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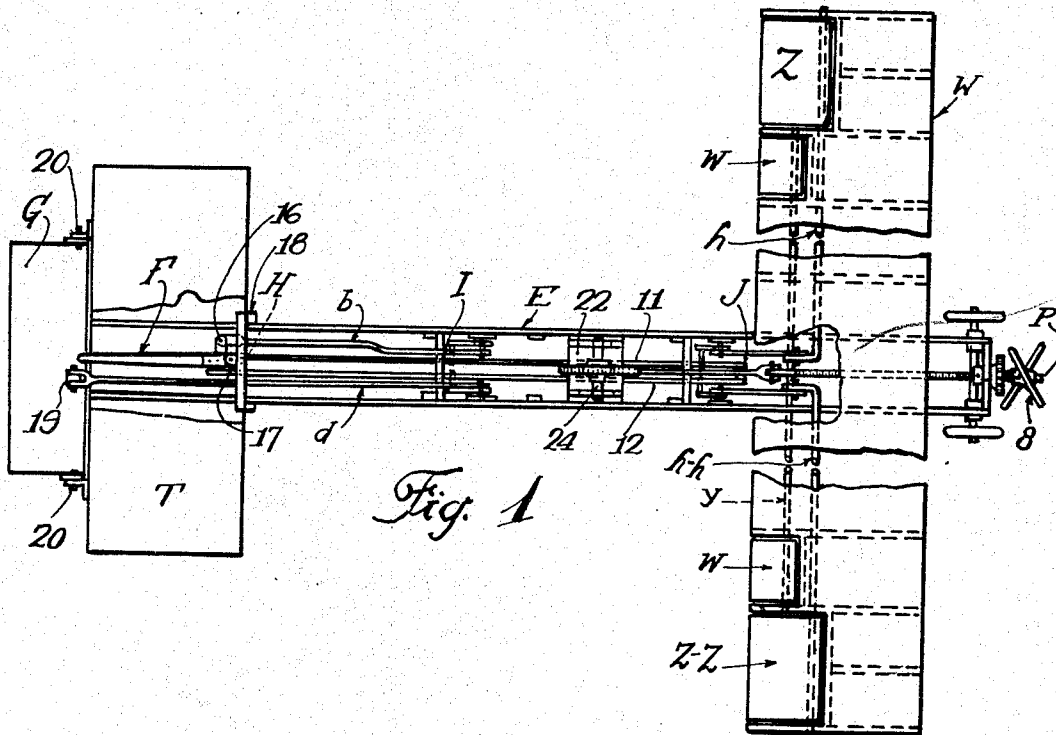
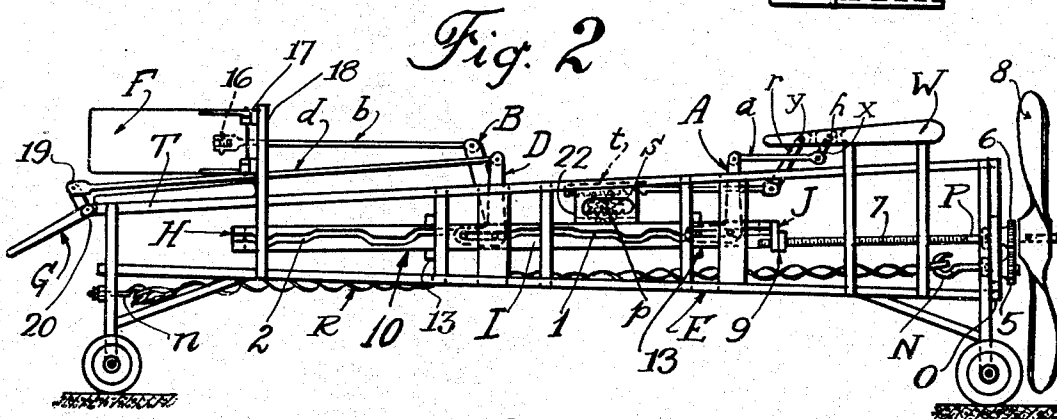
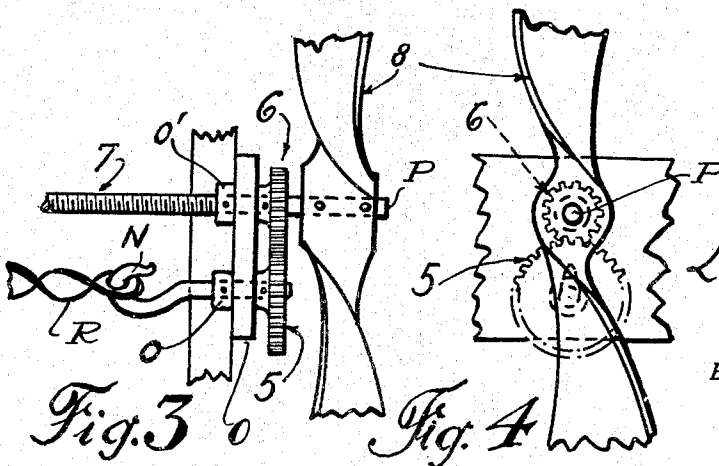
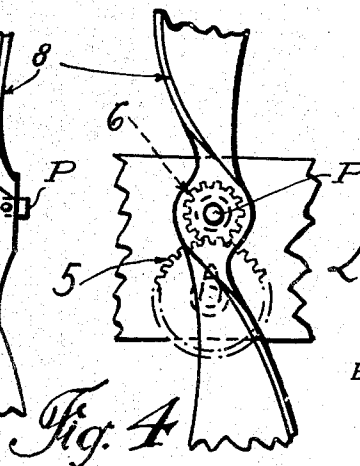
L. WEIMERSKIRCH

