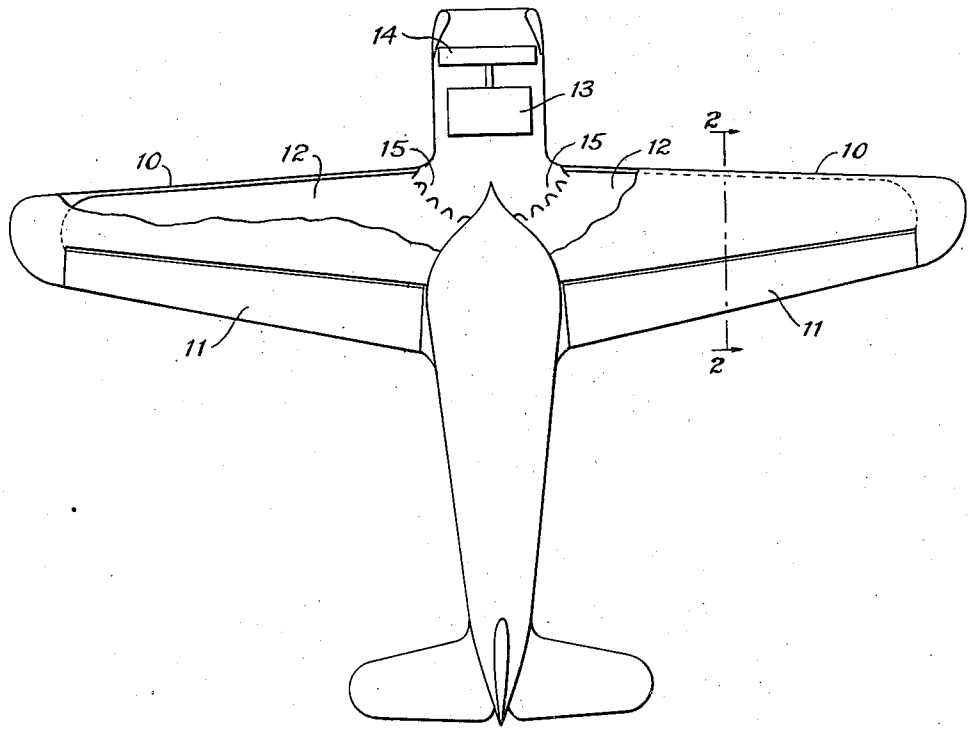
April 5, 1949. R. MORRISSON 2,466,466

FLAP AND JET DEVICE FOR AIRPLANE WINGS

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Fig.1



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Fig.2

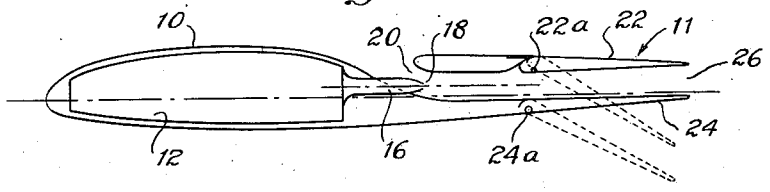


Fig.3

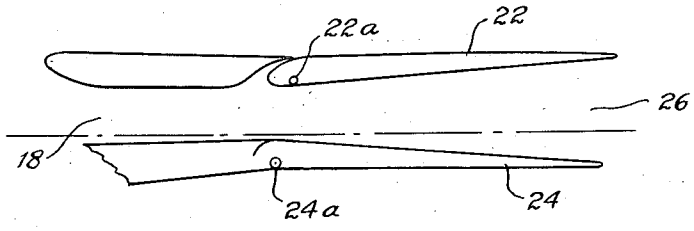


Fig.4

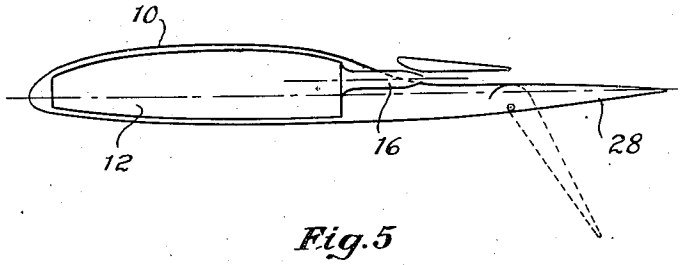


Fig.5

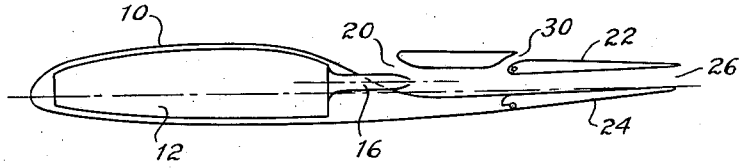
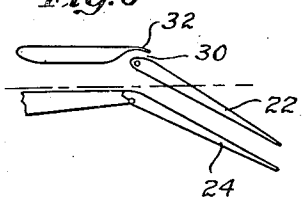


Fig.6



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Fig.7

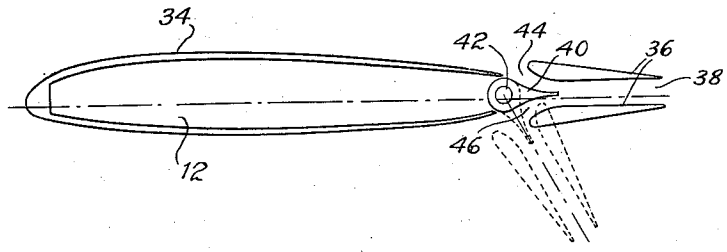


Fig.8

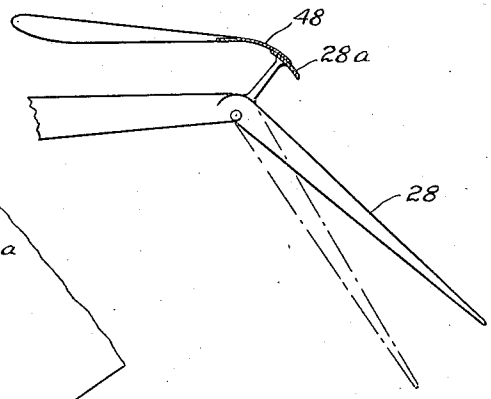


Fig.11

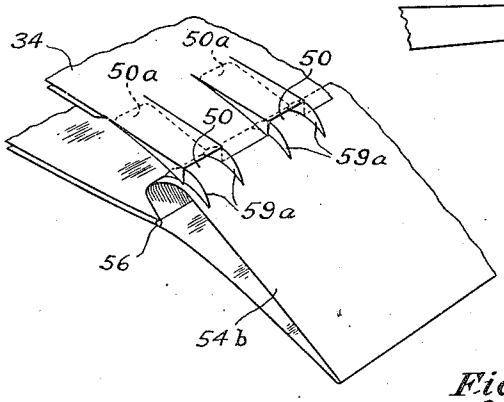


Fig.9

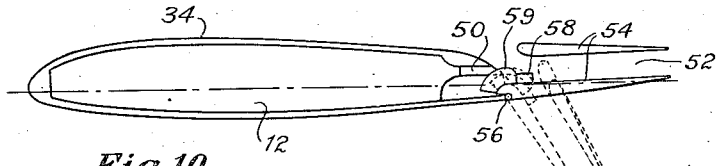
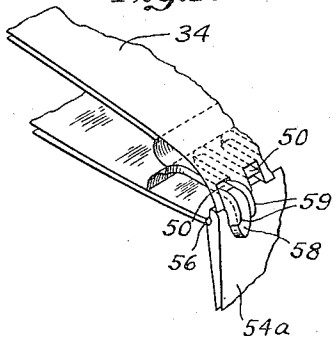


Fig.10



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Patented Apr. 5, 1949 2,466,466

UNITED STATES PATENT OFFICE

2,466,466

FLAP AND JET DEVICE FOR AIRPLANE WINGS

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Application November 1, 1945, Serial No. 626,116

10 Claims. (Cl. 244—42)

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This invention relates to jet propelled airplanes and has among its objects the provision of an improved construction for an airplane of this type by which both the lift of the wings and the propulsive effect of the jets are increased.

