March 17, 1942. F. STAUFER 2,276,522

WING SYSTEM FOR AIRPLANES

Filed July 6, 1939 3 Sheets-Sheet 1

Fig. 1.

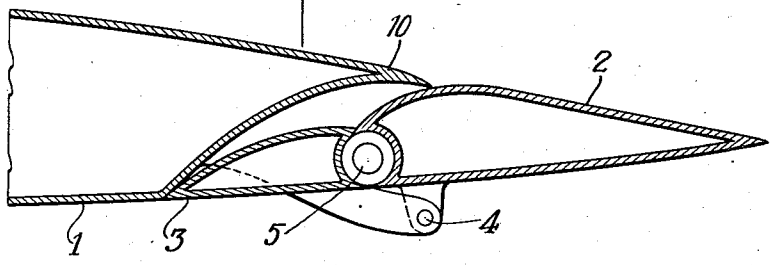


Fig. 2.

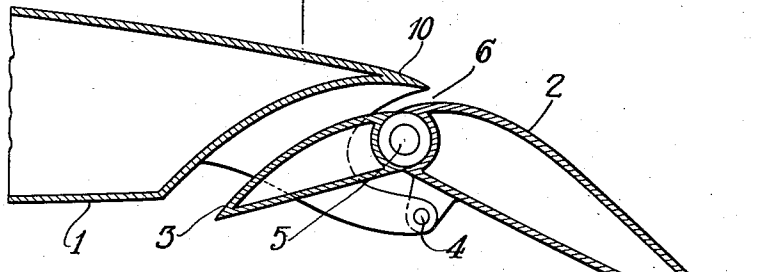
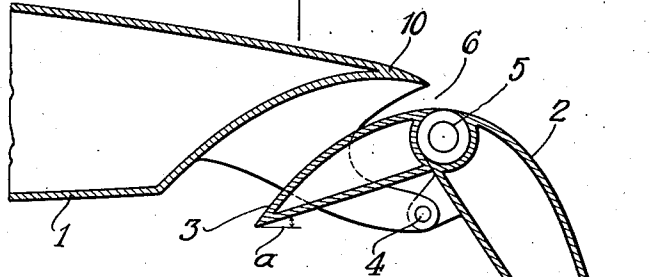


Fig. 3.



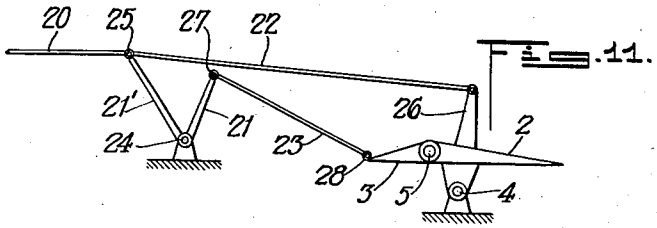


Fig. 11.

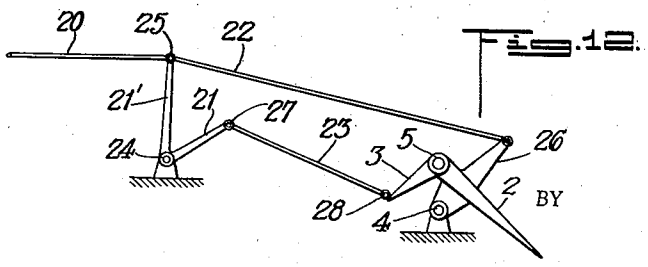


Fig. 12.

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WING SYSTEM FOR AIRPLANES

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Fig. 4.

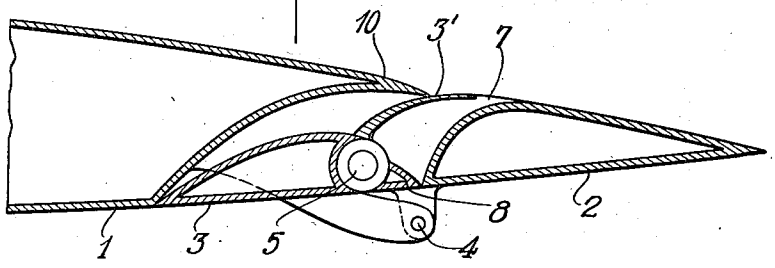


Fig. 5.

