

May 26, 1931.

H. M. SALISBURY ET AL

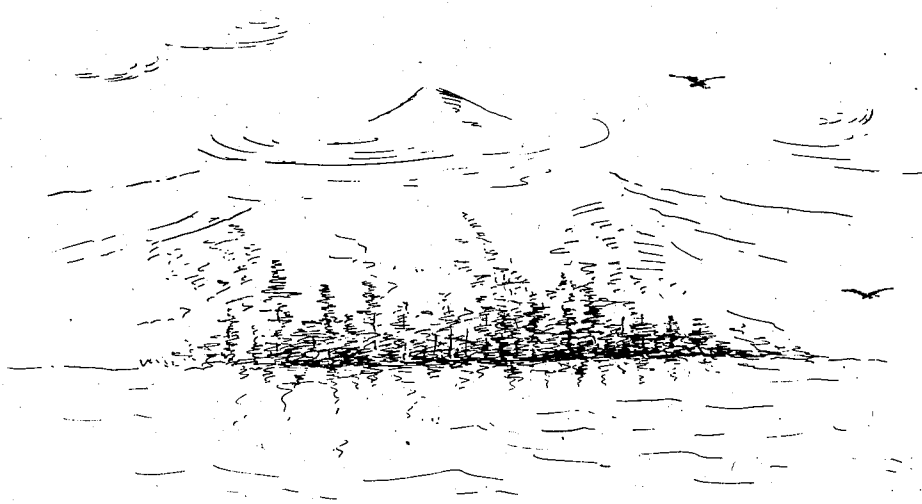
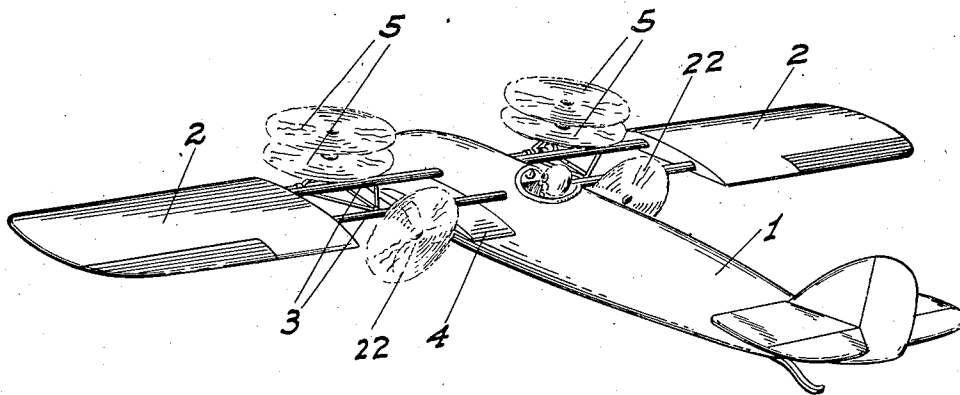
1,806,648

AIRPLANE

Filed Sept. 14, 1929

3 Sheets-Sheet 1

Fig. 1



INVENTORS

*Hervey M. Salisbury and
Arthur E. Miller*

BY *Samuel J. Webster* ATTORNEY

May 26, 1931.