More specifically it is an object of the invention to provide ejectors in the airplane wings, through which the jets discharge, arranged to improve the flow of air over the wing surfaces by drawing off the stagnant boundary layer of air and delaying wing stall and also to prevent stalling of auxiliary surfaces located at the trailing edges of the wings.

A further object of the invention is to accelerate the stagnant air that is drawn into the ejector and discharge the same rearwardly to increase the mass of the fluid stream discharged and increase the propulsion effect of the jets.

A still further object of the invention is to increase the lift of the wings and the trailing edge flaps of a jet propelled airplane.

A yet further object is generally to improve jet propelled aircraft.

Other objects and advantages of the invention will be particularly pointed out hereinafter or will be evident from the detailed description of the accompanying drawings in which several desirable embodiments of the invention have been shown for purposes of illustration.

In these drawings,

Fig. 1 is a somewhat diagrammatic plan view of a jet propelled airplane embodying the invention;

Fig. 2 is a diagrammatic sectional view on line 2—2 taken through a wing of the airplane of Fig. 1 and illustrating a jet in a flap at the trailing edge of the wing and an ejector in the wing for removing the boundary layer air and discharging it through the jet in accordance with the present invention;

Fig. 3 shows a modified arrangement in which the trailing edge flap is made in two parts and a differential motion is provided for controlling the effect of the ejector as the flap parts move about their pivots;

Fig. 4 illustrates a modified construction utilizing a different type of flap in which the jet discharges over the upper surface of the flap;

Fig. 5 shows another modification in which the jet is discharged both over and through the flap;

Fig. 6 shows a lip for directing the jet discharge over the flap of the Figs. 4 and 5 constructions;

Fig. 7 shows another modified construction in which a fairing movable with the flap forms nozzles, the discharge jets from which entrain air from above and below the wing at the flap hinge

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which merge into a single discharge jet at the trailing edge of the flap;

Fig. 8 is a detail view showing a modification of the Fig. 4 construction and including an adjustable lip for directing the jet discharge over the flap;

Figs. 9 and 10 illustrate a nozzle construction in which a plurality of cooperating surfaces carried by the wing and flap deflect the jets from fixed nozzles on the wing, causing the jets to follow the upper surface of the flap as the latter moves down; and

Fig. 11 is a somewhat similar view of a modified construction for causing the jet to follow along the top surface of the flap in its deflected positions.

Fig. 1 shows somewhat diagrammatically a jet propelled airplane having wings 10 provided with pivoted flaps 11 along the major portions of their trailing edges. Each wing 10 is provided with a spanwise duct, or compartment 12 into which compressed gasses are directed from the power plant. The power plant may comprise an engine 13 driving a compressor 14 which draws air in through the nose of the fuselage and passes it over the engine 13 before discharging it into the ducts 12 in the wings. Fuel may be injected and burned at 15 if desired to increase the energy of the air.

The gases in the wing reservoir, or duct, 12 of each wing are discharged through a nozzle 16 into an ejector passage 18 in the aft part of the wing just forward of the flap hinge. The ejector draws air from the upper surface of the wing through a passage 20, thereby removing the stagnant boundary layer on the upper surface of the wing and delaying wing stall. The removal of the boundary layer by the ejector not only improves the flow of air over the upper wing surface but also prevents stalling of the flap which is pivoted to the trailing edge of the wing. The flap is formed in two parts 22 and 24, pivoted at 22*a* and 24*a*, providing a jet discharge passage 26 between them. The jet issuing from the ejector is discharged through the discharge passage 26 carrying the stagnant air that is drawn into the ejector with it and under some conditions of operation the thrust from the discharge jet 26, due to its greater mass, is greater than that of the jet from the nozzle 16, the removal of the boundary layer air thus increasing the propulsive effect of the jet as well as increasing the lift of the wing. Suitable linkage mechanism is provided for moving the upper and lower flap parts

22 and 24 in unison about their pivots into lowered positions relative to the main part of the wing, one of which lowered positions is shown in dotted lines in Fig. 2.

