Sept. 3, 1929. R. F. HALL 1,726,558

AIRPLANE

Filed Dec. 31, 1926

Fig. 1.

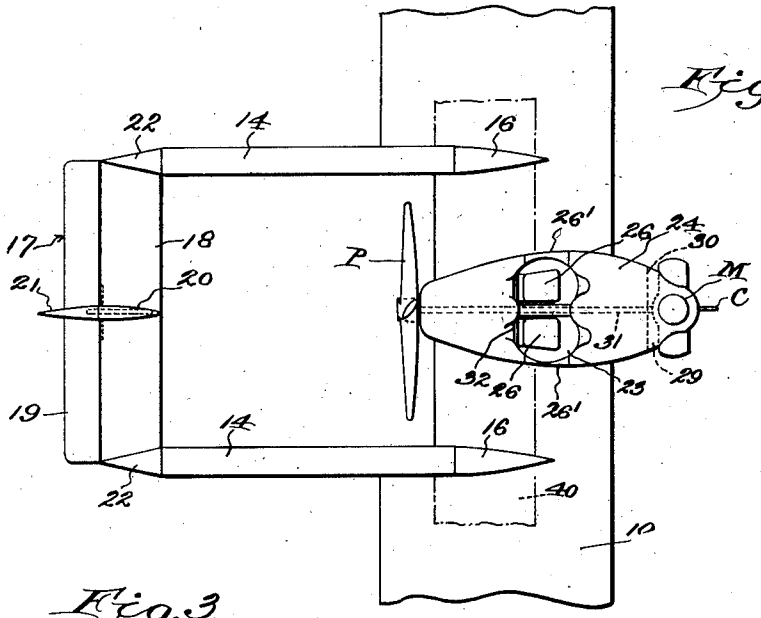


Fig. 3.

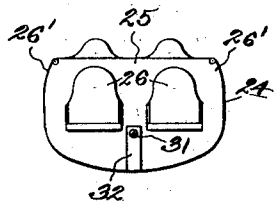
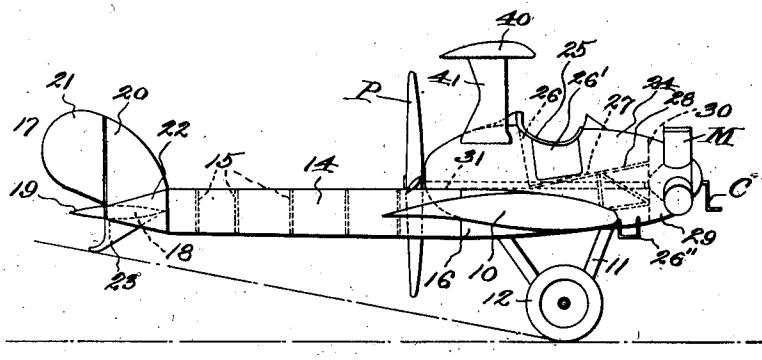


Fig. 2.



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Patented Sept. 3, 1929. 1,726,558

UNITED STATES PATENT OFFICE.

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AIRPLANE.

Application filed December 31, 1926. Serial No. 158,220.

This invention relates to certain improvements in airplanes; and the nature and objects of the invention will be readily recognized and understood by those skilled in the arts involved in the light of the following explanation and detailed description of the accompanying drawings illustrating what I, at present, consider to be the preferred embodiments or mechanical and aerodynamical expressions of my invention, from among various other forms, arrangements, combinations and constructions of which the invention is capable within the spirit and scope thereof.

The invention is primarily directed to the provision of an airplane of the light plane type which is peculiarly adapted for sport purposes and for what may be termed, amateur use, although equally adapted for commercial use as well as operation by professional pilots, which airplane lends itself readily to quantity production on a commercial basis to permit of relatively low cost of manufacture and low cost to the purchaser, and further which will be stable and safe in operation for the purposes for which intended. With an airplane of the general type referred to, safety with low cost and ease of operation and of maintenance, are fundamental requirements, and the present design fulfills and meets these requirements in a very high degree.

An airplane of the invention is characterized generally by a design which embodies the use of an outrigged empennage with a cantilever or semi-cantilever type of main wing on which a nacelle or body is mounted, carrying at its forward or nose end, a relatively light horsepower, aircooled, radial type of motor which drives a pusher propeller located at the rear end of the nacelle, within and protected by the outrigger structure, thus insuring safety to the occupants in the event of the craft nosing over, as well as through the elimination of an exposed unguarded propeller, while at the same time, by the propeller location, the occupants are removed from the slip stream.

