Nov. 29, 1938. R. POUIT 2,138,326

FLYING MACHINE

Filed Jan. 23, 1936 2 Sheets-Sheet 1

Fig. 1.

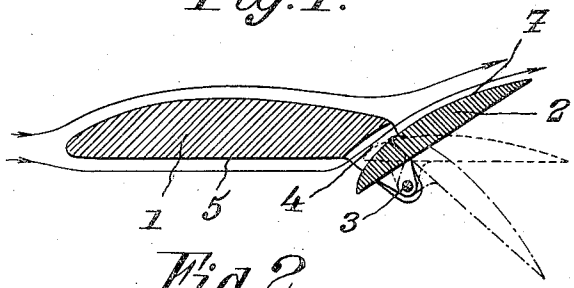


Fig. 2.

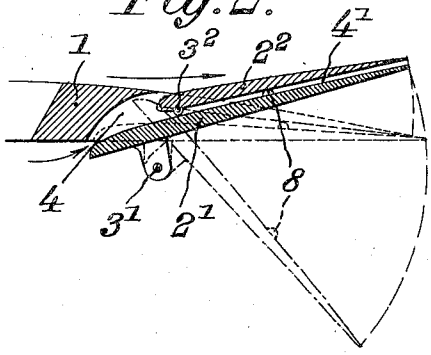


Fig. 3.

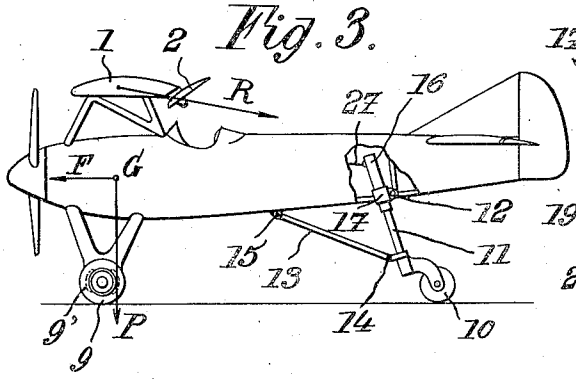


Fig. 4.

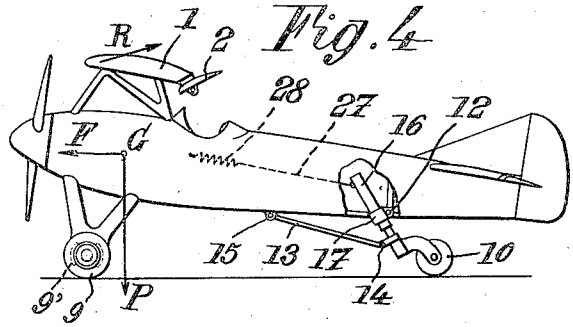
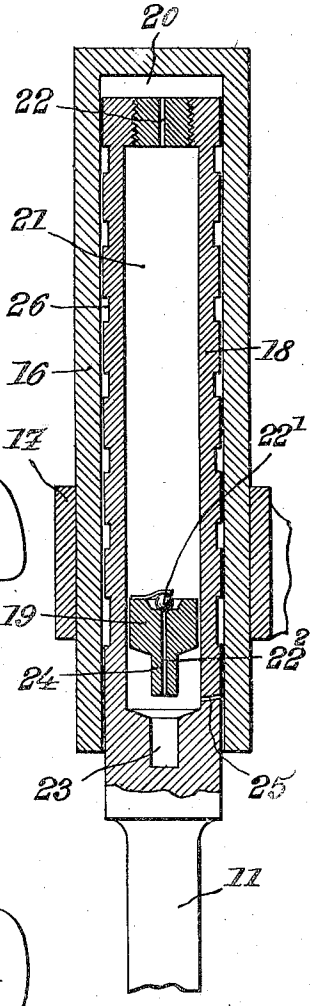


Fig. 5.