The construction shown in Fig. 3 differs from that shown in Fig. 2 in that a differential motion is provided by the operating linkage for the flap to vary the nozzle area at 26 and control the flow at passage 20.

In Fig. 4 a different type of flap is shown in which the jet discharging from the nozzle 16 discharges over the upper surface of a one-piece flap 28. The main wing is otherwise identical with that shown in Fig. 2. This arrangement makes possible a better control of flap stall and may be advantageous in some installations.

The modified construction shown in Fig. 5 illustrates a method of discharging the jet from the nozzle 16 through the divided flap parts 22 and 24 in accordance with the construction shown in Fig. 2 while also providing for a discharge through the passage 30 over the upper flap portion 22. This arrangement allows the ejector to work upon the air flowing over the wing at three points, i. e., at the intake point 20, at the flap hinge passage 30 and at the trailing edge where the passage 26 discharges. This arrangement very materially increases the lift of the wing.

Fig. 6 shows a detailed modification in which a lip 32 is provided at the hinge point for the flap part 22 which directs the discharge from the passage 30 more directly over the upper surface of the latter in the down positions of the flap.

In Fig. 7 a modified construction has been shown in which a fixed wing portion 34 carries an integral flap 36 having a centrally disposed passage 38 and a fairing 40 which moves with the flap about the flap pivot 42. Passages 44 and 46 which communicate with both the upper and lower boundary areas are provided above and below the fairing to draw off the boundary layer air at points farther aft on the wing than in the previously described constructions and discharge this boundary air through the passage 38 at the trailing edge of the flap. This arrangement very materially increases the thrust of the discharge jet from passage 38.

Fig. 8 shows an enlarged detailed modification of an adjustable lip 48 applied to the flap arrangement shown in Fig. 4. In this construction a single flap 28 is pivoted to the lower trailing edge surface of the wing and a curved lip assists in directing the jet over the upper surface of the flap in the lower positions of adjustment thereof. To further direct the jet along the surface of the flap in its lower positions an extension 28*a* of the same curvature as the lip is carried by the flap and slides along the under side of the fixed lip to form an extension of the lip in the lowered positions of the flap.

Figs. 9, 10 and 11 show still further modified constructions in which air from the main wing reservoir 12 is discharged through a series of preferably rectangular nozzles 50 arranged along the hinge line of the flap, and is caused to closely follow the upper surface of the flap in the various deflected positions of the latter.

It has been found that a jet discharged rearwardly over a downwardly deflected flap causes a low pressure area to form at the point where the jet tends to break away from the upper surface of the flap, so that the jet tends to follow the flap surface as the latter continues to be moved downwardly, provided this low pressure area is not destroyed by air entering from the sides.

In Fig. 9 one construction is shown for causing a jet discharged into the intermediate passage 52 of a flap 54 pivoted to the wing at 56 to follow the line of deflection of the flap. A series of tongues 58 fixed at spaced points to the upper surface of the flap at its hinge are provided with pairs of parallel barriers 59 also carried by the flap and between which the nozzles 50 discharge. Thus the tongues 58 and barriers 59 provide jet confining channels which prevent air from being drawn in laterally at the area where the jet is deflected downwardly, and hence cause the jets to follow along the upper surface of the flap even at extreme angles of deflection thereof.

In Fig. 10 a similar construction is shown in which the jets discharge over the top surface of a single flap 54*a* carrying tongues 58 and barriers 59.

In Fig. 11 pairs of barriers 59*a* carried by the flap 54*b* are received between the side walls of discharge nozzles 50 which communicate with the interior wing duct 12 through openings 50*a* cut in the upper wing surface. The barriers 59*a* and the top surface of the flap 54*b* form jet channels adjacent the flap hinge line having closed sides in all positions of deflection of the flap. Since the area beneath the jet at which the jet would normally break away from the deflected flap is sealed by the jet and the barriers against ingress of air from the sides of the jet, the jet will follow the flap even at extreme angles of deflection.

The operation of the several forms of the invention illustrated is believed to be apparent from the above description.