H. M. SALISBURY ET AL

1,806,648

AIRPLANE

Filed Sept. 14, 1929

3 Sheets-Sheet 2

Fig. 2

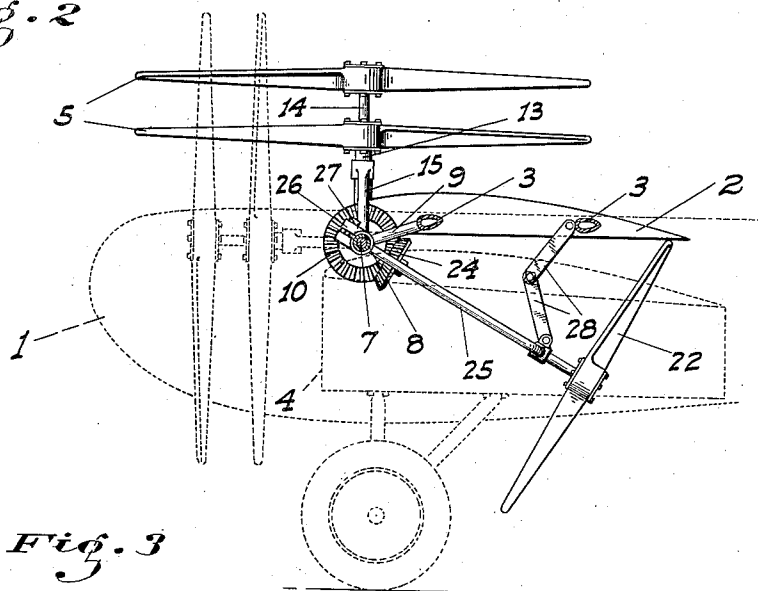


Fig. 3

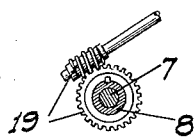
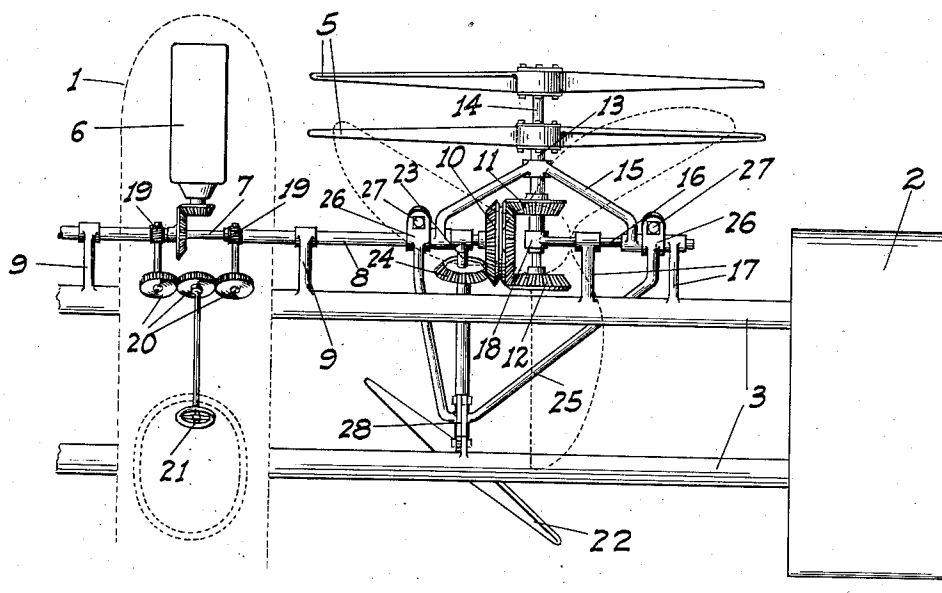


Fig. 4

INVENTORS
Hervey M. Salisbury and
Arthur E. Miller

BY *Samuel L. White* ATTORNEY

May 26, 1931.