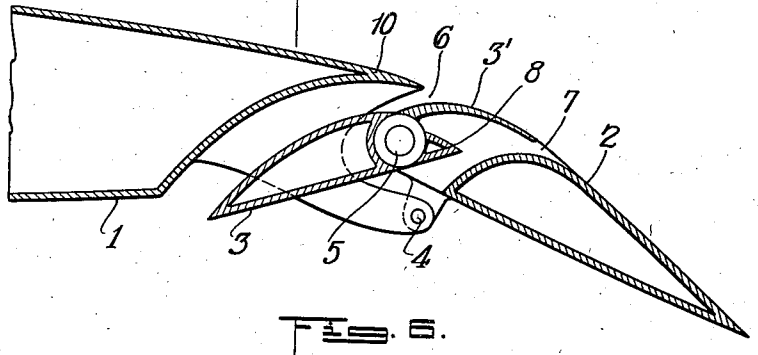
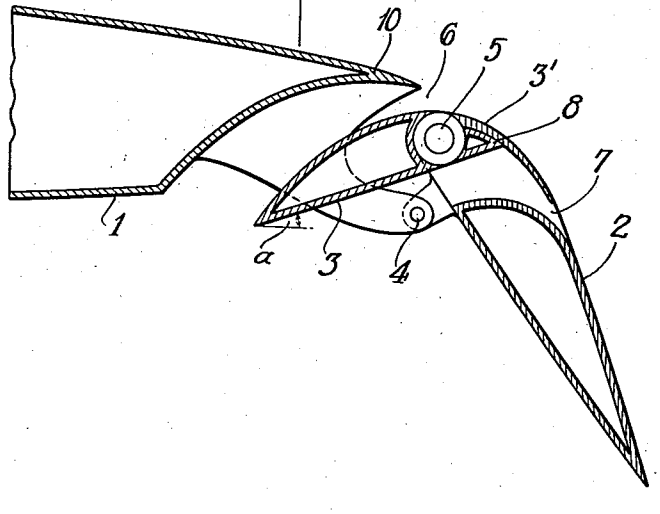


Fig. 6.



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WING SYSTEM FOR AIRPLANES

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Fig. 7.

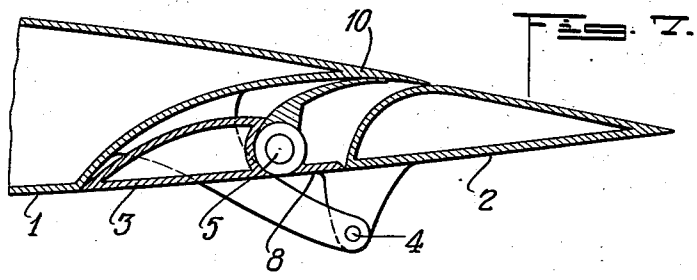


Fig. 8.

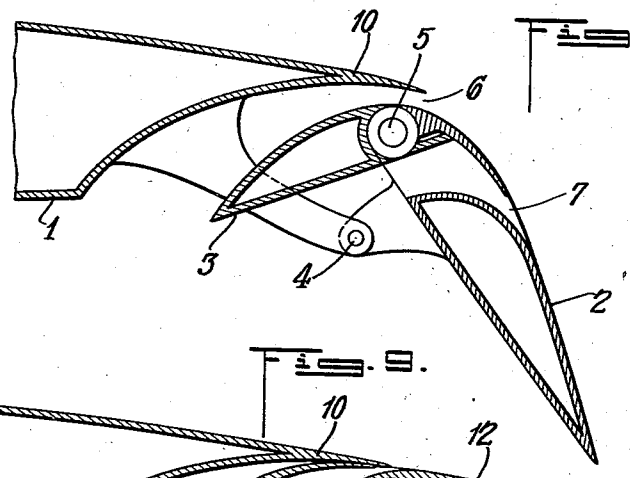


Fig. 9.