2,098,019

MECHANICAL AUTOMATIC PILOT

Filed Oct. 24, 1935

2 Sheets-Sheet 1



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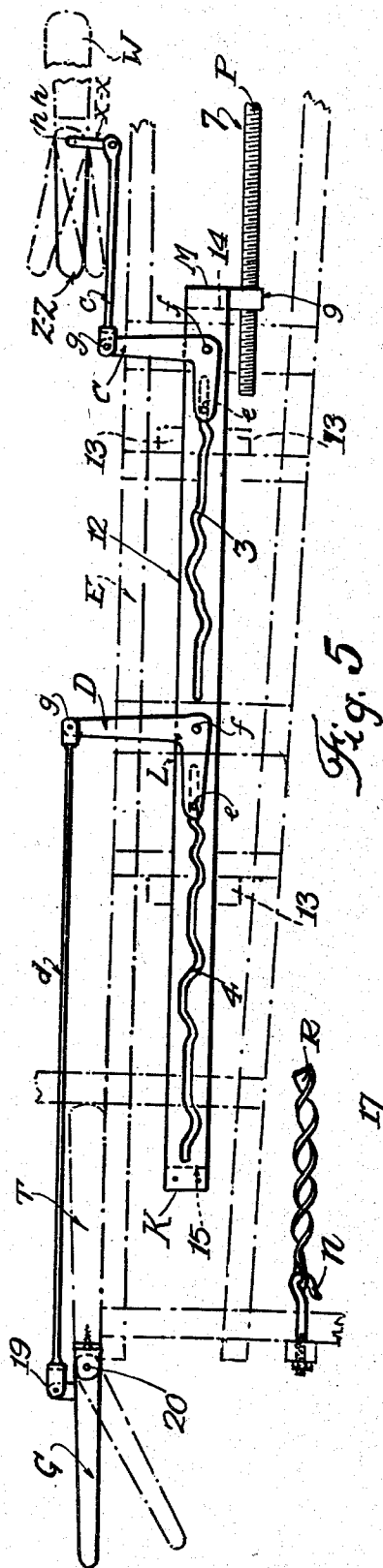
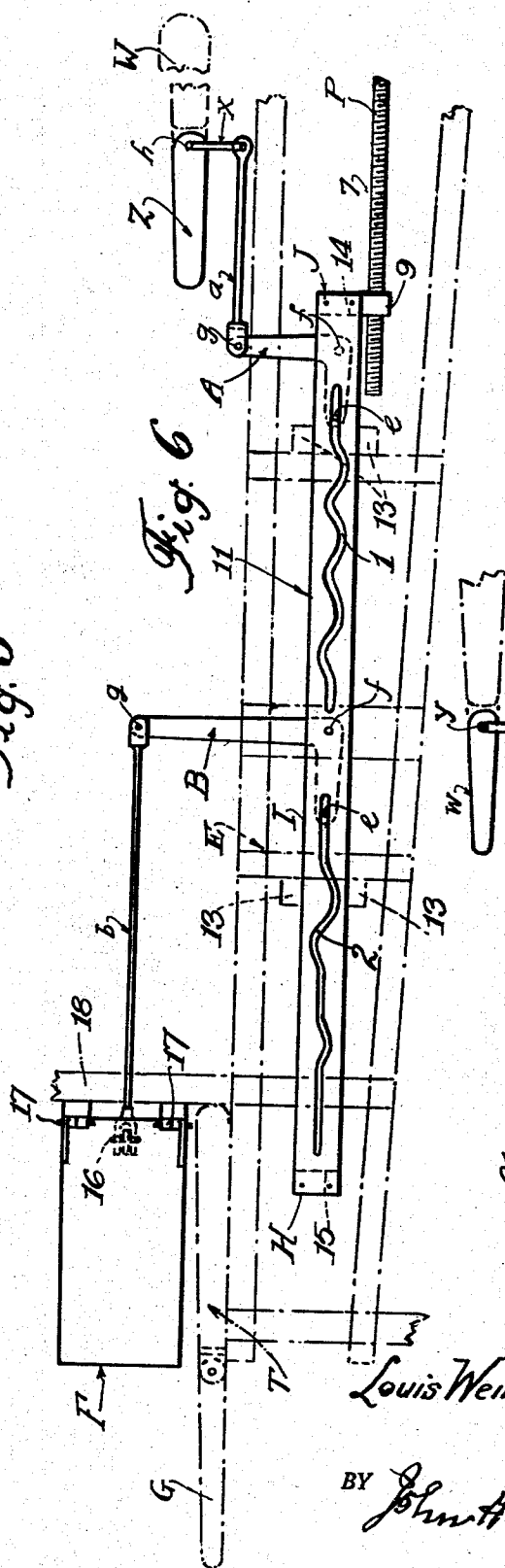
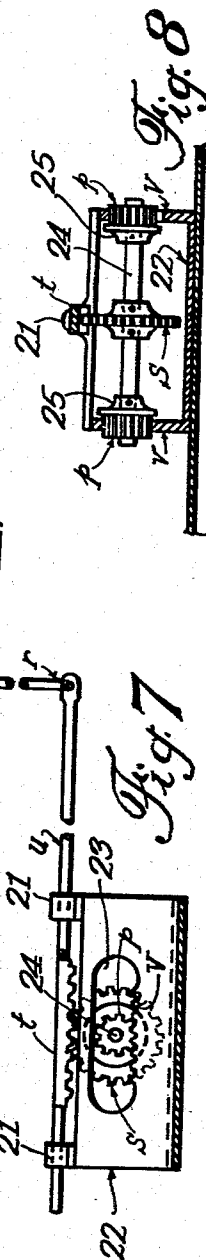
L. WEIMERSKIRCH

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MECHANICAL AUTOMATIC PILOT

Filed Oct. 24, 1935

2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE

2,098,019

MECHANICAL AUTOMATIC PILOT

Louis Weimerskirch, Pittsburgh, Pa.

Application October 24, 1935, Serial No. 46,552

5 Claims. (Cl. 46—78)

This invention relates to flying machines and more in particular to mechanical automatic pilots for airplanes and "lighter than air" flying machines.

One of the primary objects of this invention is to provide airplanes and other flying machines with a full mechanically operated automatic control system whereby the various movements or evolutions of the airplane may be predetermined for a complete flight, from "take-off" to "landing"; this mechanical automatic control being installed entirely within the flying device and, therefore, not subject to outside influences, while in flight, as may be the case with so-called radio-controlled flying machines, wherein the radio-controlled devices may be influenced by contrary radio-waves emitted from the ground or from another flying machine.

Another object of this invention is to provide in flying machines mechanically operated automatic devices to hold such machines in a level flying position once the machines have reached predetermined altitudes.

Still another object of this invention is to incorporate in flying machines flight-controlling means which may be readily applied to, or removed from, said machines, so that other controlling means intended to predetermine different flying operations or evolutions may be installed in short order and very easily.

