Dec. 29, 1942. C. T. SEARS 2,306,759

APPARATUS FOR IMPROVING WING SLOT OPERATION

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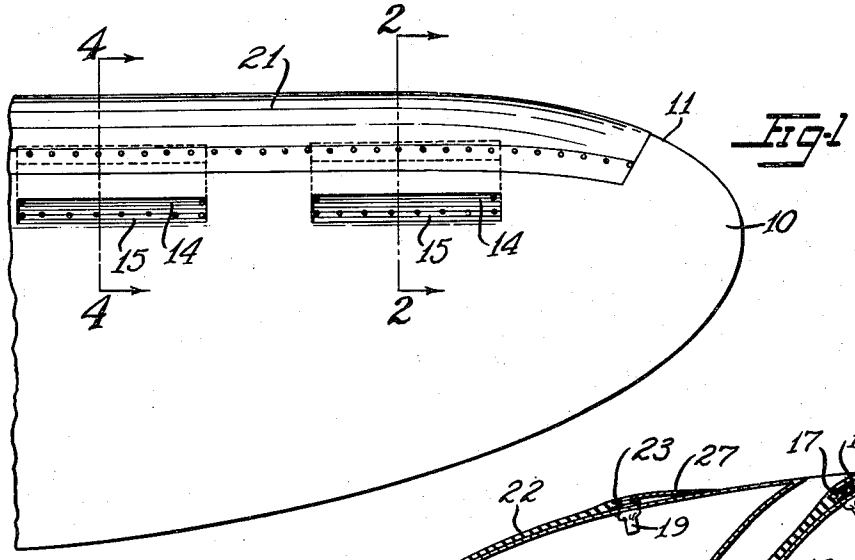


Fig-1

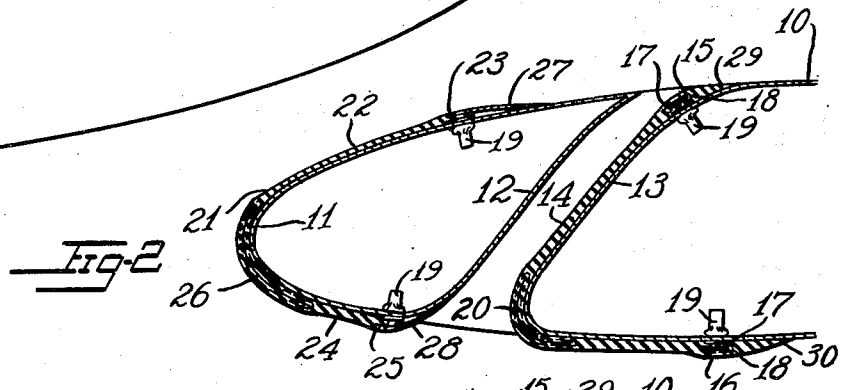


Fig-2

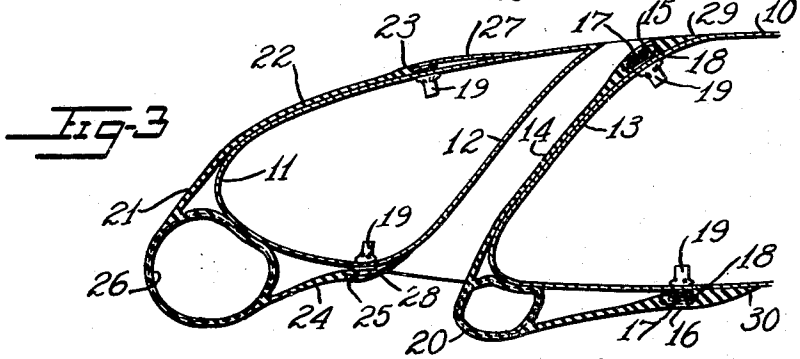


Fig-3

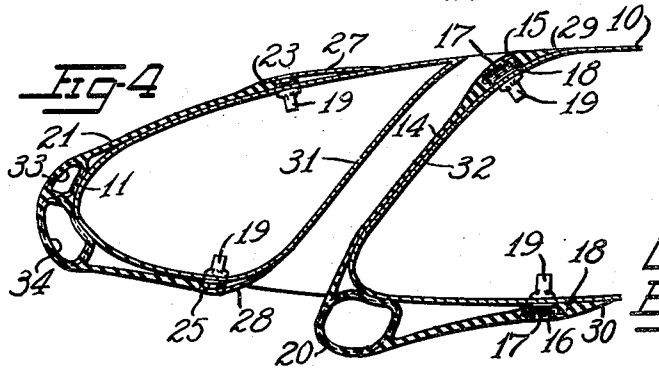


Fig-4

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APPARATUS FOR IMPROVING WING SLOT OPERATION

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9 Claims. (Cl. 244—40)

