Jan. 7, 1930. J. A. CUDDY 1,742,461

AIRCRAFT

Filed Feb. 28, 1929 2 Sheets-Sheet 1

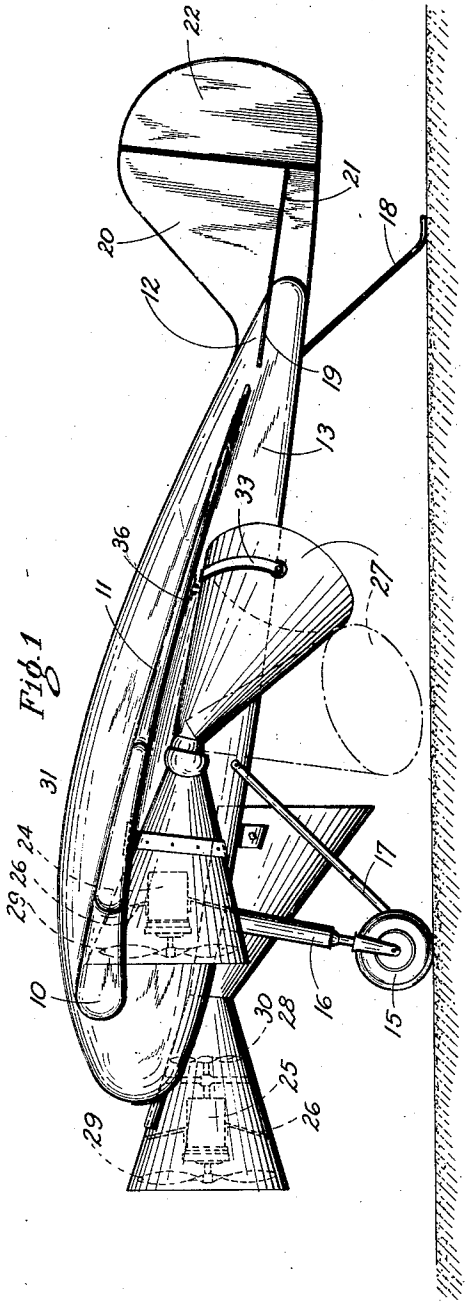


Fig. 1

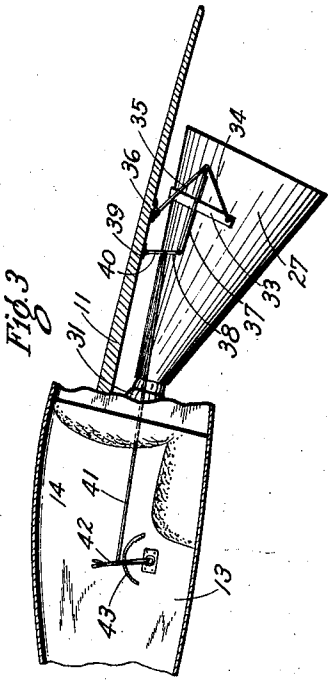


Fig. 3

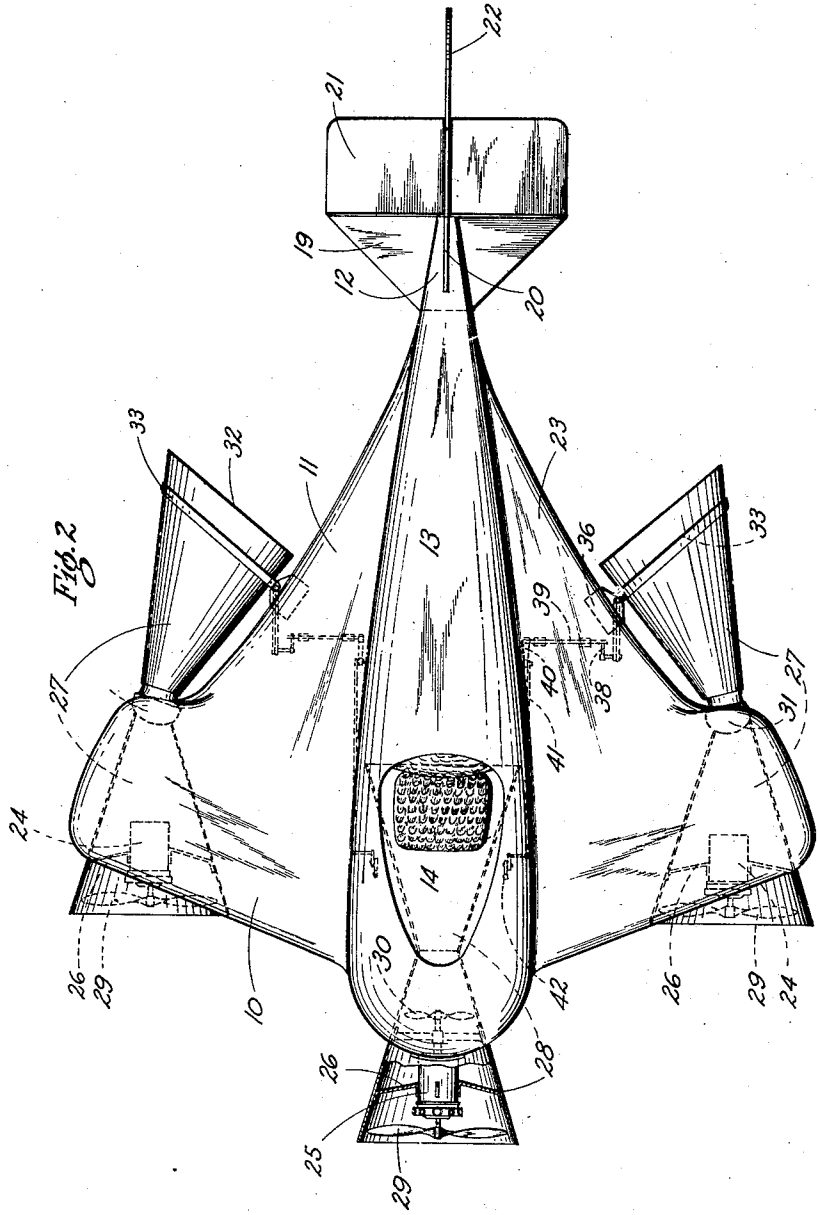
INVENTOR
JEFFREY A. CUDDY
BY Richey & Watts
ATTORNEY