Among the features of the invention which contribute largely to the low cost, quantity production possibilities of the invention, are the formation of the outrigger structure from spaced girders having a constant section throughout their length and of the built-up monocoque type permitting the use of a single size former throughout; the use of a cantilever or semi-cantilever type of wing from which the occupant seats and the motor are individually supported, and the provision of a nacelle or body, detachably mounted on and above the wing, surrounding and housing the seats for protection and stream lining purposes only, the nacelle preferably formed of a shell capable of being stamped out or pressed from suitable sheet material; the provision of an outrigger structure in which the empennage is formed by a single stabilizer extending across and between and fairing the ends of the outrigger girders, with a single elevator, vertical fin and rudder disposed centrally thereof in the line of the propeller slip stream; the detachable mounting of a radial, aircooled motor, on and in stream line continuation of the nose end of the nacelle, with a direct extension shaft extending rearwardly through the nacelle to and driving the pusher propeller at the rear end thereof; simplicity of design with particular reference to the rigging, with a maximum factor of safety and minimum of maintenance.

With the foregoing general objects and certain other objects and results in view, which other objects and results will be readily recognized and understood from the following explanation, the invention consists in certain novel features in construction and in combinations and arrangements of elements as will be more fully and particularly referred to and specified hereinafter.

Referring to the accompanying drawings in which similar reference numerals refer to corresponding parts throughout the several figures thereof:

Fig. 1 is a top plan view of an airplane embodying the several features of an invention, the optional upper wing being indicated in dotted outline.

Fig. 2 is a side elevation of the airplane of Fig. 1, and showing an upper wing included therein.

Fig. 3 is a transverse vertical section more or less diagrammatical through the cockpit of the nacelle, showing the seating arrangement and the disposition and mounting of the propeller drive shaft.

The invention is presented in the accompanying drawings and described herewith, as embodied in an airplane of the light plane or sport type, but the several features which the invention includes are not restricted in

any sense to the type of airplane herein disclosed, which type was selected purely by way of example, and not of limitation to more clearly present the various features and characteristics of the invention. It will be obvious to those skilled in this art, that the various features of the invention are capable of application to and embodiment in airplanes generally.

According to the disclosed example of the invention, the airplane includes a main wing 10, of the cantilever or semi-cantilever type, forming in effect, a monoplane wing of the relatively thick section, high lift type. A landing gear or chassis is mounted depending from the wing 10, centrally of the span thereof, and includes the trusses 11 secured at their upper ends to the internal trussing of wing 10, and carrying at their lower ends, the landing or ground wheels 12, all in the usual manner familiar in this art. The airplane is of the outrigger type, and embodies the spaced rearwardly extending outrigger girders 14, extending from points at opposite sides of and equidistant from the longitudinal center of wing 10. These girders 14 are of the built-up or monocoque type comprising a series of formers 15 (see Fig. 2) covered by and enclosed within a suitable skin or covering to form the complete girder. The girders 14 are further of a constant section throughout their length, formers 15 being of the same size and shape throughout the length of a girder, which permits low cost quantity production of these girders with the added feature of interchangeability. The wing 10 at and between the girders 14 is preferably cut away or of less chord than the chord of the outer lengths of the wing, for purposes appearing hereinafter, and the girders 14 extend inwardly or forwardly a distance of the wing span where they are detachably coupled with and connected to the covered built-in trusses 16, which form abutments for and forward continuations of the girders and are tapered forwardly to stream line or fair the same. The built-in trusses 16, are secured to and form a part of the trussing of the wing 10, so that the girder loads and stresses are transmitted to the trusses 16 and equally distributed to and through the wing trussing with which connected.

The rear ends of the girders 14, carry and support an empennage or tail structure 17 which embodies a fixed horizontal stabilizer 18, elevator 19 pivotally mounted along the stabilizer trailing edge, and a vertical fin or stabilizer 20, with a rudder 21 pivotally mounted along the trailing edge of the vertical fin. The horizontal stabilizer 18 extends across and between and is secured to the rear ends of girders 14 through the medium of the covered trusses 22, which are secured to the girder ends and stream line or form fairing for the girders in rearward continuation thereof. These trusses 22 are built into and form the outer ends of the stabilizer 18 as will be clear by reference to Figs. 1 and 2 of the drawings. The vertical stabilizer 20, is mounted centrally or stabilizer 18 along the longitudinal or fore and aft axis of the airplane, with the rudder 21 extending rearwardly therefrom in continuation thereof, and likewise along the longitudinal axis within the propeller slip stream to insure maximum rudder performance. The elevator 17 forms a rearward continuation of and is pivoted to stabilizer 18 in the usual manner. A tail skid 23 is mounted on and depends downwardly from the under side of stabilizer 18, below and in vertical alinement with fin 20, so that this tail skid 23 is disposed on the longitudinal axis of the airplane, and insures equal distribution of landing stresses to and between the outrigger girders 14. The usual or any other desired control mechanism (not shown) is provided for elevator 19 and rudder 21, operable from the control cockpit of the airplane.