Yet another object of this invention is to provide mechanical automatic control systems in flying machines, which systems are relatively simple in construction, application, and which may be actuated by any desired and suitable type of prime-mover.

Additional features and advantages of this invention will appear in the course of the following description considered in connection with the accompanying drawings forming a part of this application and which show the application of this invention to the control of a toy or model airplane.

In the drawings:

Fig. 1 is a top plan view of the toy airplane, with some parts broken away or completely eliminated to show the operating mechanism.

Fig. 2 is a side elevation of Fig. 1.

Fig. 3 is a fragmentary side elevation of the driving connections between the prime-mover and the propeller of the airplane.

Fig. 4 is a front elevation of Fig. 3.

Fig. 5 is a side elevation, on an enlarged scale, showing the automatic control mechanism for

one of the main ailerons and the so-called "elevator" of the airplane.

Fig. 6 is a similar view showing the control mechanism for the other main aileron and the rudder of the airplane.

Fig. 7 is a side elevation showing on an enlarged scale the mechanism for automatically stabilizing the level flight of the airplane, after it has reached the desired and predetermined altitude.

Fig. 8 is a cross-sectional view through the rack and gear mechanism shown in Fig. 7.

Reference being had to the drawings, the toy airplane shown therein comprises the following essential parts, to wit: the fuselage E (shown without its outer covering), the supporting wing W, the tail-wing T, the rudder F, the elevator G, the main ailerons Z and (Z—Z), the stabilizer ailerons w and the propeller 8.

The motive power to drive the propeller is, in this embodiment, assumed to be derived from the rubber strip R extending longitudinally of the fuselage and having its rear end secured to a stationary hook n, whereas its forward end is secured to a hook N, the shank of which is revolutely mounted in the front cross-member O of the fuselage and held in place thereon by means of a collar (o) and the spur gear 5, both fastened to said shank. This gear meshes with another one 6 secured on the outer end of the propeller shaft P which is also rotatably mounted in the cross-member O and held against axial displacement by the collar (o'). The inner portion of the propeller-shaft P is provided throughout beyond said collar with screw threads 7, for a purpose to be described hereinafter.

The required movements of the ailerons, rudder and elevator, for a predetermined performance of the airplane, are automatically controlled by a system of longitudinal cams and levers shown especially in Figs. 1, 5, and 6.

As shown therein, there are two parallel cam-rails 11 and 12 which are removably mounted for longitudinal sliding movement between guide-blocks 13 secured in any desired manner to the fuselage. The left hand cam-rail 11 has two longitudinal cam-slots 1 and 2, suitably shaped to respectively control the movements of the main-aileron Z and the rudder F. The right-hand cam-rail 12 also has two longitudinal cam-slots 3 and 4 which control the automatic operation of the main aileron (Z—Z) and the elevator G, respectively. These two cam-rails are made preferably of equal length and are secured in parallel relation by suitable means, such as the

spacers 14 and 15. Below the front spacer 14 is secured a threaded block, or nut, 9 suitably threaded to cooperate with the threaded portion 7 of the propeller shaft P.

5 The movements of the main aileron Z are controlled from the cam-slot 1 by means of a mechanism comprising a bell-crank-lever A fulcrumed on a stationary shaft *f* securely mounted on one side of the fuselage E. The horizontal arm of 10 this lever carries a pin *e* which engages the cam-slot 1 and at the end of the upper arm of this lever there is connected by means of the pin-connection *g* a horizontal connecting rod *a* which connects at its forward end with the arm *x* positioned at the inner end of the aileron-shaft *h* 15 rotatably supported in the frame work of the supporting wing W.

The rudder F is controlled from the cam-slot 2 by means of a similar mechanism comprising the 20 bell-crank-lever B fulcrumed on a stationary shaft *f* and having on its horizontal arm a pin *e* adapted to travel in the cam-slot 2. At the end of the upper arm of this lever is secured by the pin-connection *g* the horizontal connecting rod *b*, the outer end of which is hinged, as at 16 to one 25 side of the rudder F, supported by means of the hinges 17 mounted on a vertical frame 18, of any suitable and desired design, erected on the frame structure of the fuselage.