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Fig. 2



INVENTOR
JEFFREY A. CUDDY
BY Richey & Watts
ATTORNEY

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UNITED STATES PATENT OFFICE

JEFFREY A. CUDDY, OF CLEVELAND, OHIO

AIRCRAFT

Application filed February 28, 1929. Serial No. 343,456.

This invention relates particularly to the heavier-than-air type of aircraft and has for its purposes the provision of means whereby the propeller slip stream can be directed independently of the path of the air vessel to enhance and to increase directional stability by certain improved applications of the sweep-back principle. The principles of my invention are also applicable, with appropriate modifications, to the propulsion and control of vessels lighter than air.

Other objects and advantages will appear from the following specification taken in connection with the accompanying drawings, wherein

Fig. 1 is a side elevation of an airplane to which a preferred embodiment of my invention has been applied;

Fig. 2 is a plan view of the same; and

Fig. 3 is a detail of certain elements of the controlling mechanism.

The preferred embodiment of my invention shown and described in the present application consists of a tri-motored tractor monoplane having relatively short deep swept back wings 10 the rear edges of which merge into webs 11 which taper inwardly to the tail 12. The fuselage 13 is of substantially the ordinary type having accommodations for the pilot and passengers dependent upon the size of the plane, but herein shown as a cockpit 14. The underbody comprises landing wheels 15, shock absorbers 16, struts 17 and a tail skid 18, all of any preferred type. The usual horizontal and vertical stabilizers 19 and 20, elevators 21 and rudder 22 are mounted on the tail. These are of conventional type, controlled from the cockpit in the ordinary manner and need no further description.

The wings 10 of my plane are swept back to the ends, and are relatively narrow in their spread, but each is joined along the rear edge, slightly inward from the end, by the horizontal airfoil or web 11 which is of approximately right triangular outline, having the short side of the triangle coincident with what would be the rear edge of the wing in the usual type of plane and the long side fastened to the fuselage, with the free edge 23 of the triangle forming the hypotenuse. However this hypotenuse is not straight but is curved to fair it into the other lines of the plane structure.

The propelling machinery of my improved airplane includes three engines 24, 24 and 25 mounted respectively beneath the outer end of each wing and beneath the center of the fuselage. Each of these engines is carried by suitable struts 26 in the mouth of a Venturi tube 27 or 28 and drives a propeller 29 in the mouth of the tube. The slip stream from the propeller is thus forced back through the tube, being concentrated in the neck and then rushing outward through the rear end, thus creating a strong rearward air stream, the reaction of which is under the control of the pilot by means to be described hereinafter by which the reaction may be utilized in rising, straight flying, or landing. A smaller booster propeller 30 may be placed in the tube abaft the engine, as shown in the midship tube 28 of the present embodiment, the purpose being to utilize the full power of the engine while keeping down the diameter of the propeller and the size of the tube. In the present embodiment such a booster propeller is shown only on the midship engine 25 because since I here illustrate the customary practice of having this engine more powerful than those under the wings. Ordinarily the engine exhaust will be directed back through the tube, thus adding to the force of the air current.

By arranging the wing tubes abaft the center tube the sweep-back principle is utilized in connection with the propulsion.

Referring now particularly to the construction of the Venturi tubes, the central tube 28 is fixed in position and non-adjustable, whereas the front and rear halves of the two wing tubes 27 are connected at the neck by ball and socket joints 31, the rear halves being movable by control mechanism shown in detail in Fig. 3. The central tube at all times, and the wing tubes when in straight flying position, have only a slight downward tendency in their top lines from the ends toward the neck in either direction, the end flare be-

ing sideward and downward, as will be clear from an examination of Fig. 1.