It will be evident that as a result of this invention, means have been provided for drawing air from the wing surfaces by means of an ejector and for discharging the boundary layer air from the ejector rearwardly to provide increased thrust while also delaying the stall of the wing and of the auxiliary surfaces pivoted to the trailing edge thereof.

It will also be evident that as a result of this invention an improved high lift wing has been provided while also providing a more effective means of jet propulsion.

Several forms which the invention may take in practice have been illustrated and described herein but it will be understood that various changes may be made in the constructions illustrated without departing from the scope of the invention as defined in the appended claims.

What I claim and desire to secure by Letters Patent is:

1. In an aircraft, a wing having a pivoted flap at its trailing edge, a source of fluid under pressure in said wing, an ejector in said wing receiving fluid from said source having a nozzle discharging over a surface of said flap in the normal position of the latter in which said wing and flap are aligned, and means cooperating with said surface forming a channel-shaped passage open at the top receiving the jet issuing from said nozzle in the vicinity of the hinge line of said flap in various angular deflections of said flap.

2. In an aircraft, a wing having a trailing edge flap, an ejector in said wing including a discharge nozzle, a source of fluid under pressure in said wing discharging into said ejector, and cooperating means carried by said wing and flap for causing the fluid discharged from said ejector

nozzle to flow over the top surface of said flap in its various angular positions relative to said wing including barriers carried by said flap on opposite sides of said nozzle forming extensions of the side walls of said nozzle in the various angularly deflected positions of said flap.

3. An arrangement as set forth in claim 1 in which the channel-shaped passage for receiving the jet issuing from the nozzle is formed by spaced chordwise barriers located on opposite sides of the nozzle which form extensions of the nozzle side walls in the various angularly deflected positions of the flap.

4. An arrangement set forth in claim 3 in which the barriers are carried by the flap.

5. An arrangement as set forth in claim 1 in which a plurality of ejectors are provided in spaced relation spanwise of the wing and a plurality of channel-shaped passages are provided for receiving the jets issuing from the nozzles of said ejectors.

6. An arrangement as set forth in claim 1 in which the nozzle is elevated above the surface of the wing and has vertical chordwise side walls terminating adjacent the hinge line of the flap, and the means cooperating therewith includes vertical chordwise barriers carried by the flap and forming extensions of said nozzle side walls.

7. An arrangement as set forth in claim 6 in which the barriers carried by the flap extend within and overlap the side walls of the nozzle adjacent the hinge line of said flap.

8. In an aircraft, a wing, a flap pivoted about a hinge line adjacent the trailing edge of said wing, a source of fluid under pressure in said wing, an ejector in said wing receiving fluid from said source having a nozzle discharging over a major surface of said flap, and means for sealing off the jet issuing from said nozzle against entrance of air from the sides in the vicinity of said hinge line including barriers upstanding from said surface and forming chordwise extensions of the side walls of said nozzle in various angular deflections of said flap.

9. In an aircraft, a wing, a flap pivoted about a hinge line adjacent the trailing edge of said wing, a source of fluid under pressure in said wing, a plurality of ejectors in spaced relation spanwise in said wing receiving fluid from said source and having nozzles discharging over a major surface of said flap which is common to all of said nozzles, and means providing an open top channel on said surface for the jet issuing from each of said nozzles including a plurality of spaced chordwise barriers forming extensions of the side walls of said nozzle in various angular deflections of said flap.

10. In an aircraft, a wing, a trailing edge flap pivoted adjacent the trailing edge of said wing including spaced upper and lower airfoil sections, said lower section forming a continuation of the lower surface of said wing and said upper section forming a spanwise slot between the leading edge thereof and the trailing edge of said wing, an ejector adjacent the trailing edge of said wing including a discharge nozzle, a source of fluid under pressure in said wing discharging into said ejector for drawing off boundary layer air through said slot from above said wing, and cooperating means carried by said wing and flap for causing the combined mixture of said fluid and boundary layer air which is discharged from said ejector to flow over said lower flap section in its various angular positions relative to said wing including barriers carried by said flap on opposite sides of said nozzle forming extensions of the sidewalls of said nozzle in the various angularly deflected positions of said flap.

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