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Filed Jan. 23, 1936 2 Sheets-Sheet 2

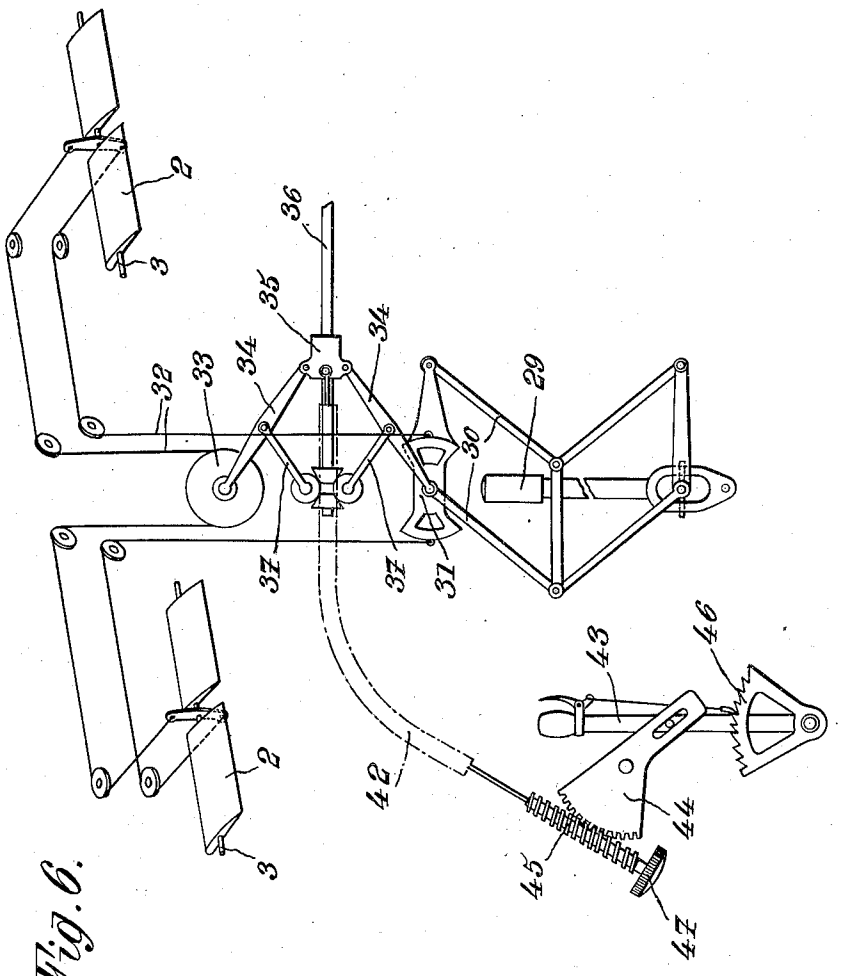

Fig. 6.

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UNITED STATES PATENT OFFICE

2,138,326

FLYING MACHINE

Robert Pouit, Issy-les-Moulineaux, France

Application January 23, 1936, Serial No. 60,538
In France January 28, 1935

19 Claims. (Cl. 244—110)

The present invention relates to flying machines of any kind whatever.

The object of the present invention is to provide a machine of this kind which is so devised that capsizing, when landing for instance, is prevented and that braking torques can be applied to the machine of considerably greater magnitude than could be applied previous to the invention.

The essential feature of the present invention consists in fitting an element of the flying machine, a wing for instance, with at least one aileron or flap adapted to pivot about an axis arranged in such manner that, when pivoted upwardly, said aileron or flap forms, between itself and the element (for instance a wing) with which it cooperates, a passage through which the air stream flowing along the underside of said element is caused to pass, in such a manner that this air stream, which is thus deviated from its original direction, is given an upward movement and therefore exerts, by reaction, a downwardly directed action on the flying machine.

Another feature of the present invention relates to the case in which multiple ailerons or flaps are provided. It consists in arranging said ailerons or flaps in such manner that, when moved upwardly, they form the passage above referred to, and, also, form a passage between them which gives a result analogous to that above mentioned.

Still another feature of the present invention consists in devising the ailerons or flaps, either single or multiple, above referred to, and in particular disposing their pivoting axes in such manner that the aerodynamic reaction due to the upward movement of the fluid produced by said ailerons or flaps creates, with respect to the point of contact of the wheels or the like of the machine with the ground an important torque intended to prevent capsizing of the machine, which strongly applies the tail supports of the machine (wheel, tail skid or the like) against the ground.

Still another feature of the present invention consists in providing a flying machine of the type above mentioned with a tail support the height of which is variable so as to modify, preferably automatically, the inclination of the fore and aft axis of the flying machine with respect to the ground when said machine is taxiing or otherwise running on the ground, in such manner as to always prevent the machine from capsizing, even when the speed of said machine is considerably reduced.

Still another feature of the present invention consists in providing means for controlling the ailerons or flaps above referred to which are devised in such manner that they are operated simultaneously with the actuation of the brakes of the flying machine through a single operating organ.