This invention relates to apparatus for improving the operation of wing slots of aircraft, and the chief objects are to provide for preventing the accumulation of ice in the vicinity of the wing slot, and further to increase, rather than decrease, the lifting effect of the wing in the region of the slot on occasion, and to reduce stalling speed.

A more specific object is to provide inflatable means so located with relation to the wing slot that the air flow through the slot is increased upon inflation of such means with an accompanying increase in the lift-drag ratio. This is useful especially in wing slots at wing tips where it is desirable that lift be mantained or increased when the craft is at or near the stalling angle, so that operation of the inflatable means will not reduce such stalling angle but will tend to provide increased safety rather than a hazardous condition.

These and further objects will be apparent from the following description, reference being had to the following drawing, in which:

Fig. 1 is a plan view of a wing tip having two slots therethrough, together with inflatable means constructed in accordance with and embodying the invention.

Fig. 2 is a section taken along the line 2—2 of Fig. 1, the inflatable means being shown in deflated condition.

Fig. 3 is a view like Fig. 2 but showing the inflatable means in the inflated condition.

Fig. 4 is a section taken along the line 4—4 of Fig. 1, the inflatable means here being of a somewhat different construction and being shown in the inflated condition.

The invention is illustrated as applied to a wing 10 having a leading edge 11, and an outboard slot through the wing shortly to the rear of the leading edge, which slot has a forward wall 12 and a rear wall 13 formed in the wing. A second slot located inboard from the first said slot will be referred to hereinafter.

In accordance with the invention, an elastic shoe indicated at 14 is mounted upon the rear wall 13 of the slot, preferably under tension with one end thereof attached near the top of the wall 13, or well up in the slot, the attached margin being indicated at 15, and with the other margin of the shoe secured to the lower skin of the wing as at 16. The shoe is of elastic rubber material and the attaching margins are reinforced by means of a metal tape or strip 17, preferably enclosed in a strip of fabric 18 all embedded in the rubber material of the shoe, and secured to the skin of the aircraft by means of screws extending through such strip and into hollow rivets 19 in the aircraft skin.

The shoe has an inflatable tube portion 20 which may be fabric reinforced. Between the tube 20 and the upper margin 15, the shoe is extensively stretchable, greater than the degree of stretchability of the shoe between the tube 20 and the lower attaching margin 16, so that upon inflation of the tube 20, that portion of the shoe will be caused to expand forwardly and also predominantly downward as is shown in Fig. 3, in which position the inflatable shoe is effective not only to loosen ice accumulation for removal, but also to provide an increase in the flow of air in the slot through the wing by virtue of the scoop action resulting from the extended form of the inflatable member. In fact the inflatable member 14 is useful for such purpose of increasing flow through the slot whether or not ice accumulations are to be removed, and an added aerodynamic control is thus provided.

A further inflatable member 21 is provided at the leading edge 11 of the wing. This member 21 may be continuous along the leading edge of the wing, but preferably varies in construction and operation at positions along the wing, in accordance with the thickness of the wing. At the position of the outboard slot it is preferred that the member 21 be of the construction illustrated in Figs. 2 and 3, such that upon inflation of the member it will coact with the inflatable member 14 to provide an increase in the length of the slot walls, and it is preferred also that the member 21 in the region of this slot be of a construction such that the camber of the wing in this region will not be decreased, but will actually be increased upon inflation of the member. These results may be effected by providing this region of the member 21 with a pronounced stretched area 22 between the leading edge and the upper fastening margin 23 thereof, and a lesser stretch area 24 between the leading edge and its lower attaching margin 25, an inflatable tube 26 being built into the member at the leading edge. Upon inflation of the member 21 the tube will be caused to extend downwardly as well as forwardly as shown in Fig. 3, thus increasing the camber of this region of the wing, and providing together with the inflated member 14 a downward extension of the walls 12 and 13 of the slot of the wing so that the effective slot passage is materially increased.