30 The righthand main-aileron (Z—Z) is controlled by the cam-slot 3 in the cam-rail 12 and the mechanism is similar to the ones above described and comprises the bell-crank-lever C with the pin *e*, the hinge-connection *g*, the connecting-rod *c*, connected to the arm (*x*—*x*) of the aileron-shaft (*h*—*h*), rockably mounted in the right 35 hand side of the frame of the supporting wing W, to which shaft said aileron is secured.

The elevator G is controlled by the cam-slot 4 40 in the rear end of the cam-rail 12, by the agency of the bell-crank-lever D fulcrumed at *f*, the pin *e*, the pin-connection *g*, the horizontal connecting rod *d*, connected at its rear end by the hinge-connection 19 to said elevator, the latter being 45 hinged, as at 20, to the tail-wing T of the airplane.

As stated heretofore, the purpose of the stabilizer-ailerons is to cause the flying machine to which applied to fly level, once the desired altitude of flight has been reached. The control 50 mechanism for these stabilizer-ailerons is independent of the cam-rails mentioned hereinabove and is governed entirely by the force of gravity.

As illustrated in Figs. 1, 2, 7, and 8, two such 55 stabilizer-ailerons are used, positioned in the supporting-wing W and disposed symmetrically on each side thereof. Both stabilizers are secured on a common shaft *y*, rockably mounted in the frame-structure of the supporting-wing, and are preferably placed in close proximity of the main 60 ailerons, as shown in Fig. 1, for greater effectiveness. Near the middle of the shaft *y* there is secured thereon a downwardly directed arm *r*, to the lower end of which is hingedly connected the outer portion *u* of a rack-bar *t*, supported for 65 reciprocal movement in the bearings 21 mounted on top of a gear-frame 22 suitably secured in a substantially horizontal position above the cam-rails, to the fuselage, in any desired manner.

70 In each of the two opposite and longitudinal sides of the gear-frame is cut a large, oblong aperture 23, the lower edge of which is provided with a rack *v* while the upper edge is straight and smooth. Placed transversely of the 75 gear-frame is a shaft 24 having at each end a

spur-gear *p* in mesh with its corresponding rack *v* and freely guided by the smooth upper edge of the aperture 23. Collars 25 are used to hold said shaft against axial displacement and the 5 gears in proper mesh with the racks. At the middle of the shaft there is securely mounted a larger gear S which meshes with the teeth of the rackbar *t*.

It will be noted that, if for any particular reason, the flying machine tends to fly upward from 10 its level flight, the gear frame, together with the fuselage, will assume a rearwardly inclined position thereby causing the freely mounted shaft 24 and attached gears to roll backwards. This 15 movement causes the gear S to shaft the rackbar *t* towards the lower, or rear, end of the machine and thus impart to the stabilizer ailerons a clockwise, or upward, rotation which creates 20 added air resistance and automatically corrects the upward flying tendency of the machine. A downward flying tendency of the machine will, of course, cause the stabilizer-ailerons to turn counterclockwise, or downward, to thus counteract 25 said tendency.

There are periods during the flight of the machine, especially during the "take-off" and the "landing" periods, when the equalizer-ailerons and the main ailerons work in opposition to each other. However, the retarding influence of the 30 stabilizer ailerons, owing to their relatively limited size as compared to the main-ailerons, may be easily overcome by correspondingly increasing the movements of the latter, which will be obtained by suitably accentuating the undulations in the 35 corresponding cam-slots 1, 3 and 4.

The operation of the illustrated embodiment of this invention may be briefly described as follows: Assuming that the proper set of cam-rails be placed in the airplane to perform a predetermined trajectory, the propeller 8 is rotated backwards, thereby winding the rubber-strip R, which 40 serves as prime-mover. Upon releasing the propeller, the stored energy in said rubber-strip will rotate the propeller in the normal direction, thus initiating the "take-off". The rotation of the 45 propeller shaft P, by virtue of the threaded portion 7, causes the two cam-rails 11 and 12 to travel slowly forward, thus bringing various parts of the cam-slots in contact with the pins *e* of the different bell-crank-levers which control the 50 main-ailerons, the rudder and the elevator during the flight and landing of the airplane.

By simply installing different sets of cam-rails, the same airplane may be conditioned to perform 55 different evolutions, as will be readily understood.