Other features of the present invention will result from the following detailed description of some specific embodiments thereof.

Preferred embodiments of the present invention will be hereinafter described, with reference to the accompanying drawings, given merely by way of example, and in which:

Fig. 1 is a cross sectional view of an airplane wing provided with a pivotable flap made according to the invention;

Fig. 2 is a similar view, showing a modification including two pivotable flaps one of which can be employed as underside flap, the whole being arranged according to the present invention;

Fig. 3 is a diagrammatic side elevational view of an airplane provided with the system according to the invention;

Fig. 4 is a view, similar to Fig. 3, showing the airplane in another position, corresponding to a reduced speed;

Fig. 5 is an axial sectional view on an enlarged scale of a portion of a rear supporting device for an airplane, according to the invention;

Fig. 6 is a diagrammatical view showing the whole of the controls of the flaps, the brake controls and the flight control, the whole being arranged according to the invention.

In a flying machine, embodying the present invention, the flying parts proper are made in any suitable manner and for instance according to conventional designs.

According to the invention, at the rear part of at least some of the supporting surfaces of the machine, for instance the main wings 1, I provide at least one movable flap 2 the direction of which, with respect to wing 1, can be varied in a suitable manner, said flap 2 being for instance pivoted about an axis 3 which is located a certain distance behind and below the leading edge of flap 2. Furthermore, the rear part of wing 1 and the leading edge of flap 2 are made of such a shape that there is formed at least one passage or channel 4 permitting a flow of air along the under side 5 of the wing and the upper side 7 of the flap, more especially when the flap is in

a position in which it is turned upwardly, as shown for instance in Fig. 1.

In such a position of the flap, which is more especially used when the airplane is running on the ground after having landed, the air flowing along the under side of the wing is deviated by the front part of flap 2, which compels said air to flow through passages 4. The upper side 7 of the flap or flaps, when they are turned upwardly, imparts to both of the airstreams flowing along the upper side and the under side of the wing an upwardly directed movement which, by reaction, produces a downwardly directed effort exerted on wing 1 and therefore on the machine. This effort, added to the action of gravity, increases the adhesion of the airplane to the ground and therefore improves the efficacy of the mechanical brake with which the airplane is provided and stops the airplane more rapidly, after landing thereof. Furthermore, the upward pivoting of the flap or flaps 2 substantially increases the drag of the airplane, which also reduces the time within which the airplane is stopped. This braking effect is produced by brakes 9^1.

The flaps 2, which, when they are given a negative angle of attack, so as to reduce the lift and even render it zero or negative, improve the conditions of running of the airplane along the ground, can also be used as lift increase devices during flight, by turning them downwardly.

In the modification shown in Fig. 2, the lift increase flaps consist essentially of so-called underside flaps 2^1, pivoted about an axis 3^1 located below the underside of the wing. These flaps, the use of which as lift increase devices is known per se, are combined, according to the invention, with other flaps, such as 2^2, which, in their normal positions, as shown in dotted lines, prolong the upper side surface of wing 1. These flaps 2^2 are pivoted about an axis 3^2 of suitably chosen position, in such manner that flaps 2^1 can produce the rotation of flaps 2^2 about their axis 3^2 only when said flaps 2^1 are rotated upwardly toward the position shown in solid lines. Flaps 2^1, however, can be moved freely in a downward direction (position shown in dash-and-dot lines) without taking along flaps 2^2. For this purpose, the upper side of flaps 2^1 may be provided with one or several abutments 8, which act merely as bearing elements.

The respective positions of axes 3^1 and 3^2 are chosen in such manner that, when flaps 2^1 and 2^2 are moved upwardly, there is formed between them a passage 4^1 through which can flow the whole or a part of the underside airstream of wing 1, said airstream being deviated toward this passage by the front part of flaps 2^1, the latter giving said airstream an upward direction.

When the airplane is in flight, the lift of the machine can be increased by turning downwardly, in the known manner, these flaps 2^1, without varying the position of flaps 2^2, as shown in dash-and-dot lines in Fig. 2.

