April 27, 1937. C. E. WEAVER 2,078,823

TANDEM HELICOPTER

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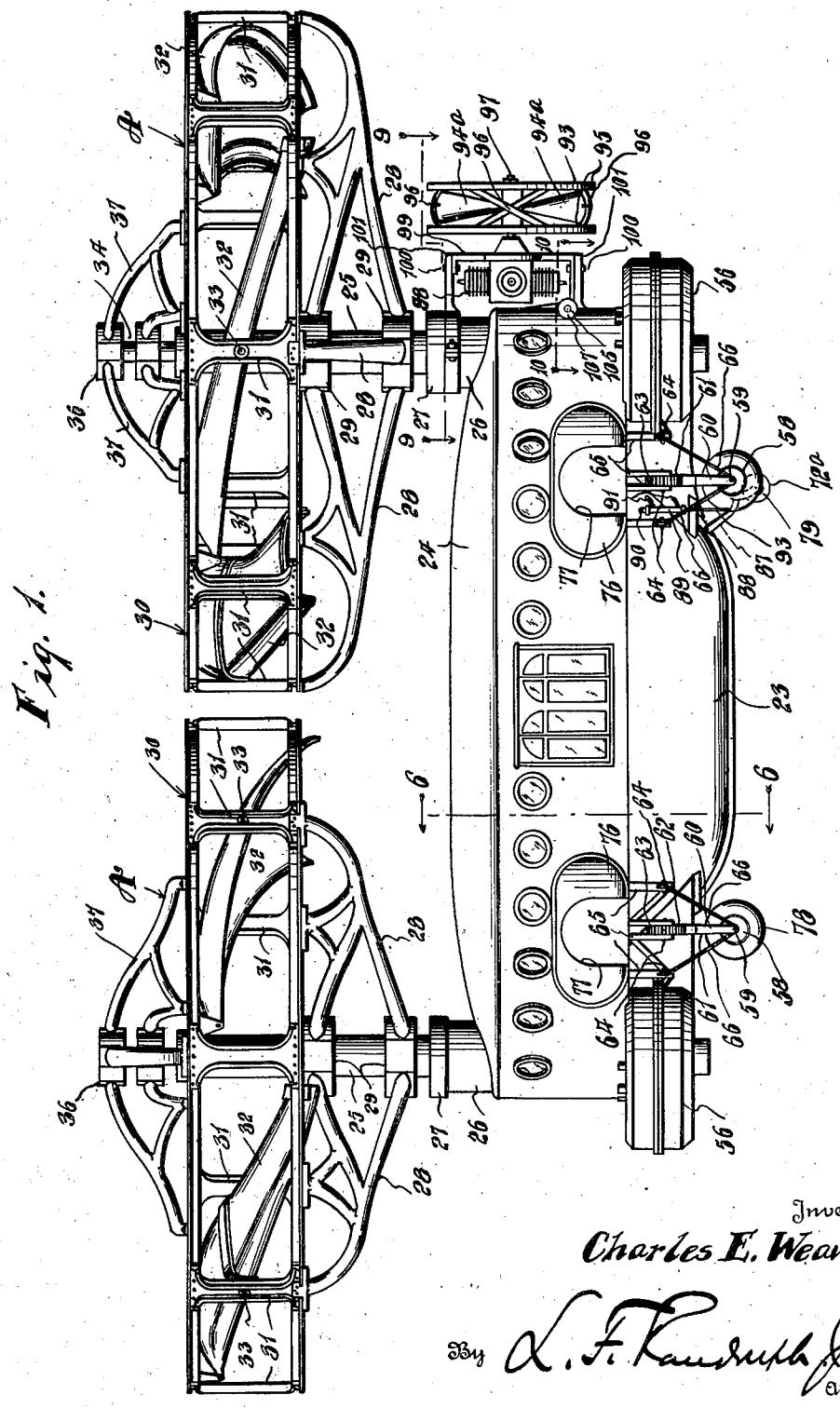


Fig. 1.

Inventor
Charles E. Weaver.