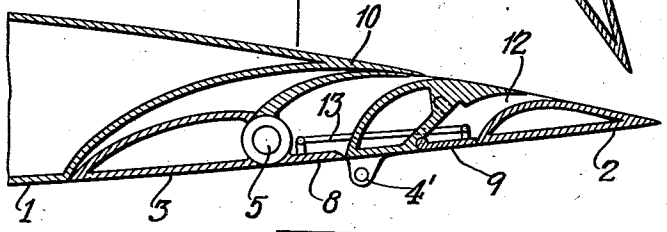
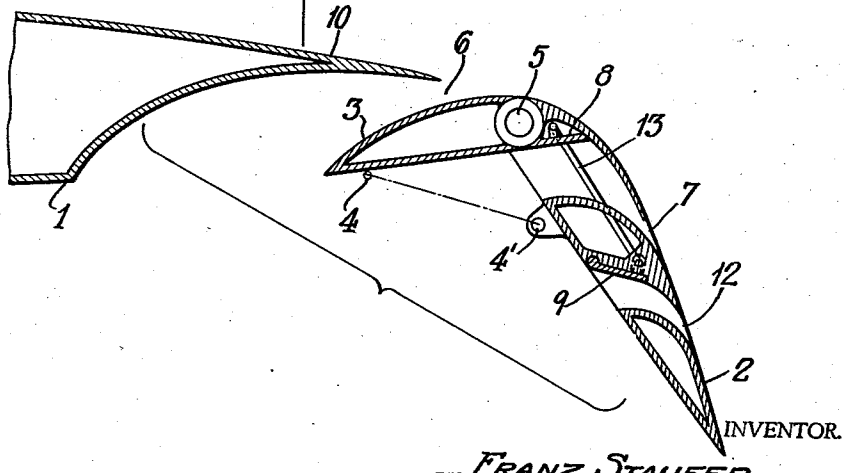


Fig. 10.



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Patented Mar. 17, 1942

2,276,522

UNITED STATES PATENT OFFICE

2,276,522

WING SYSTEM FOR AIRPLANES

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Application July 6, 1939, Serial No. 282,994
In Germany July 23, 1938

12 Claims. (Cl. 244—42)

The present invention relates to wings for aeroplanes, more particularly to comparatively high speed wings having provisions for temporarily increasing the lift coefficient for reducing the necessary landing and starting speed.

An object of the present invention is to provide wings of aeroplanes with landing flaps which are moved out of or protracted from said wings for starting and landing and which are positioned within the wing profile at high speed flying and which do not or very little increase the resistance of the wing as compared with the resistance of a slightly curved wing of smooth surface.

Landing auxiliaries are known which temporarily increase the curvature of the wing. They are, as a rule, revolvable about an axis which is in fixed relation to the trailing edge of the main wing and do not substantially change the depth of the wing or its projected area. Landing flaps are known, the fulcrum of which is not in fixed relation to the main wing but is displaceable thereon so that upon operation of a flap not only its angle of incidence is changed but it is also moved rearward whereby the depth of the wing is increased. Such landing auxiliaries simultaneously increase the curvature of the total wing and the projected wing surface. Scavenging slots may be provided or formed when operating the flaps.

The present invention relates to the provision of an improved landing auxiliary of the general type set forth above. The auxiliary according to the present invention, however, comprises a flap arrangement of such construction that a considerably higher lift coefficient is obtained than with the conventional arrangements.

An important feature of the landing flap system according to the present invention consists in the provision of a plurality of revolvably interconnected members whereby the system as a whole is revolvable about an axis which may be in fixed or in displaceable relation to the main wing. Operation of the flap system according to the present invention produces not only increased curvature but also increased active surface of the system and simultaneously a nozzle like slot opening between individual members of the system. The configuration of the air slots and leading edges of the flap members of the improved flap system is such that the velocity of the air through said passages is steadily increased, at least at medium and great displacement of the flap members and that the air passage is without undesired damming and retardation at the leading edges of the flaps.

