged fragmentary perspective view of the corrugations of the covering of Fig. 1;
Fig. 3 is a rear fragmentary perspective view of the covering of Fig. 1 attached to both wings of an aircraft;
Fig. 4 is an enlarged section through the corrugations of the covering of Fig. 1;
Fig. 5 is a plan view of the covering of Fig. 1 on the wing of an aircraft;
Fig. 6 is a plan view of the covering of Fig. 1 on the wing of an ornithopter, in a flexed attitude; and,
Fig. 7 is an enlarged sectional view of the corrugated covering of the wing tip which covering is associated with the covering according to the present invention.

Referring to the drawings, there is shown an aerodynamic covering 1, which covering 1 is of use on the wings of aircraft such as hand gliders, microlights and ornithopters, and on parts of other craft, such as the tail elevators of racing cars, having an aerofoil-like section or requiring aerodynamic properties.

The covering 1 comprises a corrugated skin 5 having a plurality of alternating ridges 2 and channels 3, which are aligned substantially parallel to the direction of thrust and which run substantially orthogonally to the length of a wing 4 when in position on such a limb.

The leading edge 11 of the covering 1 is adapted to entrain the air upwardly to the crowns 21 of the ridges 2. The crown 21 of each ridge 2 bifurcates fore and aft and each bifurcation 22 slopes to meet the bottom of the adjacent

channel 3. The regions 23 between the two fore bifurcation 22 and the two aft bifurcations 22 are formed into part-channels by a reverse fold 24 aligned with the crown 21 of the ridge 2.

These indented regions 23 fore and aft form an awning 6 to the leading edge 11 of the covering 1 and a trailing skirt 7 to the rear.

The covering 1 is flexible and when not in use can be folded away concertina-fashion for storage. The flexible corrugations are also of use with the wing of an ornithopter as it does not restrict wing articulation (see Fig. 6). The pattern of folding is, however, particularly crucial for the covering's 1 aerodynamic properties as it triples the surface area of each wing 4 to which it is attached, and creates additional lift when in flight. The pattern of folding is such that there is an aerofoil-like section to each wing 4, at least along the crown 21 of each ridge 2.

The awning 4 entrains the air to go over the crown 21 each ridge 2. The air stream passing over the upper surface of the skin is channelled by the corrugations and remains so to the point of mixing with the airstream passing beneath the skin 5. The air within the channels 3 themselves can be subject to vorticity, decreasing air pressure on the upper surface and increasing lift therefore. The dead area A behind the awning 6 is such that another area of low pressure builds-up creating further lift by increasing the angle of incidence. The lift can be improved if the angle of incidence can be increased without separation, which is accompanied by a serious loss of lift and increase in drag occurring, which in turn leads to stalling. The trailing skirt 7 of the covering 1 increases lift by its increased angle of incidence and modifying the pressure distribution over the

upper surface so reducing the adverse pressure gradient that causes separation.

The covering 1 shown in the Figures has a larger and more gently angle skirt 7 than awning 6. In certain flight conditions, the covering 1 is more efficient if reversed, the skirt 7 facing into the air flow, the then acute angle B separating the air stream, but not being so sharp as to cause turbulence if the wing 4 is not correctly orientated into the air stream. The awning 6 in this position trails 5 behind acting as a flap which increases the curvature along sections of the wing 4 with the result that lift is improved and the angle of attack at which separation occurs is increased so that the air speed can be increased without stalling.

Although the flexibility of the covering 1 makes it particularly applicable to articulated wings and limbs, the covering 1 may be readily attached to a number of different craft. In most instances, the covering 2 is attached to a frame by locking tags 13 on its leading edge 11 and in trailing edge 12.

The scale of the covering 1 (ie length to width ratio) may alter with application to different craft but the basic form of the corrugations will be retained, with some specialisations for wing tips 8 and the like. As an example, the particular pattern of folding shown in Figs 5 and 6 will be described more fully.

Referring particularly now to Figs 5 to 7. The covering 1 on the proximal portions of the wings is folded into corrugations running substantially parallel to the backbone 3 of the craft 10 with each ridge 2 having a pointed crown 21. The crown 21 of each ridge 2 bifurcates at leading and

trailing edge 11, 12 and each bifurcation 22 slopes to meet the bottom of an adjacent channel 3; the regions 23 between the bifurcations 22 are formed into part-channel by reverse folds 24 aligned with the crown 21 of the ridge 2.

The covering 1 of the wing tip 8 and tail 9 of the craft 10 is fan-shaped, the corrugations being gathered to one attachment point and of a length to extend behind each wing tip 8 or tail 9 (see Fig. 7) but without the downwardly directed trailing skirt 7 of the aforescribed covering 1.

Modifications and improvements may be incorporated without departing from the scope of the invention.

CLAIMS

1. An aerodynamic covering, the covering comprising a plurality of alternating ridges and channels running substantially parallel to the direction of thrust, and having a leading edge adapted to entrain air upwardly to the crowns of the ridges.
2. A covering according to Claim 1, wherein the crown of each ridge bifurcates fore and aft and each bifurcation slopes to meet the bottom of an adjacent channel to form an awning and a trailing skirt.
3. A covering according to Claim 2, wherein the region between the bifurcations is indented by a part-channel formed by a reverse fold aligned with the crown of the ridge.
4. A covering according to any one the preceding Claims wherein when the covering is attached to a wing the ridges and channels run substantially orthogonally to the length of the wing.
5. A covering according to Claim 4, wherein the covering is attached by tags to the leading edge and the trailing edge of the wing, the covering extending beyond the points of attachment, in front of the wing as the awning and behind the wing as the trailing skirt.
6. A covering according to Claim 4 or 5, wherein the covering covers the proximal region of the wing and is accompanied by a distal covering of alternating channels and ridges which diverge fan-like from an area of the leading edge, the covering being attached at the

leading edge and trailing edge, projecting to the front to meet at the point of ridge convergence and projecting backwards as a trailing skirt.

7. A covering according to any one of the preceding Claims, wherein the covering is flexible and folds concertina-fashion.
8. A covering according to any one of the preceding Claims comprising a waterproof material.
9. An aerodynamic covering substantially as hereinbefore described with reference to the accompanying Figures.