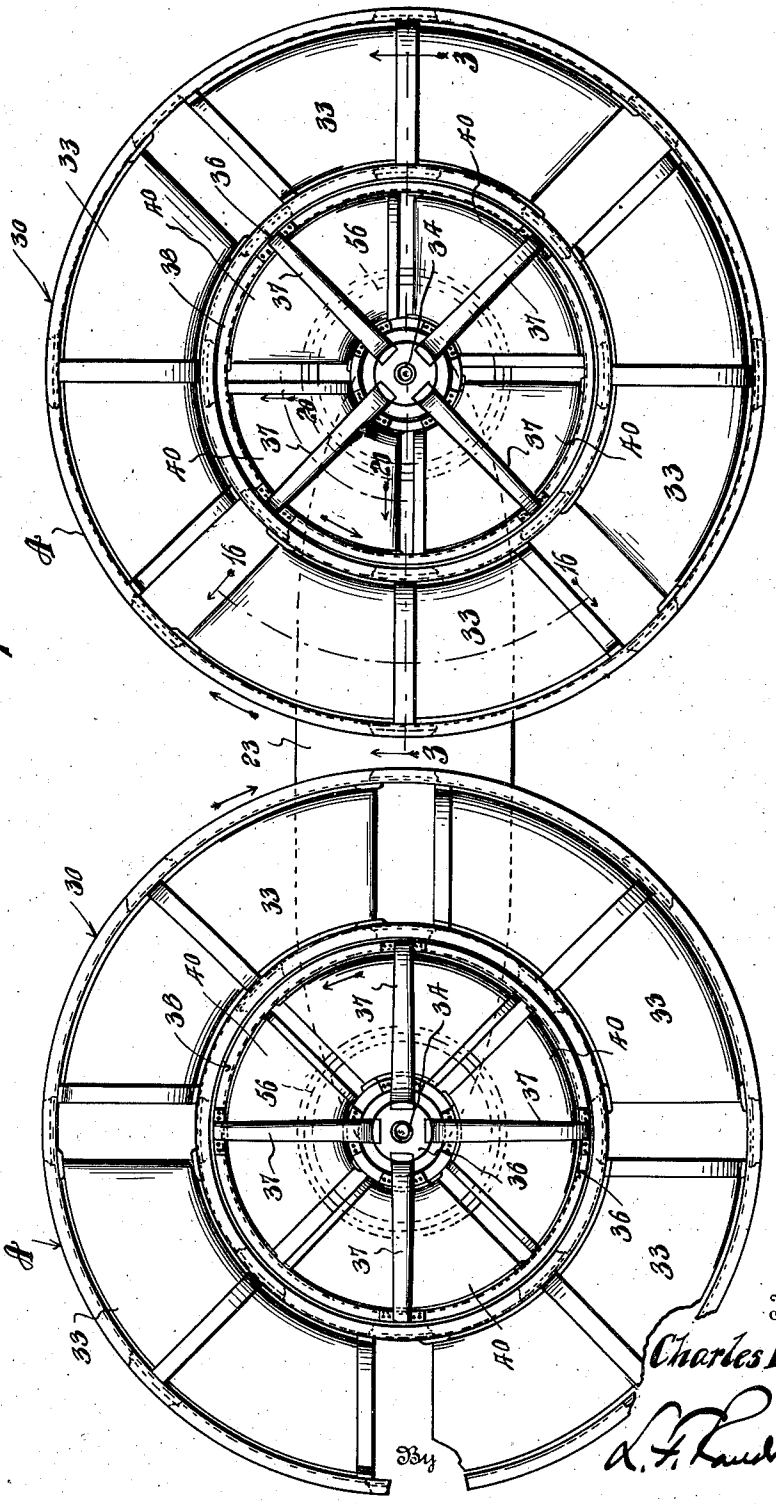
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TANDEM HELICOPTER

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Fig. 2.



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TANDEM HELICOPTER

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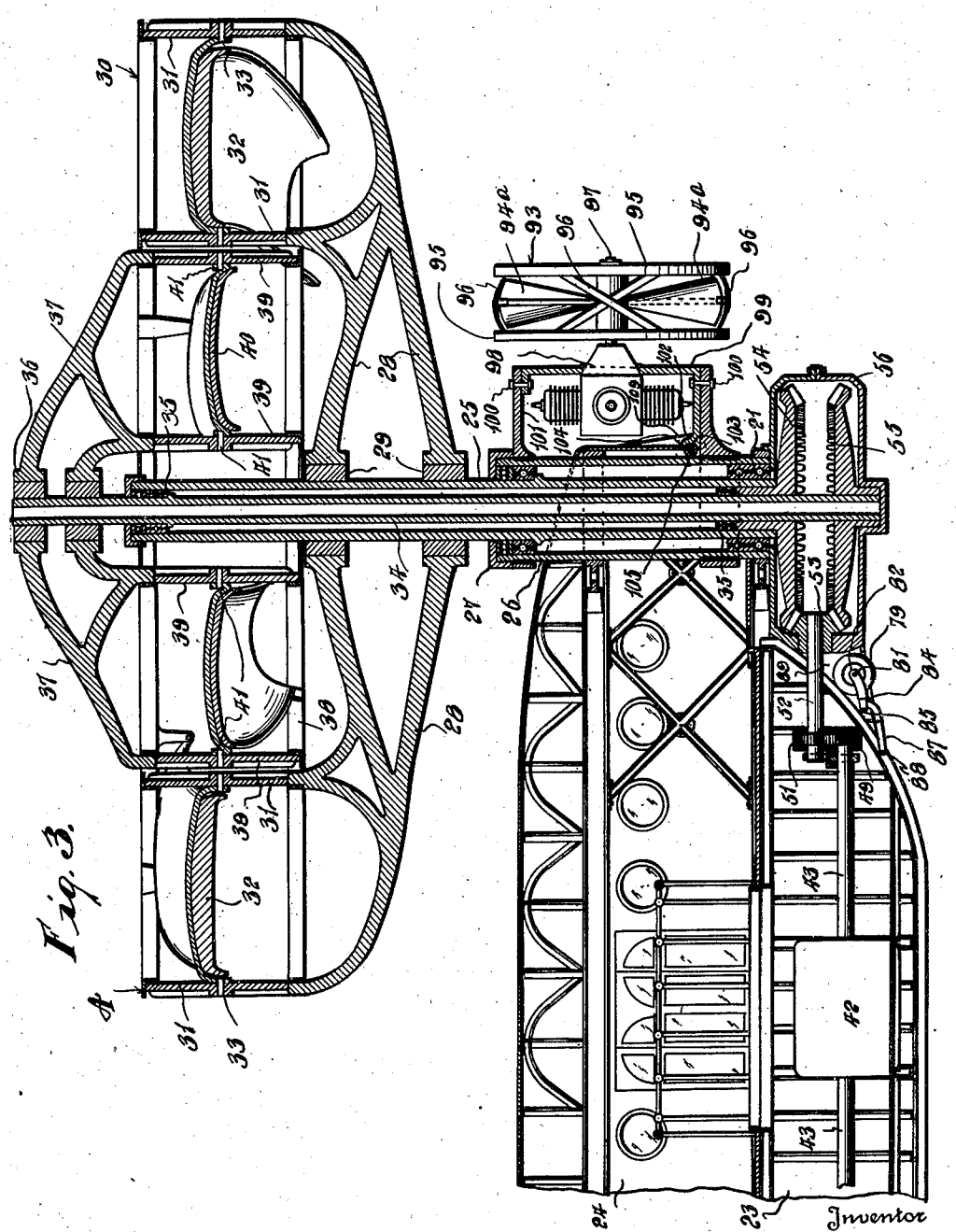


Fig. 3.