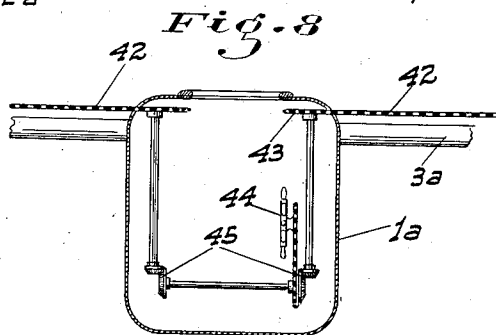
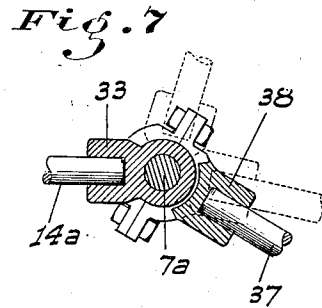
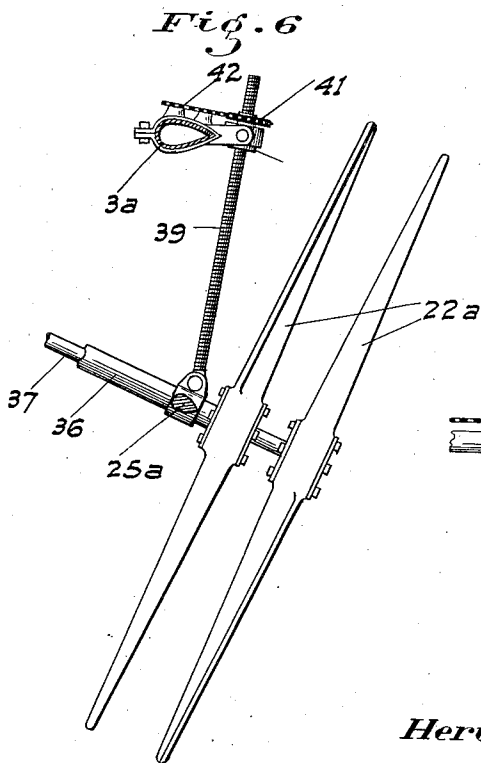
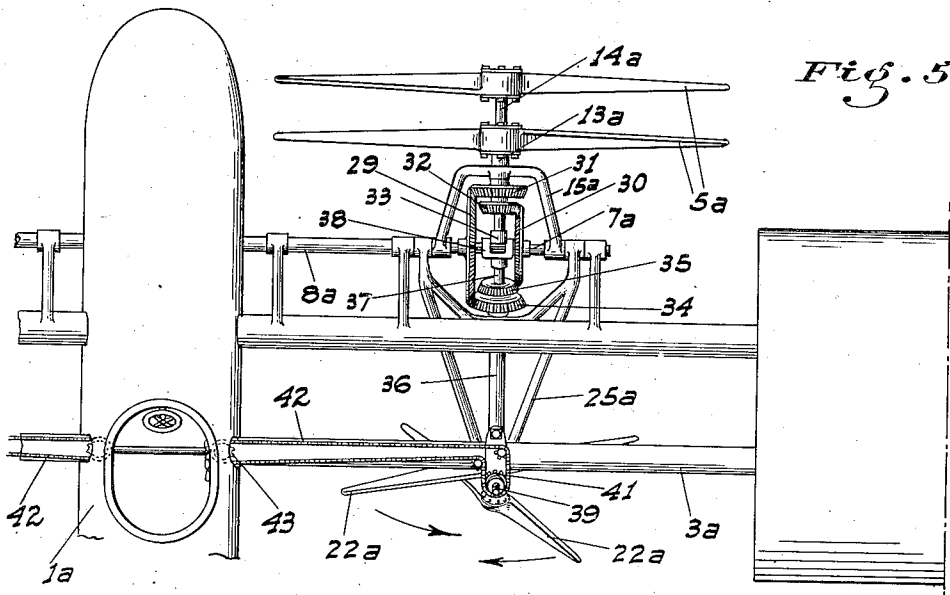
H. M. SALISBURY ET AL

1,806,648

AIRPLANE

Filed Sept. 14, 1929

3 Sheets-Sheet 3



INVENTORS

Hervey M. Salisbury and
Arthur E. Miller

BY *Permy. L. White* ATTORNEY

UNITED STATES PATENT OFFICE

HERVEY M. SALISBURY, OF WALNUT GROVE, AND ARTHUR E. MILLER, OF
SACRAMENTO, CALIFORNIA

AIRPLANE

Application filed September 14, 1929. Serial No. 392,558.

This invention relates to airplanes, and particularly to the means for propelling the same. The principal object of our invention is to provide a propeller structure so arranged that it may be selectively used to either propel the airplane vertically or horizontally, or at an angle to perpendicular and horizontal planes, at the option of the pilot, without depending on the wings or the vertical direction rudder to attain or hold the desired lift and angle of flight.

With this arrangement therefor an airplane may rise from the ground or land in a much shorter space and at considerably slower speed than is now necessary, while at the same time a greater speed when in actual flight may be obtained.