A stream lined nacelle or body forming structure or shell 24 is detachably and removably secured to wing 10 and extending upwardly therefrom, transversely thereof, along the fore and aft or longitudinal axis of the airplane, and disposed centrally of and between the outrigger girders 14 and for forward end abutments 16. This nacelle or body 24 extends forwardly beyond the leading edge of wing 10, and extends rearwardly a distance beyond the trailing edge of wing 10 between the outrigger girders 14. A suitable cockpit 25 is formed intermediate the forward and rear ends thereof, and opens upwardly through the top or upper wall thereof. The nacelle structure 24 is preferably, although not necessarily, formed of suitable sheet material which can be stamped or pressed out in quantities at relatively low cost, and this structure merely forms and provides a stream line housing or fairing for the cockpit and structure therewithin, as well as for structure or elements mounted thereon. An arrangement of seats 26 is provided within the cockpit 25 of nacelle 24, and in the example hereof an arrangement of two seats in side by side relation is shown, although obviously other seating arrangements and number of seats can be provided if desired or found expedient. The seats 26 are not supported by the nacelle 24, but are supported directly from and carried by the wing 10 through the medium of trusses or supports 27 extending upwardly from and connected with the wing trusses, as will be clear by reference to Fig. 2 of the drawings. In this manner, the loads carried by the seats are directly transmitted to the wing, and no loads or stresses are imposed upon the nacelle structure. To render the cockpit 25 and the

seats 26 readily accessible, opposite side doors 26′ are provided in nacelle 24. As an aid for mounting into the cockpit 25 through doors 26′, steps 26″ are provided depending from nacelle 24 forwardly of wing 10.

A motor M of the low power, aircooled, radial type is mounted and disposed at the forward or nose end of the nacelle 24, forward of and spaced from the leading edge of wing 10. The motor M is supported directly from the wing 10 by means of a forwardly extending truss or support 28 (see Fig. 2) which extends upwardly from wing 10 and forwardly through the nacelle 24. The motor M is preferably mounted within and carried by a casing 29, which in mounted position of the motor, forms and provides a stream line continuation of the nacelle 24. The motor M with this casing 29, forms a unit which is detachably mounted and secured on and to the forward end of nacelle 24, thereby enabling ready replacement of motor M, as well as accessibility therefor. A fire wall 30 is preferably disposed at the nose end of nacelle 24, completely shutting off and protecting the interior of the nacelle from the motor end. With the motor M mounted and disposed as described and shown, a starting crank C can be provided which is operable from the ground to start the motor M.

A direct shaft 31 is provided extending rearwardly from motor M through the nacelle 24 and cockpit 25, to and outwardly through the rear end of the nacelle, where a pusher propeller P in the present instance of the four bladed type, is mounted for direct driving by shaft 31 from motor M. The shaft 31 extends between seats 26 and is disposed longitudinally of nacelle 24 along the fore and aft axis of the airplane. A guard or housing 32 extends through nacelle 24 and forms a shaft well within which shaft 31 is mounted and operates. By this arrangement of motor M and propeller P, the propeller is mounted and disposed in the space to the rear of wing 10 between the spaced outrigger girders 14, and is thus protected by the surrounding structure and eliminates the danger attendant an exposed propeller, and prevents the possibility of those on the ground walking into the same. Further, by the use of a pusher propeller rearwardly of cockpit 25, the cockpit is removed from and not subjected to the slip stream, making it more comfortable for occupants of the cockpit, as will be readily understood.

If desired, a small upper wing 40 can be provided, disposed above and across nacelle 24 rearwardly of the cockpit 25, which wing will afford additional protection to occupants of the cockpit in the event of a nose over and which further provides a location for mounting the fuel tank for a gravity fuel system for the motor M, with all the many advantages arising from the use of a simple gravity system. The small upper wing 40 is carried and supported by struts 41, extending upwardly from nacelle 24, and vertical struts (not shown) at the girder attachments. This wing 40, with its trussing especially with cross wire bracing between the referred struts, will provide torsional rigidity between the outrigger wing supports and the nacelle. However, attention is directed to the fact that all features of the invention are not limited to the employment in the design of this small upper wing 40.