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TANDEM HELICOPTER

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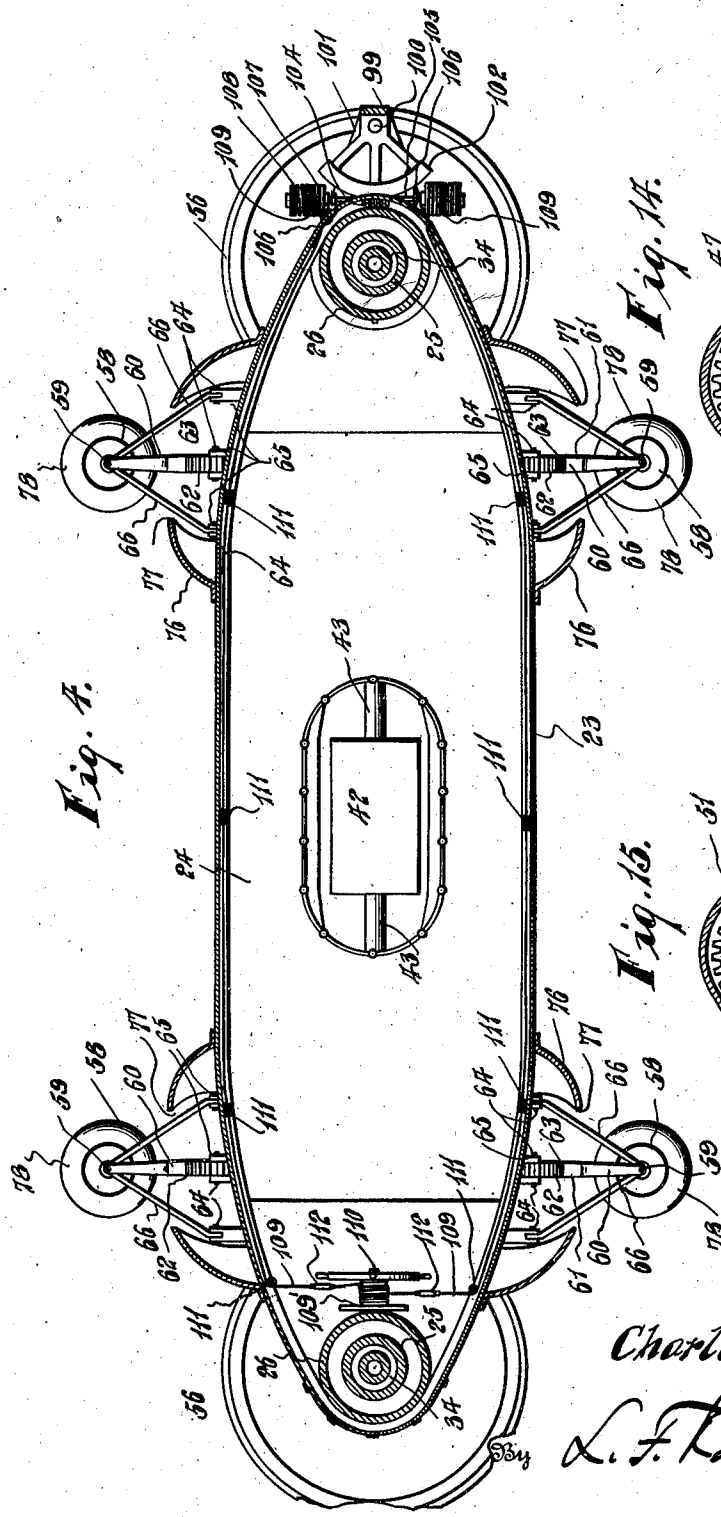


Fig. 4.

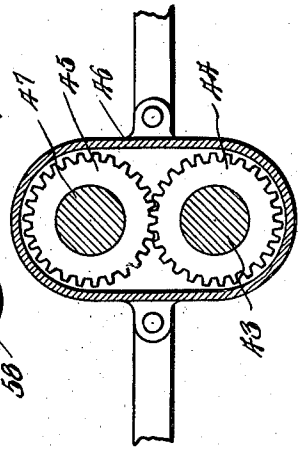


Fig. 14.

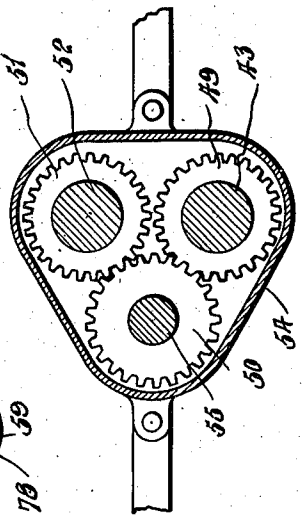


Fig. 15.