These objects we accomplish by means of such structure and relative arrangement of parts as will fully appear by a perusal of the following specification and claims.

In the drawings similar characters of reference indicate corresponding parts in the several views:

Fig. 1 is a perspective view of an airplane of the monoplane type in flight showing the position of the main tractor propellers when positioned, and acting to lift the airplane more or less directly upward.

Fig. 2 is a fragmentary sectional elevation of the airplane showing the lifting position of the tractor propellers, and with the auxiliary or pusher propeller disposed to impart a slight angular movement to the airplane, as well as propelling the same forwardly.

Fig. 3 is a fragmentary top plan view of the airplane showing the tractor propellers positioned to propel the airplane horizontally.

Fig. 4 is a fragmentary end section showing the means for rotating the torque tubes.

Fig. 5 is a fragmentary top plan view showing a modified form of propeller and drive arrangement.

Fig. 6 is a fragmentary sectional elevation of such arrangement showing the means for adjusting the setting of the rear propellers while in flight.

Fig. 7 is an enlarged fragmentary section

showing the swivel bearing members for the opposed propeller shafts.

Fig. 8 is a diagrammatic cross section showing the control means for the propeller adjustment mechanism.

Referring now more particularly to the characters of reference on the drawings, and particularly at present to Figs. 1 to 4, the numeral 1 denotes a fuselage, to the sides of which and spaced therefrom are disposed the wings 2, which are connected to the fuselage by rigid transverse and longitudinally spaced supports 3. If desired auxiliary wings 4 foldable against the fuselage, after the manner shown in our copending application for patent, Serial No. 250,760 filed January 31, 1928 may be provided to give additional supporting surface when necessary. The spaces between the wings and the fuselage are freely open except for the supports 3, and are preferably not less in extent or width than the diameter of the main tractor propellers 5, having any desired number and form of blades, and of the same or different pitch, as may be desired. These propellers are arranged in somewhat close cooperating pairs on both sides of the fuselage and are mounted as follows:

The engine or other power plant mounted in the nose of the fuselage and conventionally indicated at 6, drives a transverse shaft 7 which is disposed a short distance ahead of the forward support 3. This shaft is journaled in torque tubes 8 projecting outwardly from the fuselage and turnably supported from said forward support 3 by suitable bearing brackets 9. On each outer end the shaft carries a double faced bevel gear 10, one face of which at diametrically opposed points is constantly in mesh with pinions 11 and 12. The pinion 11 is connected to the shaft 13 of the rearmost propeller 5, while the pinion 12 is connected to the shaft 14 of the foremost propeller 5; the shaft 13 being tubular to permit the shaft 14 passing therethrough so that both propellers are coaxial. These shafts extend substantially parallel to the fuselage or to the line of flight, but may be disposed at slight angles to such line if desired.

A yoke-like frame 15 provides a bearing for

the shaft 13 between the pinion 12 and the adjacent propeller 5, and at its ends is fixed on the tube 8 and also on a dummy shaft 16. This shaft is disposed in line with the tube 8, but on the side of the gear 10 opposite the same, and is turnable in bearings 17 secured to the adjacent supports 3. The end of the shaft 16 nearest the gear 10 is also formed with a bearing 18 which engages and supports the adjacent end of the shaft 13. By reason of this structure it will be seen that the two propellers turn in the same speed but at opposite directions—an arrangement which we believe to be very efficient. Also the frame 15 and consequently the propellers may turn as a unit about the tube 8 or the shaft 7 as an axis, without interfering with the driving of the propellers.

The tubes 8 are turned simultaneously from inside the fuselage at the option of the pilot by any suitable mechanism. In the present instance this mechanism is shown as being worm gearing 19 applied to the adjacent inner ends of the tubes and connected by gearing 20 to a common operating hand-wheel 21 projecting into the pilot's compartment of the fuselage. The propellers 5 may therefore be turned from horizontal to vertical positions or to intermediate positions at will, so that they may function to lift the airplane straight up, propel the same horizontally, or to both lift and propel the airplane simultaneously as conditions may require.