As shown in particular in Figs. 5 and 6, the various cam-slots comprise horizontal parts followed by contiguous sinuous parts. The straight 60 horizontal parts correspond to the normal horizontal and straight flight of the airplane, whereas the sinuous portions will determine the up or down and sideways evolutions of the airplane. The more accentuated said sinuous parts are, the more pronounced and sudden will be said evolutions, and the gradual evolutions will be determined by drawn out sinuosities. 65

Moreover, the length of the predetermined flight will also affect the shape of the cam-slot, which, for long flights, would be practically level or of "neutral" shape in the middle, whereas the 70 two ends would be sinuous to effect a proper "take-off" and landing and an intermediate period of flight at a constant, predetermined, altitude and direction, as will be readily understood.

It is evident that when the invention is to be 75

applied to large airplane models, or even commercial planes, the necessary power could not be derived from rubber-strips, but that engines, such as internal combustion engines or compressed air motors would be used. In this case, the gear drive between the engine and the propeller-shaft would have to be revised to allow for different speeds and provisions,—operated from the cam-rails,—would have to be made to stop the flow of fuel, or compressed air as the case may be, when the airplane is about to land, all of which variations will be readily conceived and realized by persons versed in this art.

In "lighter than air" flying machines, the power requirements may be relatively less than for airplanes because of the inherent buoyancy of the former, so that only sufficient power will be required to propel them and perform the various evolutions.

In the drawings I have shown a toy airplane provided with two cam-rails, each including two cam-slots arranged in tandem. However, each cam-slot may have its own cam-rail; that is, four cam-rails, held in spaced parallel relation by suitable spacers 14 and 15, can be used and operated simultaneously by a mechanism similar to the one hereinabove described. Such an arrangement might prove preferable in airplanes intended for relatively long flights.

As will be understood, as suggested herein, other changes may be made in the construction and arrangement of the details of my invention without departing from the field and scope of the same, and I intend to include all such variations, as fall within the scope of the appended claims in this application, in which my invention has been disclosed only as applied to a toy airplane. I claim:

1. In a flying machine comprising ailerons, elevators and a single rudder, individual longitudinally slidable cams mounted within the body of the fuselage of said machine and adapted to control the movements thereof to cause said machine to perform pre-determined evolutions, and unitary means to slide said cams and propel said flying machine.

2. In a flying machine including a supporting wing, main-ailerons and stabilizer-ailerons, individual cam actuated systems of levers to control the movements of said main-ailerons; unitary

means to operate said cams and propel said machine, and gravity actuated means independent of said unitary means to operate said stabilizer-ailerons.

3. In a flying machine including a fuselage, a tail-wing and a front wing, a plurality of stabilizer-ailerons; a common shaft therefor mounted rockably in said front wing; an arm secured to said shaft; a normally horizontal rack-bar connected at one end to said cam; a rack at the other end of said rack-bar; a frame mounted in said fuselage; guide-means on said frame constructed to guide said rack-bar for longitudinal movement; a rack-gear in meshing relation with said rack, and means to support said gear in said frame for combined longitudinal and rotary movements.

4. In a flying machine including a fuselage, a tail-wing and a front-wing, a plurality of stabilizer-ailerons; a common shaft therefor rockably mounted in said front-wing; an arm secured to said shaft; a normally horizontal rack-bar connected at one end to said arm; a rack at the other end of said rack-bar; a frame mounted in said fuselage; guide-means on said frame constructed to guide said rack-bar for longitudinal sliding movement; a rack-gear in mesh with said rack; a shaft for said rack-gear; an end-gear secured at each end of said shaft, and means to guide said shaft and gears for combined longitudinal and rotary movements in said frame.

5. In a flying machine including a fuselage, a tail-wing and a front-wing, a plurality of stabilizer-ailerons; a common shaft therefor rockably mounted in said front-wing; an arm secured to said shaft; a normally horizontal rack-bar connected at one end to said arm; a rack at the other end of said rack-bar; a frame mounted in said fuselage; guide means on said frame constructed to guide said rack-bar for longitudinal sliding movement; a rack-gear in mesh with said rack; a shaft for said rack-gear; an end-gear secured at each end of said shaft, the two parallel sides of said frame having each a longitudinal slot adapted to be engaged by its corresponding end-gear; one longitudinal side of each slot being smooth and a rack cut on the opposite side of said slot in meshing engagement with said end-gear.

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