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TANDEM HELICOPTER

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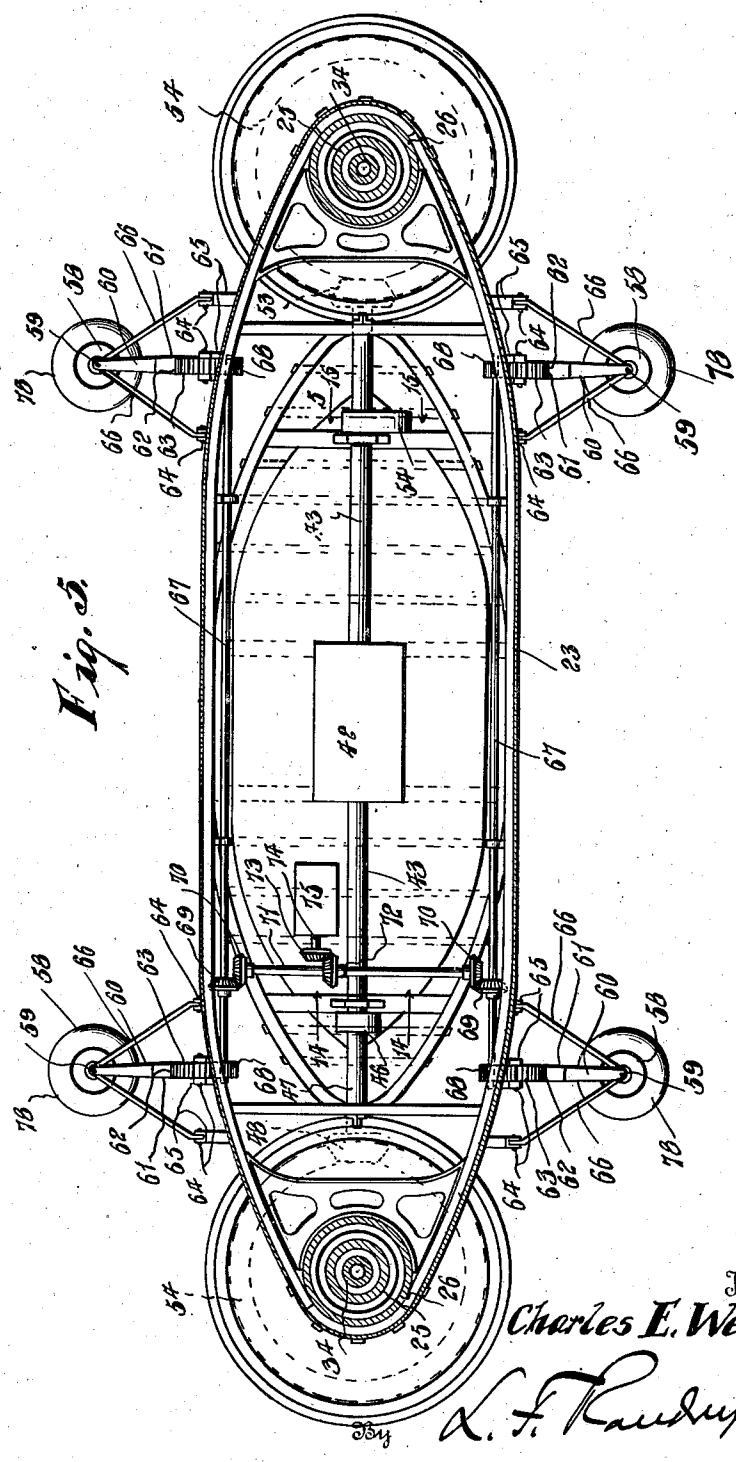


Fig. 5.

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Fig. 6.

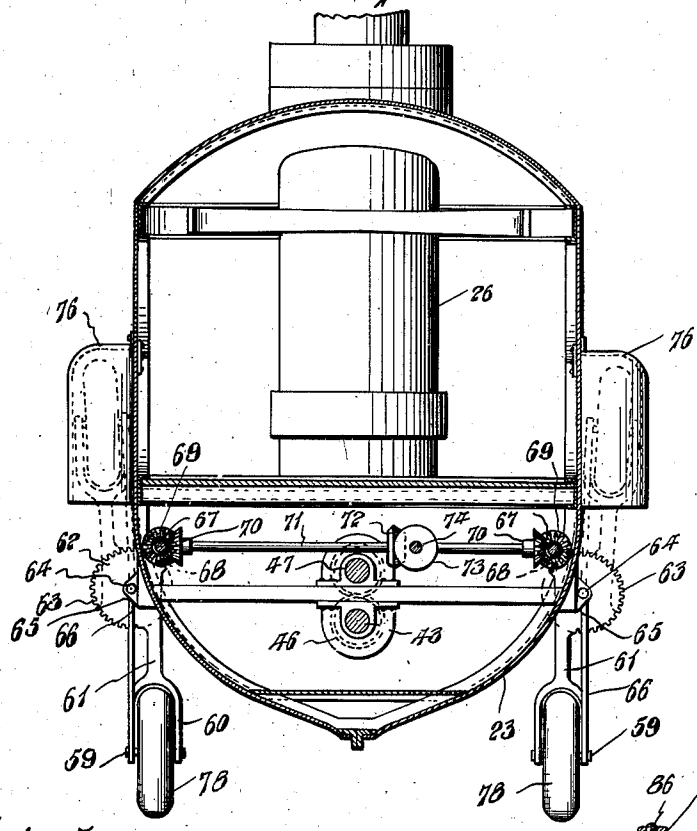


Fig. 7.

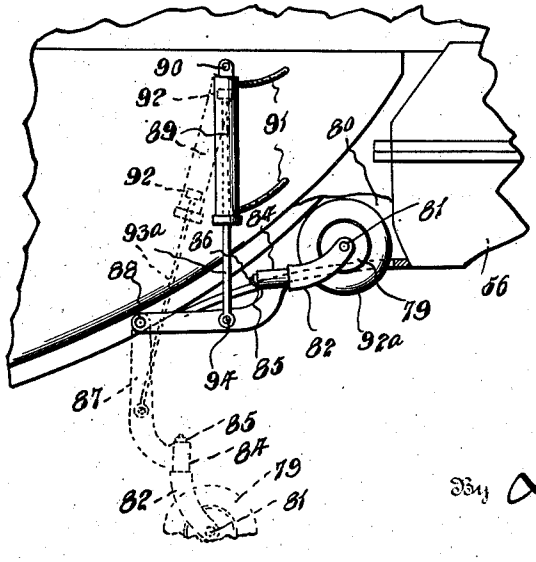
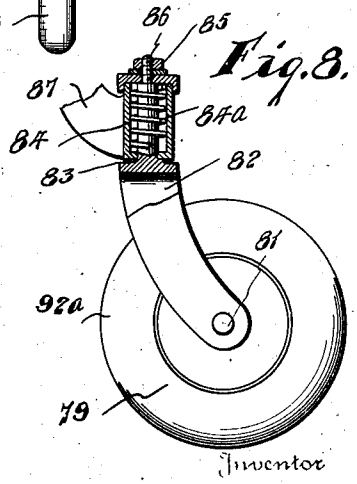


Fig. 8.