Whatever be the arrangement or shape that is chosen for flaps 2 (or 2^1—2^2), the resultant R of the action of air on wings 1 can be directed downwardly only if the angle of attack of the wings is relatively small. Accordingly, it is advantageous, as shown by Fig. 3, to have the fore and aft axis of the airplane slightly inclined with respect to the ground. The danger of capsizing, under the effect of force F, acting at G, and which would be increased if force P (gravity) moved nearer to the point of contact of wheels 9 with the ground, is not to be feared at a sufficiently high running speed of the airplane because, in this case, flaps such as 2 are turned upwardly and the value and the position of the aerodynamic resultant R create, with respect to the point of contact of the wheels with the ground, a considerable torque preventing capsizing of the airplane.

However, when the running speed of the airplane is reduced, it may happen that this aerodynamic torque is insufficient.

It is possible to increase the torque due to gravity serving to prevent capsizing by increasing the upward inclination of the nose of the airplane, for instance by lowering the tail of said airplane in the manner disclosed by Fig. 4.

According to the present invention, the gradual lowering of the tail of the airplane, as the speed thereof is decreasing may be obtained automatically by means of a device of the kind shown in Figs. 3, 4 and 5, preferably in combination with the system of rotatable flaps above described.

The tail support, consisting for instance of a wheel 10, may be mounted at the end of a telescopic rod 11, pivoted, about an axis 12, to a fixed point of the airplane, said rod being maintained through an articulated link pivoted, on the one hand, at 14 to the lower end of rod 11 and, on the other hand, at 15, to a fixed point of the airplane.

This telescopic member 11, a portion of which is shown on an enlarged scale and partly in section in Fig. 5, includes, for instance, a hollow cylindrical envelope 16, closed at its upper end, and the lower end of which carries a collar 17, pivoted to the abovementioned fixed point 12. In cylinder 16 a piston 18 is slidably mounted at the inside of which a second piston 19 is able to slide freely. These three parts enclose between them two variable volume chambers 20 and 21 communicating with each other through a calibrated orifice 22. These chambers 20 and 21 are filled with a liquid, such as for instance oil. According to the direction of the force acting on piston 18, the oil of chamber 20 passes into chamber 21 through conduit 22, driving piston 19 either downwardly or upwardly. It is clear that, according to the size of conduit 22, the shortening of telescopic rod 11 takes place gradually under the influence of the reaction that is exerted on wheel 10.

The device shown by Fig. 5 may be improved by recovering, at each stroke, the losses of liquid, for instance by providing at the bottom of the inner space of piston 18 a cylindrical recess such as 23 into which penetrates, at the end of the downward stroke of piston 19, a cylindrical prolonged part 24 of this last mentioned piston. Oil that has leaked past piston 19 is thus sent back into chamber 21 through a conduit 22^2 provided in piston 19 and controlled by a valve 22^1 carried by said piston. Atmospheric pressure is maintained, below piston 19, through a conduit 25 opening into the atmosphere when member 11 is sufficiently expanded, said conduit 25 being, on the contrary, stopped, when member 11 is shortened. It follows that, when member 11 tends to expand, the relative vacuum existing in the space under piston 19 sucks in the oil leaks that may have occurred, said oil being accumulated in annular spaces 26 provided between cylinder 16 and piston 18. In order to avoid any emulsion of oil and air, the air present in recess 23 is evacuated by providing, for instance, on the

cylindrical surface of part 24, a flat part which is sufficiently small in order that only a very small amount of air can escape, together with the air present in recess 23, from the space below piston 19.

When the airplane is in flight, the tail supports, for instance telescopic member 11 carrying wheel 10, are brought into a position analogous to that shown by Fig. 4, the pilot being capable of acting on said system, for instance through controlling means which include a rod or cable 27, advantageously combined with a spring 28, or any other transmission acting from a distance, the free end of which may be secured to a fixed point of the cabin.

A short time before landing, the pilot releases control member 27 and telescopic element 11 expands under the effect of the weight of the tail shock absorber until the latter occupies the position shown by Fig. 3, which corresponds to the maximum expansion of telescopic element 11.

When the airplane comes into contact with the ground and runs thereon at a relatively high speed, the telescopic device is expanded as shown by Fig. 3, but, as the velocity decreases under the effect of braking and of the flaps 2, as above described, the reaction of the ground on wheels 10 tends to reduce the length of the telescopic element, so that the tail of the airplane moves gradually nearer and nearer to the ground, until it comes into the position shown by Fig. 4, thus creating a torque which prevents capsizing of the airplane.

The flaps 2 above referred to may, according to the present invention, be controlled simultaneously with the wheel brakes, through a single operating organ. Besides, these flaps may, according to the invention, consist of the ailerons, and in this case, it is necessary to provide means for effecting, whenever necessary, the usual differential movements of said ailerons.