The margins of the shoe 21 may be suitably reinforced and secured in the manner described

for the shoe 14, and fairing strips 27, 28 may be secured at such margins.

In the case of the shoe 14 similar securing strips may be provided, or the rubber material of the shoe itself may be tapered to feather edges 29, 30 which are held flexed against the skin of the aircraft to serve as fairing.

At other positions of the wing, for example at the slot inboard of the slot hereinabove discussed, it may not be desired to provide an inflating action that will actually increase the wing camber. In such region the slot indicated by the walls 31, 32 in Fig. 4, may have an inflatable member 14 like that hereinabove described, secured at the rear wall 32, of the slot, and the leading edge 11 of the wing may have this region of the member 21 constructed of inflatable elements 33, 34, for example in the sinuous form disclosed in Harry E. Waner Patent No. 2,025,919, which form of inflatable elements has been found suitable especially for thin section airfoils.

Variations may be made without departing from the scope of the invention, as it is defined in the following claims.

I claim:

1. Apparatus of the class described comprising an airfoil having a slot therethrough in combination with an inflatable shoe of extensible material having a portion upon a wall of the slot, another portion upon the airfoil skin outside the slot, and an intermediate inflatable portion at a margin of the slot.

2. Apparatus of the class described comprising an airfoil having a slot therethrough in combination with an inflatable shoe of extensible material having a portion upon a wall of the slot, another portion upon the airfoil skin outside the slot, and an intermediate inflatable portion at a margin of the slot, said shoe being constructed and arranged to extend substantially the length of the wall of the slot and by virtue of its extensibility being stretchable along said wall upon inflation of said inflatable portion.

3. Apparatus of the class described comprising an airfoil having a slot therethrough in combination with an inflatable shoe of extensible material having a portion upon a wall of the slot, another portion upon the airfoil skin outside the slot, and an intermediate inflatable portion at a margin of the slot, the portion of the shoe within the slot being of a greater extent of stretchability than the portion of the shoe at the other side of the inflatable portion, whereby upon inflation thereof, the distension will be predominantly outwardly of the slot.

4. Apparatus of the class described comprising an airfoil having a slot therethrough in combination with an inflatable shoe of extensible material having a portion upon a wall of the slot, another portion upon the airfoil skin outside the slot, an intermediate inflatable portion at a margin of the slot, and a second inflatable shoe upon the airfoil surface adjacent the opposite margin of the same end of said slot, said shoes being disposed for inflation thereof in directions from the airfoil to increase the length of said slot upon inflation thereof.

5. Apparatus of the class described comprising an airfoil having a slot near its leading edge, in combination with an inflatable member at a margin of said slot, a second inflatable member at the leading edge of the airfoil, said members being disposed for inflation thereof in directions from the airfoil to increase the length of opposed walls of said slot.

6. Apparatus of the class described comprising an airfoil having a slot near its leading edge in combination with an inflatable member at a margin of said slot, a second inflatable member at the leading edge of the airfoil, said members being disposed for inflation thereof in directions from the airfoil to increase the length of opposed walls of said slot and to increase the camber of the airfoil.

7. Apparatus for preventing the accumulation of ice upon an airfoil having a slot therethrough, said apparatus comprising a shoe of elastic material having a portion along a wall of said slot and another portion upon a surface of the airfoil and an intermediate inflatable portion at a margin of the slot in a position for inflation thereof in a direction away from the airfoil to increase the length of said slot substantially without spoiling the air flow through said slot.

8. Apparatus as defined in claim 7 in which the wall portion of the shoe within the slot is of greater stretchability than the wall portion at the other side of the inflatable portion, whereby the inflation thereof tends to be predominantly in a direction outwardly of the slot.

9. Apparatus as defined in claim 7 in which the inflatable portion of said shoe is normally disposed partly within and partly without said slot, and the wall of said member in said slot is of greater stretchability than the wall portion outside said slot, whereby inflation starts within the slot and as the inflation proceeds, said inflatable portion is moved to a position of a large part thereof outside said slot.

CLIFFORD T. SEARS.