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Fig. 9.

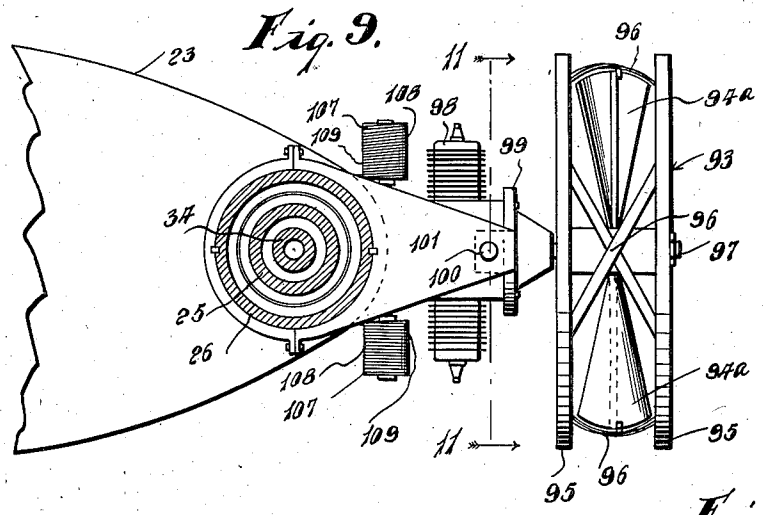


Fig. 10.

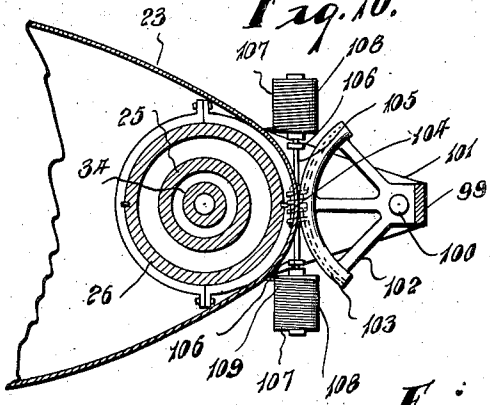


Fig. 11.

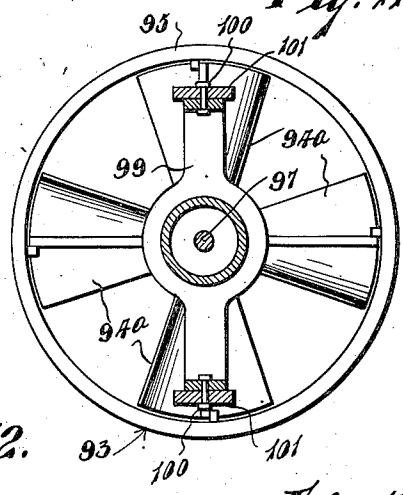


Fig. 12.

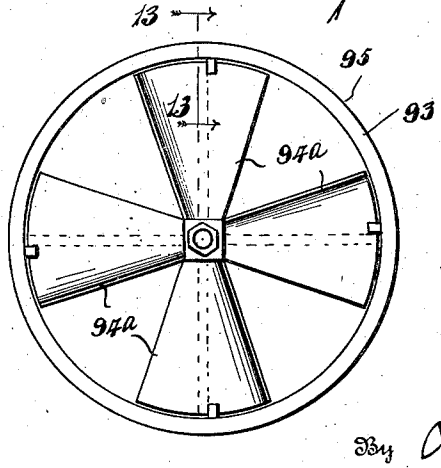
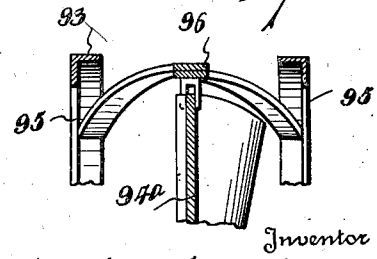


Fig. 13.



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TANDEM HELICOPTER

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Fig. 16.

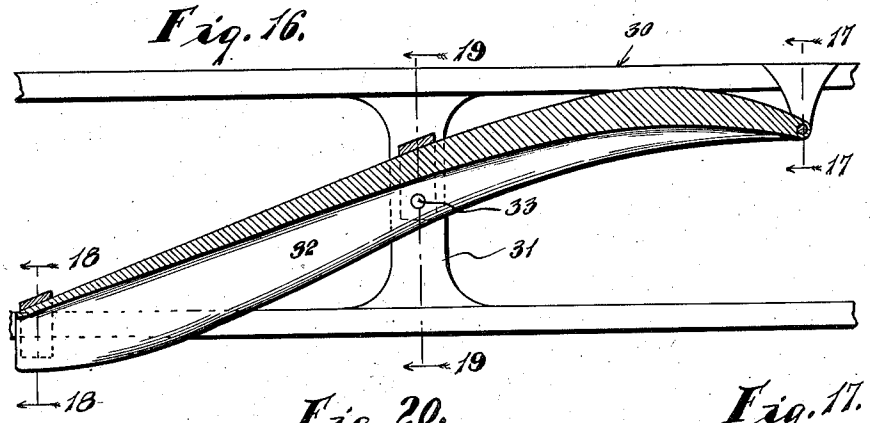


Fig. 20.