Fig. 6 diagrammatically shows an arrangement in which the aileron flaps are connected, on the one hand, with the brake control means, in such manner that, when said brakes are applied, said flaps are simultaneously turned upwardly, and, on the other hand, with the flight controls for differentially operating said flaps.

As shown by Fig. 6, flaps 2, which act as ailerons for the lateral control of the airplane, are operated through the control stick 29. This stick is connected through a double jointed parallellogram 30 with a sector-shaped member 31 which controls, in the usual manner, ailerons 2 through cables passing around an equalizing pulley 33. Sector shaped member 31 and pulley 33 are mounted, respectively, on the free ends of two symmetrical levers 34 the other ends of which are pivoted to a sliding member 35 adapted to move along a rectilinear guide 36. To the middle parts of levers 34 are pivoted rods 37 the free ends of which bear upon spindles supported by the frame of the airplane.

It will be readily understood that any displacement of sliding member 35 produces a symmetrical displacement of parts 31 and 33 toward, or away from, each other, and therefore a simultaneous upward or downward displacement of flaps 2.

The sliding movement of member 35 may be imparted through a control such as 42, by the brake lever 43 which, when actuated, produces a displacement of a toothed sector 44 which drives, in a manner similar to the action of a rack, a helical screw 45 connected to control 42. The position of the ailerons can be adjusted micrometrically to correspond with any position of the brake lever 43, when the latter is locked by a toothed sector 46, by turning a handwheel 47 or the like, which imparts a rotary movement to screw 45 the threads of which are, for this purpose, slightly inclined so as to be irreversible.

Of course, the examples above described have been given merely by way of example and might be modified. For instance, in the arrangement shown by Fig. 2, in which the double lift increase and life reduction is ensured by multiple flaps, the upper flaps such as 2^2 may be employed as ailerons and connected, for this purpose to the flight controls, while the lower flaps, such as 2^1, would constitute, when taken alone, the lift increase device. The common upward displacement of the lower and upper flaps is advantageously effected by the brake control.

In the arrangement shown by Fig. 1, the flap 2 may be connected to the surface 1 in such a manner as to be turned upwardly and downwardly, a passage being formed between the surface and the flap in both the cases.

In a general manner, while I have, in the above description, disclosed what I deem to be practical and efficient embodiments of the present invention, it should be well understood that I do not wish to be limited thereto as there might be changes made in the arrangement, disposition and form of the parts without departing from the principle of the present invention as comprehended within the scope of the appended claims.

What I claim is:

1. In a flying machine, having a fuselage, landing wheels arranged under the front part of said fuselage, and mechanical means for braking said landing wheels while running on the ground, at least one surface subjected to the reaction of air, at least one trailing edge flap of substantially smaller area than said surface mounted along and trailing the rear edge of said surface symmetrically at both sides of said fuselage, means for adjusting the angular position of said flap relative to said surface, the front part of said flap and the rear part of said surface being so shaped that a passage is formed between said surface and said flap when said flap is turned in the direction in which the rear edge thereof is raised, whereby the air stream flowing along the under side of said surface is deviated upwardly and the flap not only serves as an air brake but also as a lift eliminator for said surface, common means for controlling said braking means and for turning said flap in upward direction simultaneously with the actuation of said braking means, whereby the upward displacement of said air stream increases the adhesion of the machine to the ground and the action of said braking means can be increased.

2. In a flying machine, having a fuselage, landing wheels arranged under the front part of said fuselage, and mechanical means for braking said landing wheels while running on the ground, at least one surface subjected to the reaction of air, two trailing edge flaps of substantially smaller area than said surface mounted along and trailing the rear edge of said surface symmetrically at both sides of said fuselage, means for adjusting the angular position of both flaps relative to said surface and for moving them in the same direction, the front part of each said flap and the rear part of said surface being so shaped that passages are formed between said

surface and said flaps when said flaps are turned in the direction in which the rear edge thereof is raised, whereby the air stream flowing along the under side of said surface is deviated upwardly and the flap not only serves as an air brake but also as a lift eliminator for said surface, common means for controlling said braking means and for turning said two flaps in upward direction simultaneously with the actuation of said braking means, whereby the upward displacement of said air stream increases the adhesion of the machine to the ground and the action of said braking means can be increased.

