

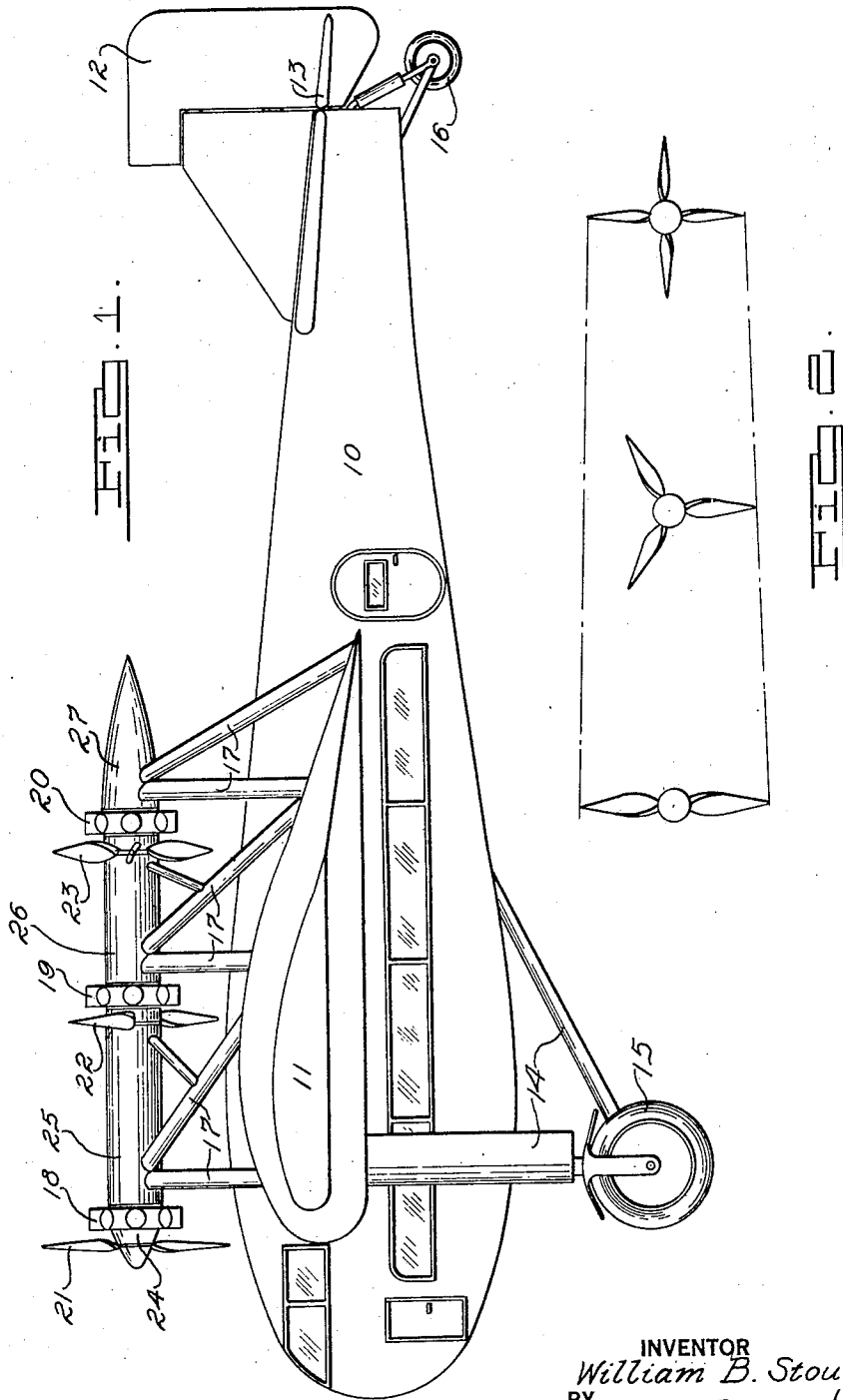
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AIRPLANE

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AIRPLANE

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This invention relates to airplanes, and particularly to the driving means therefor, the principal object being the provision of a new and novel arrangement of power plants and propellers.

Another object is the provision of means for mounting the engines on an airplane whereby maximum efficiency may be obtained with minimum parasitic resistance.

Another object is to provide a novel multiple power plant unit for airplanes.

Another object is the provision of an airplane provided with one or more power plant units, each of which includes a plurality of engines arranged in alignment longitudinally of the airplane.

Another object is to provide a construction as above described in which each of the engines is provided with an independent propeller and in which the pitch of one propeller is greater than that of a propeller rearward thereof.

Another object is to provide a construction as above described in which all of the power plants are of the tractor type, that is, in which the propellers are forward of their respective engines, whereby the engines will be cooled by the blast of air from their respective propellers when the airplane is taxiing on the ground.

Another object is the provision of a construction as above described in which the diameter of any one of such propellers is larger than that of a propeller rearward thereof and smaller than that of a propeller forward thereof.

Another object is the provision of a power plant unit for airplanes including a plurality of engines mounted in alignment longitudinally of an airplane, each of the engines being provided with an independent propeller and each engine being spaced from its next adjacent engine by a distance at least as great as the diameter of the propeller driven thereby.

Another object is to provide a power plant unit for airplanes including a plurality of engines mounted in alignment longitudinally of the airplane, each airplane being provided with an independent propeller and

the number of blades on said propellers increasing in number from the first one thereof to the last one thereof.

The above being among the objects of the present invention, the same consists in certain novel features of construction and combination of parts to be hereinafter described with reference to the accompanying drawing, and then claimed, having the above and other objects in view.