With the construction according to the present invention energy is conducted from the high pressure side to the low pressure side without practically any loss and the scavenging effect is considerably increased. A further improvement is obtained by the fact that the nose of the front part of the protracted flap projects into the normal air flow at the underside of the wing so that a greater amount of air is diverted than is possible with conventional slots; on the other hand the fore end of the flap is displaced only so far that no appreciable damming of the air occurs in front of the nose of the flap and the air flow adheres to the flap behind the nose thereof. The configuration of the flap system according to the invention is so that when the system is operated not only the curvature or camber of the suction surface of the system is increased but that the suction surface is also continuous and without appreciable interruptions or sharp bends also adjacent to the hinges and that particularly at medium and large diversion of the flap members. For accomplishing this the thickness of the forward part of the flap members adjacent to the hinge is such that the flap surface smoothly continues into the next adjacent flap member. The total flap composed of the individual flap members is of such construction that a curved profile is produced at medium and large flap diversions and the low pressure side is without or practically without breaks and that the leading edge of the flap is so positioned in the air flow that, also at medium and large diversions of the total system damming of the air on the suction side of the flap and separation of and eddy currents in the air flow on the pressure side of the flap are substantially avoided. For this purpose, in the systems shown in Figures 3 and 6 of the drawings which form part of the present application, the angle α should not be larger than, say, 30°.

Arrangements are known in the art in which a cover plate is articulated to the nose of the main flap which plate primarily serves for reducing the force required for operating the main flap and also for covering the slot when the flap is in in-operative position and which plate does not substantially contribute in increasing air flow through the slot. Increase of air flow through the slot is one of the main features of the present invention. This is accomplished by special configuration of the forward flap member with respect to thickness and profile whereby, at medium and large diversion of the flap, a practically kink-free configuration of the suction

side of the flap system is assured and that also at such an angle of diversion of the flap members at which in front of the nose of the forward flap no damming of the air and behind the nose no eddy current occurs so that there is no damming of the air flow at the suction side of the flap system and no appreciable eddy formation at the pressure side which would considerably reduce the efficiency of the flaps. With conventional constructions there is an abrupt change of the thickness from the forward flap to the main flap whereby the effect of the flaps is greatly reduced. An object of the present invention is the provision of a flap system which, in toto, constitutes a profile of changeable and continuous curvature.

In order to increase the scavenging effect of the arrangement the system according to the present invention is much subdivided so that, when it is operated, further slots are opened which are closed when the system is in inoperative position.

Further and other objects and advantages of the present invention will be apparent from the accompanying specification and claims and shown in the drawings which, by way of illustration, show what I now consider to be a preferred embodiment of my invention.

In the drawings:

Figure 1 is a diagrammatic cross sectional view of a flap system according to the present invention in rest or in-operative position.

Figure 2 shows the system illustrated in Figure 1 in take-off position.

Figure 3 shows the system illustrated in Figure 1 in landing position.

Figure 4 is a diagrammatic cross section of a modification of the flap system in inoperative position according to the present invention.

Figure 5 shows the system illustrated in Figure 4 in take-off position.

Figure 6 shows the system illustrated in Figure 4 in position for landing.

Figure 7 is a diagrammatic cross sectional view of another modification of the flap system in rest position according to the present invention.

Figure 8 shows the system illustrated Figure 7 in landing position.

Figure 9 is a diagrammatic cross sectional view of a third modification of a flap system according to the present invention in rest or inoperative position.

Figure 10 shows the system illustrated in Figure 9 in landing position.

Figure 11 is a schematic layout of the operating mechanism for the flap system shown in Figures 1 to 10, the mechanism holding the system in inoperative or rest position.

Figure 12 is a schematic layout of an operating mechanism for operating the flap systems shown in Figures 1 to 10, the mechanism being shown in position for taking off or landing.

Like parts are designated by like numerals in all figures of the drawings.

Figure 1 shows the flap system according to the invention in inoperative position in which, aerodynamically, it forms part of the main wing. The flap members 2 and 3 which form the flap system are revolvable about an axis 4 which is connected with the main wing 1. Member 3 is hinged to the nose of member 2 by means of the hinge 5. The curvatures of the upper surfaces of members 2 and 3 are such that at great deflections of said members a smooth continuous surface is formed at the suction side of the flap system. On the pressure side the flap members 2 and 3 enclose a flat angle at average operating conditions. See Figure 2 which shows the system in take-off position.

The trailing edge 10 of the main wing may be of such configuration that, in inoperative position of the wing system, the slot 6 between main wing 1 and main flap member 2 is closed without any interruption of the total profile. See also Figure 7. The position of the operating axis 4 is such as to produce proper balance of the system and reduce resistance. Hinges 4 and 5 may be arranged coaxially.