In addition we may provide if desired one or more pusher propellers 22 disposed rearwardly of each propeller unit 5 and also rearwardly of the rearmost wing support 3. This propeller is mounted on a shaft 23 having a bevel pinion 24 on its forward end which meshes with the gear 10 on the face thereof opposite to that engaged by the pinions 11 and 12.

The drive connections between the shafts 7 and 23 may be so proportioned relative to those between shafts 7 and 13 as to cause the pusher propeller to be rotated faster or slower than, or the same speed as, the tractor propellers, as may be found to give the best results. The shaft 23 is supported by a yokelike frame 25 which has split bosses 26 on its ends embracing the tube 8 and the shaft 16, with bolts 27 through said bosses to enable them to be releasably clamped onto the respective parts. A brace unit 28 of a nature such that its operative length may be altered, is detachably connected to the rear support 3 and to the adjacent end of the frame 25. It will therefore be seen that if the brace is removed and the bosses 26 are clamped about the tube 8 and shaft 16 the pusher propeller will turn as a unit with the propellers 5 when the position of the latter is altered by manipulation of the wheel 21. It will also be seen that said propeller 22 may be set at any desired angle relative to the propellers 5 before being actu-

ally clamped in a definitely fixed position. If, on the other hand, the brace is applied and the bosses are loosened the pusher propeller will remain in a fixed position relative to the airplane without interfering with the turning of the propellers 5 from one position to another.

In this case also, due to the adjustable nature of the brace, the angle of setting of the propeller 22 may be altered relative to the airplane, as may be desired. It is of course to be understood that any adjusting or setting of the tractor and pusher propellers relative to each other are intended to be made while the plane is on the ground, and any position of the pusher propeller when once set is retained throughout the duration of any flight.

It is also to be understood that while we have above described only one set of propellers, an identical set, with the same operating and control mechanism, is mounted on the other side of the airplane as well.

While we have shown and described the propeller 22 as being of the pusher type and disposed rearwardly of the tractor propellers 5, it also may be of the tractor type and disposed ahead of the propellers 5, by a suitable rearrangement of the same relative to the supporting structure.

The arrangement in Figs. 5 to 8, while functioning to attain the same ends as above described, is somewhat different in construction as to the means for driving the sets of propellers and as to the means for adjusting the pusher propeller.

In this arrangement the main drive shaft 7a carries two bevel gears 29 and 30 of different sizes and facing each other in spaced relation. A bevel pinion 31 meshes with the larger gear 29 and is connected to the tubular shaft 13a of the rearmost tractor propeller 5a, of which there may be more than one. A pinion 32 meshes with the relatively small gear 30 and is connected to the shaft 14a of the foremost propeller 5a, of which also there may be more than one. With this arrangement the propellers of course rotate in opposite directions and at different speeds relative to each other, depending upon the relative sizes of the gears and pinions. A yoke frame 15a is connected to the torque tube 8a and embraces the shaft 13a so that the propeller unit above described may be turned about the shaft 7a as an axis, just as in the first described type. The end of the shaft 14a adjacent the shaft 7a is journaled in a bearing socket 33 turnable on said shaft 7a between the gears 29 and 30.

Likewise meshing with the gears 29 and 30 are pinions 34 and 35 respectively, which are connected to the adjacent ends of tubular and solid shafts 36 and 37 respectively, the latter fitting in the former. The outer ends of these shafts support the pusher propellers 22a, which likewise with this construction turn

at different speeds and in opposite directions. A yoke frame 25a is turnably axially of the shaft 7a and supports the shaft 36 at spaced points. The end of the shaft 37 adjacent the shaft 7a turns in a bearing socket member 38 which is itself turnable on the shaft 7a adjacent the member 33. These two sockets are arranged so that while turnable independently of each other they cannot turn to an extent such as would cause interference between the propellers 5a and 22a. As in the first described type, the tractor and pusher propeller units may be mounted together in a rigid manner so as to turn simultaneously about the shaft 7a as an axis when the tube 8a is rotated.