In the accompanying drawing which shows a suitable embodiment of the present invention, and in which like numerals refer to like parts throughout the several different views; Fig. 1 is a more or less diagrammatic side elevation of an airplane.

Fig. 2 is a more or less diagrammatic face view of the three propellers shown in Fig. 1.

With the development of large airplanes, it has been found necessary to increase the number of power plants or engines employed for driving the same, rather than increasing the size of the engines themselves. In thus increasing the number of engines, it has been the common practice to so position them that the parasitic resistance offered by the engines during flight is increased directly in accordance with the number of engines. It has been suggested that two engines be provided in back to back relationship, each driving its own independent propeller, and with the forward propeller serving as a tractor and the rearward propeller serving as a pusher. However, as far as I am aware, this is as far as the attempts have been carried to reduce the parasitic resistance offered in multiple power plant designs.

A disadvantage of such a construction is that the rear engine, in being placed forwardly of its propeller, is very inefficiently cooled when the airplane is taxiing on the ground, and likewise in the air when the front engine stops, as it receives very little benefit from the air set in motion by its own propeller.

In accordance with the present invention I provide a construction particularly adaptable for large planes, and in which the parasitic resistance set up by the power plants is increased over that of smaller planes but very

little, if any, due to the multiplicity of the power plants. The essential feature of the present invention is the arrangement of the power plants in alignment longitudinally of the airplane, suitable fairing being provided between the various engines so as to reduce the parasitic resistance offered by them to substantially no more than is set up by the first engine, and in so incorporating in this assembly of engines certain novel features which offset the losses which would otherwise arise because of the aligned condition of the engines.

Referring to the accompanying drawing, I show in a more or less diagrammatic manner an airplane comprising a fuselage 10, wings 11, rudder 12, stabilizer 13, landing gear 14 provided with suitable wheels 15, and tail wheel 16. As a means of illustrating the principals of the present invention, I show mounted above the fuselage on suitable struts 17 three engines 18, 19, and 20. The forward engine 18 is provided with a propeller 21, the center engine 19 is provided with a propeller 22 and the last engine 20 is provided with a propeller 23. The engines are positioned with their axes in alignment longitudinally of the airplane. The propeller 21 is of greater diameter than the propeller 22, and the propeller 22 is of greater diameter than the propeller 23. I have shown the forward propeller 21 as having two blades, the center propeller 22 as having three blades, and the last propeller 23 as having four blades, this being preferable but not necessary in the broader aspects of the present invention. Furthermore, the engine 18 is spaced from the engine 19 by a distance at least as great as the diameter of the propeller 21, and the engine 20 is spaced from the engine 19 by a distance at least as great as the diameter of the propeller 22. Furthermore, the pitch of the propeller 23 is greater than the pitch of the propeller 22, and the pitch of the propeller 22 is greater than the pitch of the propeller 21.

The forward engine is preferably provided with a streamlined nose portion 24, and the engines 18 and 19, and 19 and 20 are connected by preferably cylindrical fairing members 25 and 26 respectively of substantially the same diameter as the maximum diameter of the nose piece 24, and the engine 20 is provided with a rearwardly projecting streamlined tail 27, this reducing the areas of the engines which are exposed to the flow of air so as to reduce as much as possible the parasitic resistance which would otherwise be offered by the engines in direct proportion to their number. Where the engines are of the radial air-cooled type as shown, their cylinders are preferably permitted to project beyond these fairing members in order to permit the proper cooling of the same.

The reason that I reduce the diameter of the propellers from the front to rear is that the slip stream from a propeller is known to reduce in diameter rearwardly of the propeller, and accordingly I reduce the diameter of the following propellers an amount to insure such propellers working in the slip stream from the propeller in advance thereof. Furthermore, it eliminates the tendency of blade tip flutter which would otherwise occur due to the propeller blades passing into and out of the slip stream from the propeller in advance thereof. This permits me to design the pitch of the propellers with certainty, inasmuch as the velocity of such slip stream can be quite accurately determined. This permits me to increase the pitch of the following propellers an amount sufficient to overcome the loss that would otherwise occur due to such propellers working in the slip stream of the propeller or propellers in advance thereof, and so that I am enabled to insure all of the engines working at the same efficiency and speed.

I prefer to position the engines in the spaced relation described in order to prevent the turbulence of the air that may be present immediately behind a propeller from affecting the efficiency of the following propeller, and I prefer to increase the number of blades on the propellers, from front to rear, to compensate for the loss of blade area due to reduction in diameter.

While I have shown only three engines supported in a manner herein described, it is to be understood that this is merely for the purpose of explanation, and that this number may be increased as may be found necessary or desirable, the same proportioning as above described being preferably carried out throughout all of the engines regardless of the number mounted in alignment. Furthermore, it is also to be understood that any number of such units may be employed on an airplane as may be found necessary or desirable, and that as far as the present invention is concerned, whether such engines are mounted above or below the wings, or in any other position, is immaterial, it being understood that wherever they are mounted they are preferably positioned sufficiently outside of the zone of influence of the wings upon the air so as not to interfere with the efficiency of the wings or their own efficiency.

Formal changes may be made in the specific embodiment of the invention described without departing from the spirit or substance of the broad invention, the scope of which is commensurate with the appended claim.

What I claim is:

In an airplane engine nacelle structure three or more engines disposed in tandem, a propeller driven by each engine, the propellers being in alternating relation with the engines and each propeller being disposed in ad-

vance of its driving engine, the diameter of
the rear propellers being such that the tips
thereof will revolve in the slip stream of the
preceding propellers and the pitch of the
rearward propellers being greater than that
5 of the forward propellers, the axial distance
between any two propellers being at least
equal to the diameter of the foremost of the
pair.

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