3. In a flying machine, having a fuselage, landing wheels arranged under the front part of said fuselage, and mechanical means for braking said landing wheels during running on the ground, at least one surface subjected to the reaction of air, at least one trailing edge flap of substantially smaller area than said surface mounted along and trailing the rear edge of said surface symmetrically at both sides of said fuselage, means for adjusting the angular position of said flap with respect to said surface, the front part of said flap and the rear part of said surface being so shaped that a passage is formed between said surface and said flap when said flap is turned in the direction in which the rear edge thereof is raised, whereby the air stream flowing along the under side of said surface is deviated upwardly and the flap not only serves as an air brake but also as a lift eliminator for said surface, common means for controlling said braking means and for turning said flap in upward direction at an angle of less than 90° from its normal position simultaneously with the actuation of said braking means, whereby the upward displacement of said air stream increases the adhesion of the machine to the ground and the action of said braking means can be increased.

4. In a flying machine, having a fuselage, landing wheels arranged under the front part of said fuselage, and mechanical means for braking said landing wheels while running on the ground, at least one surface subjected to the reaction of air, at least one trailing edge flap mounted along and trailing the rear edge of said surface symmetrically at both sides of said fuselage, means for adjusting the angular position of said flap relative to said surface, common means for controlling said braking means and for turning said flap in upward direction simultaneously with the actuation of said braking means to act as an air brake and lift eliminator for said surface, and tail supporting means for gradually reducing the height of the tail of the machine from the ground as the machine is running along the ground and after landing in response to the killing of the lift and the application of the drag by the actuation of said flap.

5. A flying machine according to claim 1 in which said flap is pivoted to said surface about an axis located behind and below the leading edge of said flap.

6. A flying machine according to claim 1 in which said flap is so shaped and so connected to said surface that its leading edge projects beyond the under side of said surface when said flap is turned in the direction in which the rear edge thereof is raised.

7. In a flying machine having mechanical means for braking the movement of said machine running on the ground, at least one surface subjected to the reaction of air, two superposed flaps, means for pivotally securing said flaps to the rear part of said surface so as to be capable of turning with respect thereto about an axis close to their front parts, means for pivoting the lower flap in both directions from its intermediate position, in which it is in line with the underside of said surface, means for pivoting the upper flap only in the upward direction from its normal position, in which it is in line with the upper side of said surface, means for connecting said upper flap with said under flap only when said under flap is pivoted in upward direction, said flaps being so shaped and positioned relative to said surface that a passage is formed between the front parts of said flaps and the rear part of said surface when said flaps are pivoted in upward direction, whereby the airstream flowing along the underside of said surface is deviated upwardly through said passages so as to act on the upper sides of said flaps to increase the adhesion of the machine to the ground whereby the action of said mechanical braking means can be increased, said under flap, when pivoted downwardly, being adapted to act as a lift increase device, and means for controlling the position of said flaps with respect to said surface.

8. A flying machine according to claim 7 in which said flaps are shaped and positioned relative to each other to form a passage therebetween and to cause at least a portion of the airstream deviated by pivotal movement of said under flap in upward direction to flow between said flaps.

9. A flying machine according to claim 1 further including tail supporting means for gradually reducing the height of the tail of the machine from the ground as the machine is running along the ground after landing in response to the killing of the lift and the application of the drag by the actuation of said flap.

10. A flying machine according to claim 4, said tail supporting means comprising a member adapted to run on the ground, telescopic elements interposed between said member and the tail part of said flying machine, and means forming a part of said tail supporting means for gradually reducing the length of said telescopic elements when the machine is running on the ground.

11. A flying machine according to claim 4, said tail supporting means comprising a member adapted to run on the ground, a telescopic rod carrying said member at its lower end and pivotally connected about a horizontal axis to the tail part of said flying machine, a connecting rod pivoted about horizontal axes at one end to the said machine intermediate said telescopic rod and said landing wheels, and at the other end to the lower end of said telescopic rod, and means forming a part of said tail supporting means for gradually reducing the length of said telescopic rod when the machine is running on the ground, whereby said telescopic rod gradually pivots toward the tail end of said machine simultaneously with the gradual reduction of its length.