The wing tubes are also disposed with the outer lines of the forward and after halves in approximately the same straight line so that the flare of these tubes is accomplished by inward and downward direction of the funnel elements. The discharge mouth of each of the wing tubes is also inclined inwardly, as shown at 32, Fig. 2, in order that the slip stream in normal flight will be directed aft along the sides of the fuselage, following somewhat the outline of the outer edge 23 of the triangular web 11 and impinging against the horizontal and vertical stabilizing surfaces at the tail. Thus the slip stream reaction is concentrated, and the vacuum which tends to form behind the plane is destroyed.

The ball and socket joints 21 between the forward and rear halves of the wing tubes, and the controlling mechanism for the rear halves of these tubes, are so arranged that the tubes can be adjusted to any position from the full line position of Fig. 1, which is that used for straight flying, to the dotted line of Fig. 1, wherein the direction of the slip stream is almost directly downward, but with a slight rearward inclination. Adjustments intermediate between these two positions are provided for by suitable controlling gear, one possible type of which is illustrated by Fig. 3.

The controlling mechanism, which is identical for each wing tube, comprises a yoke 33 trunnioned to a strap 34 fastened across the top of the tube near the discharge mouth, this yoke being in turn pivoted to the lower end of a link 35 the upper end of which is pivoted to a plate 36 secured to the under side of the wing, the yoke and link constituting a toggle joint. This toggle is operated by a system of rods and levers herein shown as a horizontal rod 37 from the toggle to a downward crank 38 on the outer end of a cross shaft 39. A shorter crank 40 on the inner end of the shaft 39 is connected by another horizontal rod 41 to a hand lever 42 in the cockpit. This hand lever carries a dog engageable with a toothed rack 43, whereby the rear end of the tube may be fastened in any position within the limits of its travel.

In the operation of my improved airplane the rear ends of the wing tubes will be set downward for taking off, thus giving a strong propulsive effect directly upward and permitting the plane to rise much more quickly than is possible in planes of types now known, approaching the performance of a helicopter in this respect. After rising, the pilot will direct the discharge ends rearwardly so that the reaction of the slip stream will drive the plane forward. At the same time the slip stream current directed against the sides of the fuselage, as described above, and against the rear control and stabilizing surfaces, gives the plane great directional and horizontal stability. If necessary to overcome unusual conditions, such for example as a dangerously steep bank, either wing tube may be trained independently of the other. For landing the tubes are again directed downwardly as in taking off, thus accomplishing two purposes, first reducing the forward speed of the plane because the reaction of the two wing tubes is now no longer utilized for driving, and second, directly retarding the descent by the reaction of the wing propeller slip streams.

It will be seen from the foregoing that I have invented an airplane which is characterized by constructional and propulsive features which result in great flexibility of maneuvering and lateral stability with consequent safety and capacity to rise or land quickly and in a restricted space, and wherein the slip streams from the propellers are employed to assist in propulsion and control instead of being wasted in detrimental resistance against the airplane structure.

It is apparent that the principles of my invention might be employed to planes having more than a single wing, or having a different number of engines, and also that they might be applied to the propulsion of buoyant airships, obvious modifications in applying the principles herein shown being used in each instance.

Although Venturi tubes are preferred for directing the slip streams, it is apparent that many of the advantages of my invention may be obtained by directing the air currents from the propellers through plain tubes. Even with plain tubes these air currents will be prevented from being diffused, and can be controlled for direction.

The scope of my invention is not limited either to the preferred embodiment above described, or to the modifications herein suggested, but is indicated by the following claims.

I claim:

1. In a self moving vehicle, in combination, a tractor air propeller, a body, a Venturi tube mounted in axial relation to said body and having its opening directly behind said propeller, a movable neck connecting the front and rear ends of said tube, and a movable mounting for the rear end of the tube whereby the rear end may be set to direct the slip stream from the propeller through said tube in any desired direction at the control of the operator.

2. An air vessel comprising in combination sweep back wings and propelling means including a tractor air screw, a Venturi tube in the mouth of which said screw is mounted and a relatively movable discharge end on said tube, said discharge end being adapted for controlled movement to direct the slip

stream at will, and control means for effecting such direction.

3. Aircraft propelling means comprising in combination three fore-and-aft Venturi tubes, and power-driven propellers mounted in operative relation to the front section of each of said tubes, a movable discharge end on the rear of each of said tubes whereby the fluid current issuing therefrom can be selectively directed.

4. In combination with an airplane having a tractor propeller, a Venturi tube extending rearwardly longitudinally of the plane beneath the body thereof, the rear flare of said tube being movable relatively to the front flare and to the plane body, a flexible connecting neck between the front and rear flares, said neck lying close beneath the plane structure, the top line of the rear flare lying in prolongation of the top line of the front flare and close beneath the plane structure when the rear flare is trained dead aft.

In testimony whereof I hereunto affix my signature this 25th day of February, 1929.

JEFFREY A. CUDDY.