Thus, by a design of the invention, an airplane of the light plane type is provided, which will be practical for the amateur pilot or individual owner. The mounting of the propeller in the space between outrigger girders 14, eliminates the danger of anyone walking into this propeller, and further by this mounting, a maximum propeller ground clearance is obtained during take off. The mounting of motor M at the nose end of nacelle 24, in combination with the pusher propeller enables the use of the starting crank C and also protects the occupants of the nacelle in case of a nose over, which is of considerable importance in a machine of this type designed for sporting or amateur use. The simplicity and practical elimination of complicated rigging arrangement, due to the use of the main cantilever or semi-cantilever type of wing 10, materially reduces maintenance as well as manufacturing difficulties and makes it possible to operate such a craft with minimum attention. A high lift wing can be employed for improved performance, and which will enable the use of a small powered light weight motor of low fuel consumption. The construction and arrangement is such that the airplane can be readily knocked down or disassembled for shipment and transportation, and as readily assembled, while these features also tend as hereinbefore explained, to enable quantity production at low cost.

It is also evident that various substitutions, modifications, variations and changes might be resorted to without departing from the spirit and scope of my invention, and hence I do not wish to limit myself to the exact and specific disclosures hereof.

Desiring to protect my invention in the broadest manner legally possible, what I claim and desire to secure by Letters Patent of the United States, is:

1. The combination in an airplane of; a main supporting wing of the internally trussed type, spaced rearwardly extending outrigger girders supported at their forward ends from the wing trussing, an empennage supported on said outrigger girders, the girders transmitting empennage loads directly to said wing trussing, a motor supporting truss extending forwardly and upwardly from and supported by the wing trussing, a

motor mounted and supported on the forward end of said truss spaced forwardly from the wing leading edge, the motor truss disposed along the longitudinal axis of the airplane and transmitting motor loads directly to the wing trussing, a propeller shaft extending rearwardly from said motor across said wing, a pusher propeller mounted on said shaft to the rear of the wing trailing edge between and laterally protected by said outrigger girders, a streamline nacelle forming body mounted on the wing extending between and fairing said motor, said nacelle forming body providing a cockpit therewithin, and seats disposed within the cockpit formed by said body, said seats supported on and transmitting their loads directly to the wing trussing, the said nacelle forming body unstressed by the motor, propeller, empennage, and seat loads, all of which are transmitted directly to the wing trussing.

2. The combination in an airplane of; a main supporting wing, an empennage supported from said wing and having its loads transmitted directly to the wing, a motor truss disposed along the longitudinal axis of the airplane and supported from the wing extending forwardly therefrom, a motor mounted on the forward end of the truss with the truss transmitting motor loads directly to the wing, a pusher propeller mounted at the rear of the wing trailing edge, a propeller shaft extending rearwardly from the motor across the wing to and for driving said propeller with the propeller and shaft loads transmitted directly to the wing, a nacelle forming body secured in position on the wing extending rearwardly from the motor to the propeller over and enclosing the motor truss and steamlining the motor, said nacelle forming body providing a useful load compartment therewithin above the wing between the motor and propeller, and the wing within the useful load compartment receiving and supporting a useful load therewithin without stressing said body which latter forms a protecting and fairing enclosure therefor solely.

3. The combination is an airplane of; a wing, a nacelle forming body mounted on the upper side of said wing and supported thereby extending thereacross along the longitudinal axis of the airplane, a motor supported directly from and transmitting its loads to the wing at the forward end of said nacelle forming body and rearwardly faired by said body, a propeller shaft extending from the motor rearwardly across and supported directly by the wing within said body, a pusher propeller on the rear end of said shaft at the exterior of said body aft of the wing trailing edge with the propeller loads transmitted directly to the wing, said nacelle forming body providing a cockpit therewithin above said wing between the motor and the propeller, occupant seats mounted on and supported by said wing within the body cockpit and transmitting their loads directly to the wing, spaced outrigger girders supported and extending rearwardly from the wing at opposite sides of and protecting said pusher propeller, and an empennage mounted on the rear ends of said girders with the girders transmitting empennage loads directly to the wing; the motor, propeller and shaft, seat, and the empennage loads being all transmitted to said wing without passing through the nacelle forming body which is unstressed thereby.

Signed at Ithaca, New York, this 23rd day of December, 1926.

RANDOLPH F. HALL.