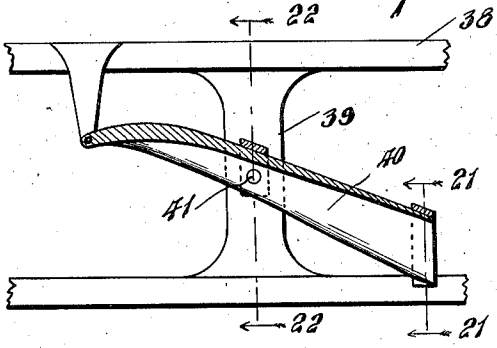


Fig. 21.

Fig. 17.

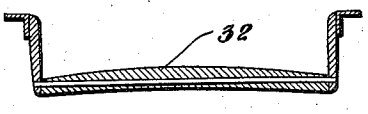


Fig. 18.

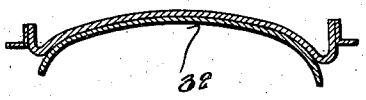


Fig. 19.

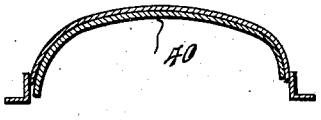
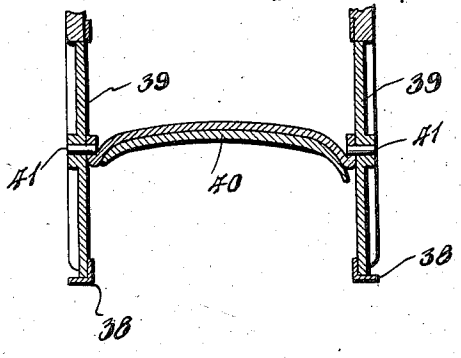
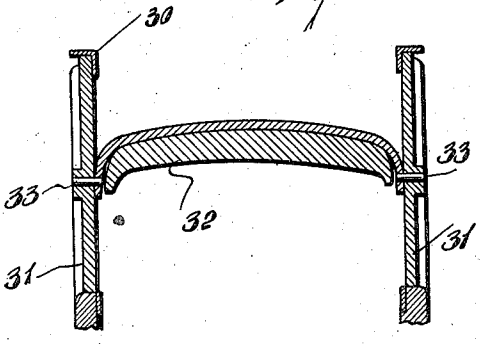


Fig. 22.





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Patented Apr. 27, 1937 2,078,823

UNITED STATES PATENT OFFICE

2,078,823

TANDEM HELICOPTER

Charles E. Weaver, Watertown, N. Y.

Application July 25, 1935, Serial No. 33,130

10 Claims. (Cl. 244—17)

This invention relates to an airship and it aims to provide a novel and generally improved construction embodying tandem helicopter principles.

It is particularly aimed to provide such a construction wherein the tandem helicopters are similar in size and weight and comprise inner and outer, oppositely rotating foils to provide the lifting force.

It is also aimed to provide a novel aircraft wherein means are provided operable to serve as landing wheels and buoying means, selectively, according to whether the ship is used on land or water, and which means normally is rotated within cowl pockets of the cabin.

Another object is to provide a novel pushing propeller and means operable from within the cabin to vary the angle of use of such propeller.

Further it is aimed to provide a novel means wherein the land wheels may yield laterally but are urged normally to a straight ahead position.

The more specific objects and advantages will become apparent from a consideration of the description following taken in connection with accompanying drawings illustrating an operative embodiment.

In said drawings:—

Figure 1 is a view of the airship in side elevation;

Figure 2 is a top or plan view thereof;

Figure 3 is an enlarged central longitudinal sectional view taken on the line 3—3 of Figure 2;

Figure 4 is a horizontal sectional view through the airship;

Figure 5 is another horizontal sectional view through the airship taken on a lower plane than figure 4;

Figure 6 is a vertical sectional view taken on the line 6—6 of Figure 1;

Figure 7 is an enlarged side elevation showing one of the land wheels and its mounting;

Figure 8 is a detail side elevation, showing the resilient mounting for one of the land wheels in section;

Figure 9 is a horizontal sectional view taken on the line 9—9 of Figure 1;

Figure 10 is a horizontal sectional view taken on the line 10—10 of Figure 1;

Figure 11 is a vertical sectional view taken on the line 11—11 of Figure 9;

Figure 12 is a front elevation of the pushing propeller structure;

Figure 13 is a detail section taken on the line 13—13 of Figure 12;

Figure 14 is a detail section taken on the line 14—14 of Figure 5;

Figure 15 is a sectional detail taken on the line 15—15 of Figure 5;

Figure 16 is a section taken on the line 16—16 of Figure 2;

Figure 17 is a cross section taken on the line 17—17 of Figure 16;

Figure 18 is a cross section taken on the line 18—18 of Figure 16;

Figure 19 is a cross section taken on the line 19—19 of Figure 16;

Figure 20 is a longitudinal section taken on the line 20—20 of Figure 2;

Figure 21 is a cross section taken on the line 21—21 of Figure 20; and

Figure 22 is a cross section taken on the line 22—22 of Figure 20.

Referring specifically to the drawings wherein like reference characters designate like or similar parts, 23 designates a gondola-shaped body having a cabin 24. These parts may be of any desired construction but preferably have their framework and bracing of a light metal, usually an aluminum alloy and for instance duralumin. Tandem helicopter devices are employed one at each end of the machine as at A. These devices are similar, in weight and dimensions, and are disposed at the same height or elevation.

Each device A comprises a vertical tubular shaft which is journaled in a vertical tubular bearing 26 on the machine, preferably with ball bearings 27 interposed as shown. Shafts 25 have radiating arms 28 rigidly attached thereto by means of hubs 29 and such arms 28 mount frames 30 having spaced annular walls 31, concentric with the axis of the shaft 25. Such walls 31 have foils 32 connected thereto as at 33.