We preferably however mount the frame 25a so as to turn independent of the frame 15a and have provided means to control such turning and the consequent angle of setting of the pusher propeller relative to the airplane and to the tractor propellers while the machine is in flight. Such means comprises a screw 39 flexibly connected at one end to the frame 25a and extending upwardly through a nut 40 which is turnably and swivelly mounted in connection with the rear wing support 3a. These parts serve the purpose and take the place of the brace 28 of the first described type. A sprocket wheel 41 is fixed in connection with the nut and has an endless chain 42 about the same which extends along the support 3a and into the fuselage 1a and about another sprocket wheel 43 mounted in the fuselage. The sprocket wheels 43 on both sides of the fuselage (for controlling the corresponding propeller units) may be operated from a single hand wheel 44 by means of suitable driving connections 45 therebetween, as shown in Fig. 8.

By means of this arrangement the pusher propellers may be turned at any time through a considerable vertical arc, as from a horizontal position downwardly to an angle of 30° or more, depending on the length of the adjusting screw used.

Since the shaft 7a in this type of structure does not necessarily terminate at the propeller shafts, it may be extended farther for driving other sets or batteries of propellers, as might be of value in large airplanes. It is to be noted that the term "turning" when applied to the movement of the propellers, refers to their adjustment in a vertical plane about the transverse drive shaft as an axis, as distinguished from the rotation of the propellers about their own axes.

From the foregoing description it will be readily seen that we have produced such a device as substantially fulfills the objects of the invention as set forth herein.

While this specification sets forth in detail the present and preferred construction of the device, still in practice such deviations from such detail may be resorted to as do not

form a departure from the spirit of the invention, as defined by the appended claims.

Having thus described our invention what we claim as new and useful and desire to secure by Letters Patent is:

1. An airplane including a fuselage, wings disposed to the sides of the fuselage in transversely spaced relation thereto, tractor propellers mounted in the transverse planes of the spaces between the wings and fuselage, pusher propellers mounted independently of the tractor propellers and disposed in said planes rearwardly of the tractor propellers, means for turning the tractor propeller from horizontal to vertical positions at will, and selectively controlled means for causing the pusher propeller to turn with the tractor propellers or to remain relatively stationary.

2. In an airplane, a drive shaft projecting transversely from the fuselage thereof, separate tractor and pusher propellers whose axes lie in planes at right angles to the shaft, separate shafts for said propellers, driving connections between the drive shaft and the propeller shafts at their adjacent ends, a torque tube about the drive shaft, a bearing support for the tractor-propeller shaft fixed on the tube, and a bearing support for the pusher-propeller shaft releasably and adjustably clamped about said tube.

3. A structure as in claim 2, with an additional and detachable supporting means for said pusher-propeller shaft when said first named support thereof is unclamped from the tube.

4. In an airplane, a drive shaft projecting transversely from the fuselage thereof, a bevel gear on the outer end of the shaft, a shaft at right angles to said drive shaft, a pinion on said second shaft engaging the gear, a propeller mounted on said second shaft, a bearing support for said second shaft mounted for rotation axially of the drive shaft, and brace means, adjustable as to length, between said support and a fixed member of the airplane.

5. In an airplane, a drive shaft projecting transversely from the fuselage thereof, a second shaft at right angles to said drive shaft, driving connections between the shafts arranged to permit the second shaft to turn about the drive shaft as an axis without affecting the driving relationship, a propeller mounted on said second shaft, a bearing support for said second shaft mounted for rotation axially of the drive shaft, a screw secured at one end to and projecting vertically from said support, a nut about the screw, means supporting said nut in a fixed position relative to the airplane, and means operable from the fuselage for rotating said nut.

6. An airplane including a fuselage, tractor propellers disposed to the sides of the fuselage, pusher propellers also disposed to the sides of the fuselage rearwardly of the

tractor propellers, means for turning the tractor propellers from horizontal to vertical positions at will, and selectively controlled means to permit the pusher propeller to be
5 turned with the tractor propellers as a unit, and to be initially set at different selected angles relative thereto.

In testimony whereof we affix our signatures.

10

HERVEY M. SALISBURY.
ARTHUR E. MILLER.

15

20

25

30

35

40

45

50

55

60

65