In order to further increase the scavenging effect one or more slots may be arranged in the main flap member as shown in Figures 4 to 10.

Referring more particularly to Figures 5 and 6 a slot 7 is produced in the main flap by positioning members 2 and 3 to form an angle with one another. In this position, the forward end of the rear member 2, aerodynamically, forms the rear part of the profile of the forward flap. Slot 7 may be closed by means of a cover plate 3' which is rigidly connected with and forms the front part of flap 2 which is swingable about fulcrum 5. In rest position, the front part 3' closes the scavenging slot between the rear end of part 10 of the main wing and member 2. Member 3' and part 10 may have such configuration that part 10 closes slots 6 and 7 and member 3' may be hidden underneath part 10 as is shown in Figure 7.

If there is only one slot in the flap system this may be closed in known manner by means of a rearwardly protracting nose 8 of member 3 or by means of a suitable flap coupled to the system in known manner.

If a plurality of slots are provided in the main flap 2 as, for example, in the embodiment of the invention illustrated in Figures 9 and 10 whereby member 2 is provided with an additional slot 12, the slots may be closed on the pressure side of the system by means of cover plates 9 which are controlled by the flap system 2, 3. A control member 13 interconnecting part 8 of member 3 and plate 9 is provided for this purpose.

The rear end 10 of the main wing 1 may be made to extend so far back as to close a part or all of the slots of flap member 2 at the suction side of the system.

In the embodiment of the invention shown in Figures 1 to 8 the fulcrum 4 of the wing system 2, 3 is shown rigidly connected with the main wing 1. This fulcrum may also be arranged displaceable with respect to the main wing so that it can be moved along a curved or straight path, for example, from position 4 to position 4' as shown in Figure 10. The active wing depth is thereby enlarged and the lift coefficient increased.

In Figures 11 and 12 an operating mechanism for the flap system according to the invention is shown schematically. In Figure 11 the system is shown in rest position and in Figure 12 in operating position. Operating rod 20 can be displaced in the direction of its longitudinal extension. Rod 20 is movably connected to the end 25 of arm 21' of bell crank lever 21', 21 which is swingable about fulcrum 24. Also connected to arm 21' at 25 is one end of the connecting rod 22. The other end of rod 22 is movably connected to arm 26 which is fixed to flap member 2. A link rod 23 interconnects the end 27 of arm 21 of bell crank lever 21', 21 and a point 28 at

the forward end of flap member 3. The bearing of fulcrum 24 and that of fulcrum 4 is supported by the main wing 1 as is shown in Figures 1 to 8.

While I believe the above described embodiments of my invention to be preferred embodiments, I wish it to be understood that I do not desire to be limited to the exact details of design and construction shown and described, for obvious modifications will occur to a person skilled in the art.

I claim:

1. A wing system for aeroplanes comprising a main wing having a rear portion, a fulcrum member connected with said rear portion, a flap system swingably supported by said fulcrum member and adapted to be swung into high speed and into slow speed flying position, said flap system comprising a forward flap member and a rear flap member, a second fulcrum member connected with and swingably interconnecting said flap members, said forward flap member having a lower surface of such configuration as to form the continuation of the lower surface of said main wing when said flap system is in high speed flying position and having an upper surface forming, with the adjacent surface of said rear portion, a nozzle passage when said flap system is swung about said first mentioned fulcrum into slow speed flying position, said flap members having upper surfaces of such configuration as to form a substantially continuous surface when said flap system is swung about said first mentioned fulcrum into slow speed flying position and said flap members form an angle with one another about said second fulcrum.

2. A wing system for aeroplanes comprising a main wing having a rear portion, a fulcrum member connected with said rear portion, a flap system swingably supported by said fulcrum member and adapted to be swung into high speed and into slow speed flying position, said flap system comprising a forward flap member and a rear flap member, a second fulcrum member connected with and swingably interconnecting said flap members and being positioned adjacent to said first mentioned fulcrum member, said forward flap member having a lower surface of such configuration as to form the continuation of the lower surface of said main wing when said flap system is in high speed flying position and having a curved upper surface forming, with the adjacent surface of said rear portion, a nozzle passage of continuously diminishing passage area from the pressure to the suction side thereof when said flap system is swung about said first mentioned fulcrum into slow speed flying position, said flap members having upper surfaces of such configuration as to form a substantially continuous surface when said flap system is swung about said first mentioned fulcrum into slow speed flying position and said flap members form an angle with one another about said second fulcrum.