Journaled within the shaft 25 concentric therewith are shafts 34 with ball bearings 35 preferably interposed between such shafts. Hubs 36 rigidly connect arms 37 to the shaft 34 and they suspend a frame 38 having annular walls 39 concentric with the walls 31 and axis of shafts 25 and 34. Such walls 39 have foils 40 attached thereto as at 41.

The outer foils 32 of such helicopter device are preferably similar and four in number although they may be of any desired number. The number of the foils 40 of each helicopter device, corresponds to the number of the outer foils 32 of that helicopter. All of the foils 32 are mounted at an angle of about 12 degrees and so constructed as to force air in toward the center, the depth of the curve thereof increasing and narrowing

inwardly as it approaches the receding or trailing end, the inner edge having a slighter curve or roll, thus compressing the air taken in by the advancing or leading edge. The foils 40, in the main, are constructed generally like the foils 32 except that the outside curve or roll is less than the inner curve or roll, which is sharp at this point, thus forcing the air taken in by the leading edge toward the outside, thereby causing compression of the air between the outer and inner foils which adds materially to the lifting force exerted by both sets of foils 32 and 40, forcing the air downward. The inner and outer frames 38 and 30, respectively, revolving in opposite directions, are timed at one-fourth of a turn with each other so that the side-wash caused by one is picked up by the other, again increasing the lift by compression. While the frames 30 and 38 and the foils 32 and 40, as well as their mounting and supporting means may be of any material desired, yet they are preferably made of light metal, usually an aluminum alloy such as duralumin.

The specific shape of the foils 32 and 40 will be better understood from a consideration of the detail Figures 16 to 22. Arrows indicate the direction of turning of the said frames 30 and 38 and foils 32 and 40 in Figure 2.

The aforesaid shafts 25 and 34 are driven from a suitable prime mover or engine 42 located centrally within the hull of the cabin, which under suitable control, drives a longitudinally disposed shaft 43. Such shaft 43 is suitably journaled and at its forward end has a spur gear wheel 44 keyed thereto enmeshed with a spur gear wheel 45 disposed above the same and both gear wheels preferably being housed within a casing 46 suitably mounted within the hull. Said gear wheel 45 is keyed to a countershaft 47 in turn having a bevel gear wheel 48 keyed thereto.

At the rear end, shaft 43 has a spur gear wheel 49 keyed thereto enmeshed with a spur gear wheel 50 in turn enmeshed with a spur gear wheel 51 keyed to a countershaft 52 having a bevel gear wheel 53 keyed thereon. The gear wheels 49, 50, and 51 are preferably located within a casing 54 and the latter has a short shaft 55 journaled therein on which the idler gear wheel 50 is carried.

The gear wheels 53 and 48, are interposed between and in mesh with larger gear wheels 54 and 55 keyed to the hollow shaft 25 and 34 respectively. Shafts 52 and 47, are journaled in and the gear wheels 53, 54, 55, and 48, are preferably housed in enlargements or casings 56 at opposite ends of the hull of the gondola as shown.

Referring now to the landing gear, four wheels 58 are employed, being journaled on axles 59 mounted in forks 60 at one end of arms 61, equipped with segments 62 at their other ends provided with gear teeth at 63. Such segments 62 are pivoted on rods 64 extending longitudinally of the machine and fastened to brackets 65 on the hull. Braces 66 are connected to each axle 59 and pivoted on the rods 64, so that the wheels, braces, and arms 61 may swing on the axes of rods 64. As best shown in Figure 5, a pair of longitudinal shafts 67 are suitably journaled within the hull adjacent opposite sides thereof and each having spur gears 68 thereon enmeshed with the teeth 63. Bevel gear wheels 69 are keyed to the shafts 67 meshing with bevel gear wheels 70 carried by a cross shaft 71 having a bevel gear wheel 72 keyed thereto and enmeshed with a bevel gear wheel 73 carried by the main shaft 74 of a motor or engine 75. Such motor or engine 75 is preferably operable from the cabin of the gondola so as to position and maintain the wheels 58 in landing position as shown in Figure 6 in horizontal position as shown in Figures 4 and 5 or in retracted position as shown in dotted lines in Figure 6. In the retracted position, such wheels are located within cowled pocket members 76 on the cabin, having openings 77, to enable the wheels to pass into and out of the same.

Particular attention is called to the fact that said wheels 58 have buoyant tires 78 thereon, preferably being pneumatic balloon or mushroom tires so that in the horizontal position shown in Figures 4 and 5, the tires will act as floats, pontoons or stabilizers when landing on water.

A fifth wheel is employed as at 79 which is normally retracted as shown in full lines in Figure 7 into a central longitudinal pocket 80 beneath the gondola. This wheel is adapted to be projected into the dotted line position shown in Figure 7 to raise the adjacent wheels 58 from the ground, when it is desired to taxi. Such wheel 79 is journaled on an axle 81 carried by a fork 82 from which a post 83 rises. Post 83 is pivoted within a bearing 84, secured in place by screw cap means 85 engaging a screw stud 86 on the post 83. Bearing 84 is carried by a lever 87 pivoted at 88 along the center line of the hull of the gondola. Within the bearing 84 is a coil spring 84a fastened at one end to the post 83 and at the other end to the bearing 84, being so tensioned as to normally maintain the wheel 79 in a straight ahead position, but permitting the same to yield when striking an obstruction and thereafter to return to normal position. Such lever 87 and wheel 79 thereon are adapted to be raised and lowered by any suitable means. For instance, hydraulically under control of suitable means within the pilot's cabin. To this end a cylinder 89 is pivoted at 90 to the machine and at opposite ends has pipe connections 91 to admit and exhaust power fluid. A piston 92 is operable within the cylinder 89 intermediate the pipe connections 91 and a rod 93a extends therefrom and is pivoted at 94 to the lever 87. According to the direction of admission of power fluid to the tubes 91 against the piston 92, the lever 87 will be raised and lowered and the wheel 79 thereon correspondingly raised and lowered. This wheel is also preferably provided with a pneumatic balloon or mushroom tire as at 92a.