12. A flying machine according to claim 4, said tail supporting means comprising a member adapted to run on the ground, a telescopic rod carrying said member at its lower end and pivotally connected about a horizontal axis to the tail part of said flying machine, a connecting rod pivoted about horizontal axes at the upper end to said machine intermediate said telescopic rod and said landing wheels, and at the lower end to

the lower part of said telescopic rod, means forming a part of said tail supporting means for gradually reducing the length of said telescopic rod under the effect of the reaction of the ground on said member, when said member is in contact with the ground, whereby said telescopic rod gradually pivots toward the tail end of said machine simultaneously with the gradual reduction of its length, and means, operable from the pilot's seat, for pivoting said telescopic rod about said first mentioned axis for moving said member rearwardly, the pivoting movement of said telescopic rod in the opposite direction taking place freely.

13. A flying machine according to claim 4, said tail supporting means comprising a member adapted to run on the ground and telescoping elements interposed between said member and the tail part of said flying machine, said elements including a cylinder closed at one end and rigid with one of the two last mentioned parts, a hollow piston rigid with the other of said parts and slidable in said cylinder, the head of said piston being provided with a passage of restricted section, said passage connecting the inside of the piston with the inside of said cylinder, and a piston freely movable inside said first mentioned piston, the cylinder and first piston being filled with liquid.

14. A flying machine according to claim 4, said tail supporting means comprising a member adapted to run on the ground, and telescopic elements interposed between said member and the tail part of said flying machine, said telescopic elements including a cylinder closed at one end and rigid with one of the two last mentioned parts, a hollow piston rigid with the other of said parts and slidable in said cylinder, the head of said piston being provided with a passage of restricted section, said passage connecting the inside of said piston with the inside of said cylinder, a second piston freely movable inside said first mentioned piston, said first mentioned piston being provided with a socket at the bottom of the inside thereof, said second mentioned piston having an extension adapted to engage into said socket, said second piston being provided with a conduit extending from the free end of said extension to the opposite face of said second piston, said first piston and said cylinder being filled with a liquid, and a check valve adapted to control the last mentioned conduit so as to permit said liquid to flow from said socket to said opposite face of the second piston through said conduit.

15. A flying machine according to claim 4, said tail supporting means comprising a member adapted to run on the ground and telescopic elements interposed between said member and the tail part of the apparatus, said elements including a cylinder closed at one end and rigid with one of the two last mentioned parts, a hollow piston rigid with the other of said parts and slidable in said cylinder, the head of said piston being provided with a passage of restricted section, said passage connecting the inside of the piston with the inside of the cylinder, and a second piston freely movable inside said first mentioned piston, said first mentioned piston and said cylinder being filled with a liquid, said first mentioned piston being provided, near the bottom thereof, with a conduit connecting the inside thereof with the outside, said last conduit opening into the atmosphere when said first piston is in one position relative to said cylinder and being closed when said first piston is in another position relative to said cylinder.

16. In an airplane having mechanical means for braking the movement of said airplane when running on the ground and at least one wing, a flap, means for securing said flap to the rear of said wing on each side of the middle part thereof, means for adjusting the angular position of each flap with respect to said wing, the front part of each flap and the rear part of the wing being so shaped that a passage is formed between said wing and said flap when said flap is turned in the direction in which the rear edge thereof is raised, whereby the airstream flowing along the underside of said wing is deviated upwardly so as to increase the adhesion of the airplane to the ground, means operatively connected to the controls of the airplane, for simultaneously turning said flaps with respect to said wing in opposite directions, respectively, control means for said mechanical braking means, and means, operatively connected with said last mentioned control means, for simultaneously turning both flaps in the direction in which the rear edges thereof are raised.

17. An airplane according to claim 16 in which the means for simultaneously turning said flaps in opposite directions include a pivoting member movable angularly by the flight controls of the airplane and transmission means interposed between said flaps and opposite ends of said pivoting member, respectively, the means for simultaneously turning said flaps in the same direction including a mechanical transmission, operable by said brake control means, for imparting translatory displacements to said pivoting member.

18. A flying machine according to claim 1 in which a passage is formed between said surface and said flap by turning the latter upwardly as well as downwardly.

19. A flying machine having a body, at least one surface subjected to the reaction of air and means for braking the movement of said machine when running on the ground, said means comprising mechanical braking means, a flap adapted to create an aerodynamic moment for preventing capsizing of the machine and for killing the lift when said mechanical braking means are actuated, a member adapted to run on the ground, supporting means interposed between said member and said body and means adapted to vary the length of said supporting means in such a manner as to increase gradually the inclination of the axis of said body with respect to the ground in response to the killing of the lift and the application of the drag by the actuation of said flap.

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