3. A wing system for aeroplanes comprising a main wing having a rear portion, a fulcrum member connected with said rear portion, a flap system swingably supported by said fulcrum member and adapted to be swung into high speed and into slow speed flying position, said flap system comprising a forward flap member and a rear flap member, a second fulcrum member connected with and swingably interconnecting said flap members, said forward flap member having a lower surface of such configuration as to form the continuation of the lower surface of said main wing when said flap system is in high speed flying position and having an upper surface forming, with the adjacent surface of said rear portion, a nozzle passage when said flap system is swung about said first mentioned fulcrum into slow speed flying position, said flap members having curved upper surfaces of such configuration as to form a substantially continuous curved surface adapted to be swung about said first mentioned fulcrum, said flap members being adapted to form a downward opening angle with said second fulcrum member forming the point of the angle when said flap system is swung about said first mentioned fulcrum member out of high speed flying position.

4. A wing system for aeroplanes comprising a main wing having a rear portion, a fulcrum member connected with said rear portion, a flap system swingably supported by said fulcrum member and adapted to be swung into high speed and into slow speed flying position, said flap system comprising a forward flap member and a rear flap member, a second fulcrum member connected with and swingably interconnecting said flap members, said forward flap member having a lower surface of such configuration as to form the continuation of the lower surface of said main wing when said flap system is in high speed flying position and having an upper surface forming, with the adjacent surface of said rear portion, a nozzle passage when said flap system is swung about said first mentioned fulcrum into slow speed flying position, said rear flap member having channel means extending from the pressure to the suction side thereof, and a channel closing means disposed adjacent to the pressure side of said rear flap member and adapted to close the intake side of said channel means when said flap system is in high speed flying position.

5. A wing system for aeroplanes comprising a main wing having a rear portion, a fulcrum member connected with said rear portion, a flap system swingably supported by said fulcrum member and adapted to be swung into high speed and into slow speed flying position, said flap system comprising a forward flap member and a rear flap member, a second fulcrum member connected with and swingably interconnecting said flap members, said forward flap member having a lower surface of such configuration as to form the continuation of the lower surface of said main wing when said flap system is in high speed flying position and having an upper surface forming, with the adjacent surface of said rear portion, a nozzle passage when said flap system is swung about said first mentioned fulcrum member into slow speed flying position, said rear flap member having channel means extending from the pressure to the suction side thereof, and a channel closing means connected with and extending rearward from said forward flap member and adapted to close said channel means when said flap system is in high speed flying position.

6. A wing system for aeroplanes comprising, in combination, a main wing having a rear portion, a fulcrum member connected with said rear portion, a flap system swingably supported by said fulcrum member and adapted to be swung into high speed and into slow speed flying position, said flap system comprising a forward flap member and a rear flap member, a second fulcrum member connected with and swingably interconnecting said flap members, said forward flap

member having a lower surface of such configuration as to form the continuation of the lower surface of said main wing when said flap system is in high speed flying position and having an upper surface forming, with the adjacent surface of said rear portion, a nozzle passage when said flap system is swung about said first mentioned fulcrum into slow speed flying position, said rear flap member having a head portion adjacent to said second fulcrum member and forming together with said forward flap member an additional wing, and the rest of said rear flap member forming a further wing having an angle of incidence different from the angle of incidence of said additional wing when said flap system is swung out of high speed flying position.

7. A wing system for aeroplanes comprising, in combination, a main wing having a rear portion, a fulcrum member connected with said rear portion, a flap system swingably supported by said fulcrum member and adapted to be swung into high speed and into slow speed flying position, said flap system comprising a forward flap member and a rear flap member, a second fulcrum member connected with and swingably interconnecting said flap members, said forward flap member having a lower surface of such configuration as to form the continuation of the lower surface of said main wing when said flap system is in high speed flying position and having an upper surface forming, with the adjacent surface of said rear portion, a nozzle passage when said flap system is swung about said first mentioned fulcrum member into slow speed flying position, said rear flap member having channel means extending from the pressure side to the suction side thereof, said rear flap member having a head portion disposed adjacent to said second fulcrum member and forming the forward wall of said channel means, said head portion forming together with said forward flap member an additional wing, the portion of said rear flap member extending rearward from said channel means forming a further wing having an angle of incidence different from the angle of incidence of said additional wing when said flap system is swung out of high speed flying position.