A pushing propeller is employed at 93. While this propeller may be of any desired construction, it preferably comprises any suitable number of angularly disposed blades 94a, carried by a skeleton reinforcing frame 95, and which has brace members 96 coacting with the outer ends of the blades. This propeller 93 is keyed to a shaft 97, driven by a suitable motor 98 carried by a bracket 99 pivotally mounted by alined vertical elements 100, connected to arms 101 on one of the hollow bearing devices 26. This propeller is adapted to be swung laterally, that is to either side on the vertical axis passing through the pivot members 100, and to this end, the bracket 99 has a segment 102 provided with gear teeth 103. Teeth 103 are preferably worm teeth and mesh with a worm gear 104 keyed to a shaft 105, suitably journaled in bearings 106 on the gondola and at opposite ends, said shaft 105 has drums 107 keyed thereto, and each provided with spiral grooves 108, with the angle of such grooves of the different drums being oppo-

site. Flexible wires or other elements 109 are fastened one to each drum 107, occupying the grooves 108 thereof, and such cables or flexible elements are also connected to a windlass or drum 109' pivoted at 110, within the gondola, and preferably operable from the pilot's cabin. The flexible elements 109 are suitably trained and guided by pulleys and the like as at 111 along the side walls of the gondola, and they have suitable turnbuckles 112 within their length whereby they may be maintained taut. It will be understood that the elements 109 are wrapped on the windlass 109' in opposite directions so that by turning the windlass in one direction one element 109 will be shortened and the other correspondingly lengthened, and vice versa, correspondingly swinging the propeller 93.

Various changes may be resorted to provided they fall within the spirit and scope of the invention.

I claim as my invention:—

1. An airship of the class described having a gondola, and lifting helicopter devices therefor, said devices each comprising inner and outer oppositely rotating frames in the same plane and having rims closely adjacent at the center of the machine, the other frames rotating in opposite directions and foils carried by said frames.

2. An airship of the class described having a gondola, vertical bearings adjacent opposite ends thereof, outer shafts journaled in said bearings, inner shafts journaled within said outer shafts, means operable to drive the inner and outer shafts in opposite directions, concentric inner and outer frames in the same plane carried by said inner and outer shafts, said outer frames extending one substantially to the other at the center of the airship and being rotatable in opposite directions, and foils carried by said frames.

3. An airship of the class described having a gondola, vertical bearings adjacent opposite ends thereof, outer shafts journaled in said bearings, inner shafts journaled within said outer shafts, means operable to drive the inner and outer shafts in opposite directions, concentric inner and outer frames in the same plane carried by said inner and outer shafts, said outer frames extending one substantially to the other at the center of the airship and being rotatable in opposite directions, foils carried by said frames of an area to function as parachutes, arms on one of said bearings, a bracket pivoted to said arms, a pushing propeller mounted by said bracket, means operable to drive said propeller, and means operable to shift said bracket and propeller on the axis of the bracket.

4. An airship of the class described having a helicopter device, said device comprising concentric shafts, frames in the same plane on said shafts terminating relatively close to each other, said frames operable in opposite directions, rows of foils carried by said frames, the area of the foils of each frame being substantially co-extensive with the area of that frame.

5. An airship of the class described having a helicopter device, said device comprising concentric shafts, frames on said shafts in the same plane terminating relatively close to each other, said frames operable in opposite directions, rows of foils carried by said frames, the foils of the outer row having the depth of the curve thereof increasing and narrowing as it approaches the trailing end, the inner end of such latter foils having a slighter curve to cause compression of the air taken in by the leading edge, the inner foils having the outside curve less than the inner curve to force the air taken in by the leading edge toward the outside to compress the air between the outer and inner foils to aid the lifting force.

6. An airship of the class described having a rotor including peripheral frames operable in opposite directions, said frames being disposed in the same plane and terminating relatively close to each other at their rims, each frame having inner and outer rings in vertically spaced relation, means connecting the inner and outer rings, and foils connected to said means between the rings.

7. An airship of the class described having a rotor including peripheral frames operable in opposite directions, said frames being disposed in the same plane and terminating relatively close to each other at their rims, each frame having inner and outer rings in vertically spaced relation, means connecting the inner and outer rings, and foils connected to said means between the rings, said foils being in inner and outer rows.

8. An airship of the class described having a rotor including peripheral frames operable in opposite directions, said frames being disposed in the same plane and terminating relatively close to each other at their rims, each frame having inner and outer rings in vertically spaced relation, means connecting the inner and outer rings, and foils connected to said means between the rings, said foils being in inner and outer rows, the foils of the outer row having inwardly curved portions and the foils of the inner row having outwardly curved portions to coact with the first mentioned curved portions.

9. An airship of the class described having a helicopter device, said device comprising a peripheral frame, said frame having spaced inner and outer rings, the latter being above the former, vertical arms spacing said rings, foils connected to said arms between the rings, an oppositely rotatable body surrounded by said rings, said body comprising inner and outer spaced rings, arms joining the last mentioned inner and outer spaced rings, foils connected to the last mentioned arms and being in substantially the same plane as the first mentioned foils.

10. An airship of the class described having a helicopter device, said device comprising a peripheral frame, said frame having spaced inner and outer rings, the latter being above the former, vertical arms spacing said rings, foils connected to said arms between the rings, an oppositely rotatable body surrounded by said rings, said body comprising inner and outer spaced rings, arms joining the last mentioned inner and outer spaced rings, foils connected to the last mentioned arms and being in substantially the same plane as the first mentioned foils, the first mentioned foils having inwardly curved portions and the second mentioned foils having outwardly curved portions to coact with the first mentioned curved portions.

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