8. A wing system for aeroplanes comprising, in combination, a main wing, a fulcrum member connected with the rear portion of said main wing, a flap system swingably supported by said fulcrum member and being adapted to be swung into high speed and into slow speed flying position, said flap system comprising a forward flap member and a rear flap member, a second fulcrum member connected with and swingably interconnecting said flap members, said forward flap member having a lower surface of such configuration as to form the continuation of the lower surface of said main wing when said flap system is in high speed flying position, said flap members being of such cross sectional configuration as to form a substantially continuously curved upper profile when positioned at an angle with respect to one another, said rear flap member having an opening, and a closure member swingably connected with said rear flap member and adapted to close said opening.

9. A wing system for aeroplanes comprising, in combination, a main wing, a fulcrum member connected with the rear portion of said main wing, a flap system swingably supported by said fulcrum member and being adapted to be swung into high speed and into slow speed flying position, said flap system comprising a forward flap member and a rear flap member, a second fulcrum member connected with and swingably interconnecting said flap members, said forward flap member having a substantially convexly shaped upper surface and having a lower surface of such configuration as to form the continuation of the lower surface of said main wing when said flap system is in high speed flying position, said flap members having such cross sectional configuration as to form a curved profile when positioned at an angle with respect to one another, said rear flap member having an opening, and a closure member swingably connected with said rear flap member and disposed at the pressure side thereof and adapted to close said opening.

10. A wing system for aeroplanes comprising in combination, a main wing, a fulcrum member connected with the rear portion of said main wing, a flap system swingably supported by said fulcrum member and being adapted to be swung into high speed and into slow speed flying position, said flap system comprising a forward flap member and a rear flap member, a second fulcrum member connected with and swingably interconnecting said flap members, said forward flap member having a lower surface of such configuration as to form the continuation of the lower surface of said main wing when said flap system is in high speed flying position, said flap member having such cross sectional configuration as to form a substantially continuously curved upper profile and an air passage between said forward flap member and said main wing when positioned at an angle with respect to one-another, said rear flap member having a plurality of openings extending from the pressure side to the suction side thereof and forming air passages when said rear flap member is swung to form an angle with said forward flap member, and a closure member swingably connected with said rear flap member adjacent to the pressure side of one of said openings and adapted to close said one of said openings.

11. A wing system for aeroplanes comprising, in combination, a main wing, a fulcrum member connected with the rear portion of said main wing, a flap system swingably supported by said fulcrum member and being adapted to be swung into high speed and into slow speed flying position, said flap system comprising a forward flap member and a rear flap member, a second fulcrum member connected with and swingably interconnecting said flap members, said forward flap member having a lower surface of such configuration as to form the continuation of the lower surface of said main wing when said flap system is in high speed flying position, said flap members being of such cross sectional configuration as to form a substantially continuously curved upper profile when positioned at an angle with respect to one another, said rear flap member having an air passage means extending from the pressure to the suction side thereof, a closure member swingably connected with said rear flap member adjacent to the pressure side of said passage means, and operating means connected with and operatively interconnecting said forward flap member and said closure member and adapted to move said closure member into opening and closing position in dependence on the relative position of said flap members.

12. A wing system for aeroplanes comprising,

in combination, a main wing, a fulcrum member connected with the rear portion of said main wing, a flap system swingably supported by said fulcrum member and being adapted to be swung into high speed and into slow speed flying position, said flap system comprising a forward flap member and a rear flap member, a second fulcrum member connected with and swingably interconnecting said flap members, said forward flap member having a lower surface of such configuration as to form the continuation of the lower surface of said main wing when said flap system is in high speed flying position, said flap members being of such cross sectional configuration as to form a substantially continuously curved upper profile when positioned at an angle with respect to one another, said rear flap member having a plurality of channel openings extending therethrough from the pressure to the suction side, and closure means associated with each of said channel openings on the pressure side thereof and operatively connected with said forward flap member.

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