

C. H. TOLIVER.
AIRSHIP.

APPLICATION FILED AUG. 16, 1910.

Patented Mar. 12, 1912.

4 SHEETS—SHEET 1.

1,020,118.

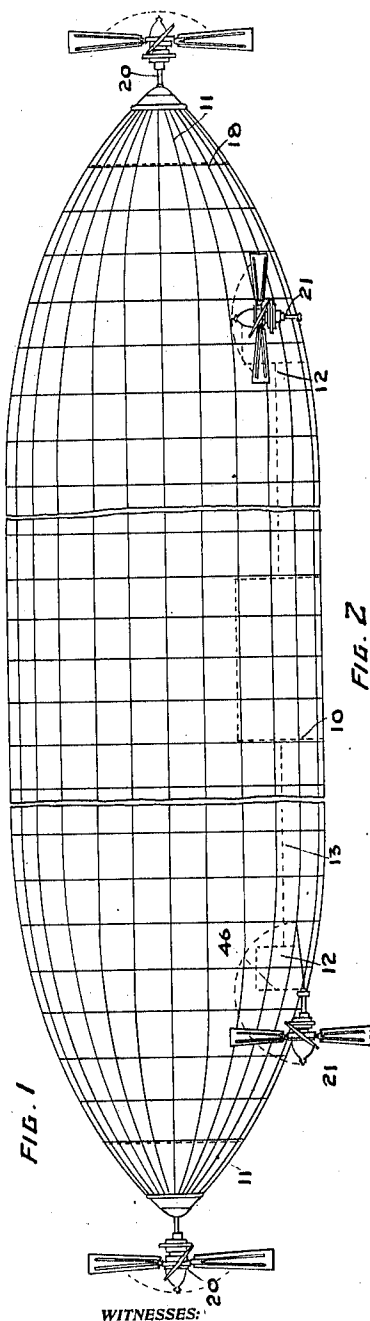
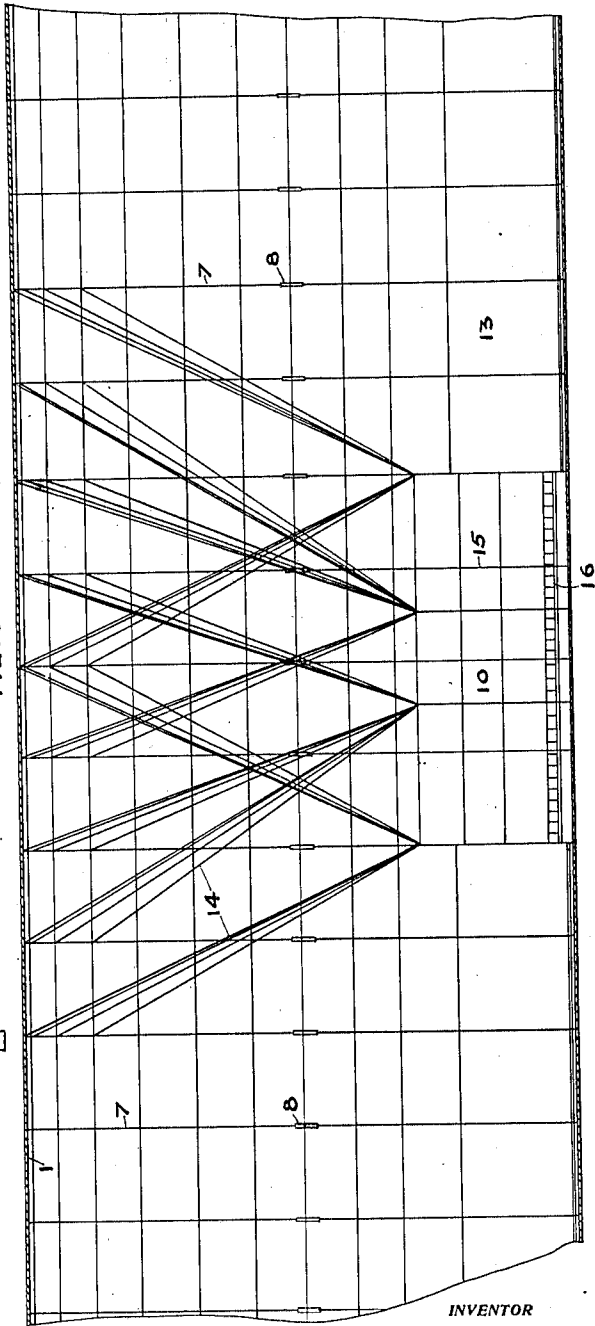


FIG. 1

WITNESSES:

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FIG. 2



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FIG. 3

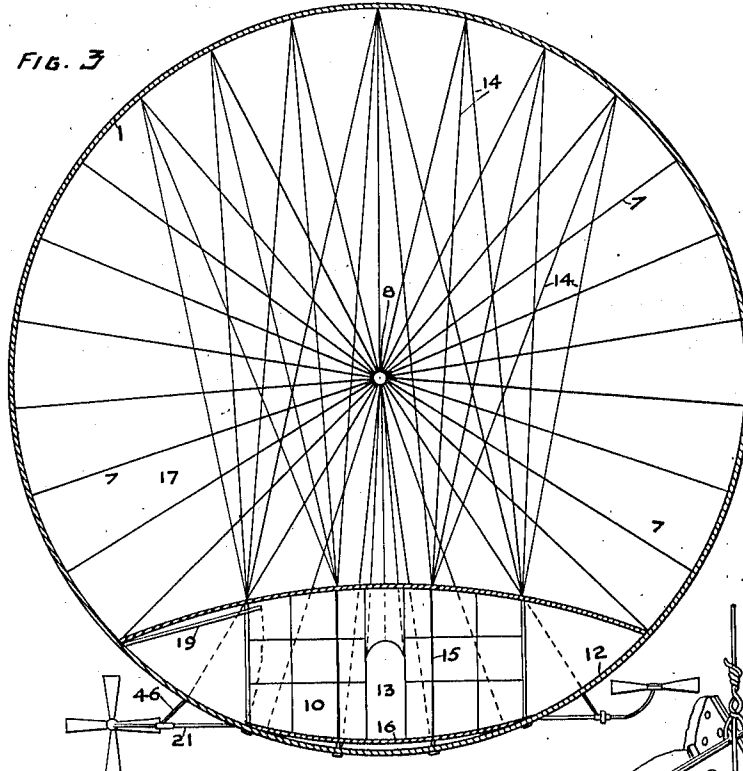


FIG. 4

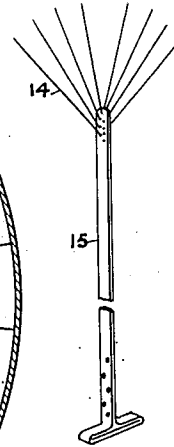


FIG. 5

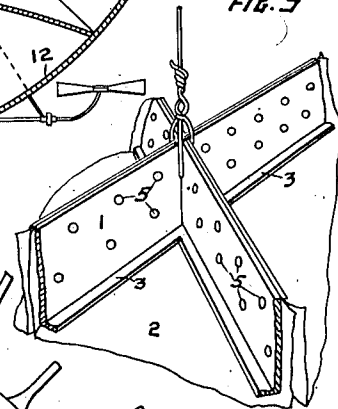


FIG. 6

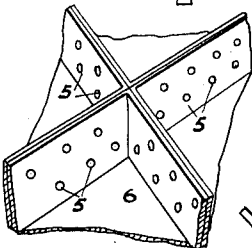
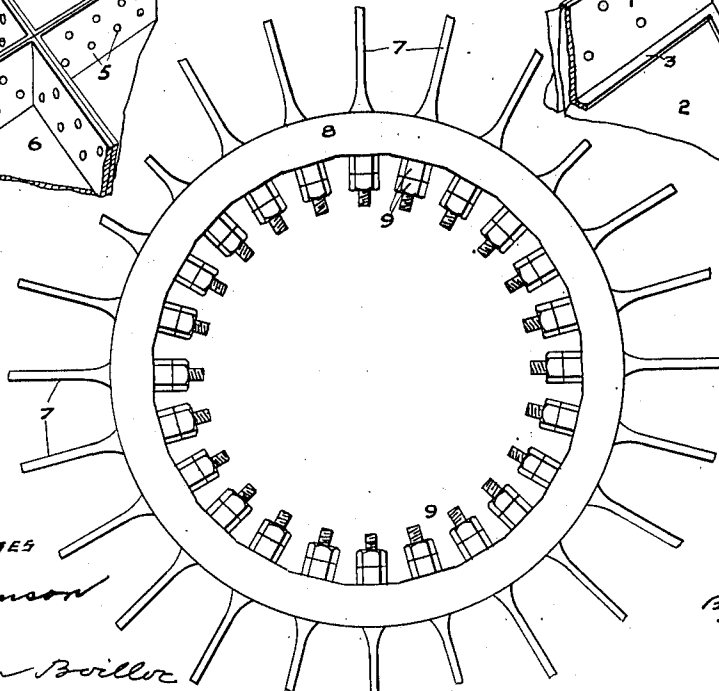


FIG. 7



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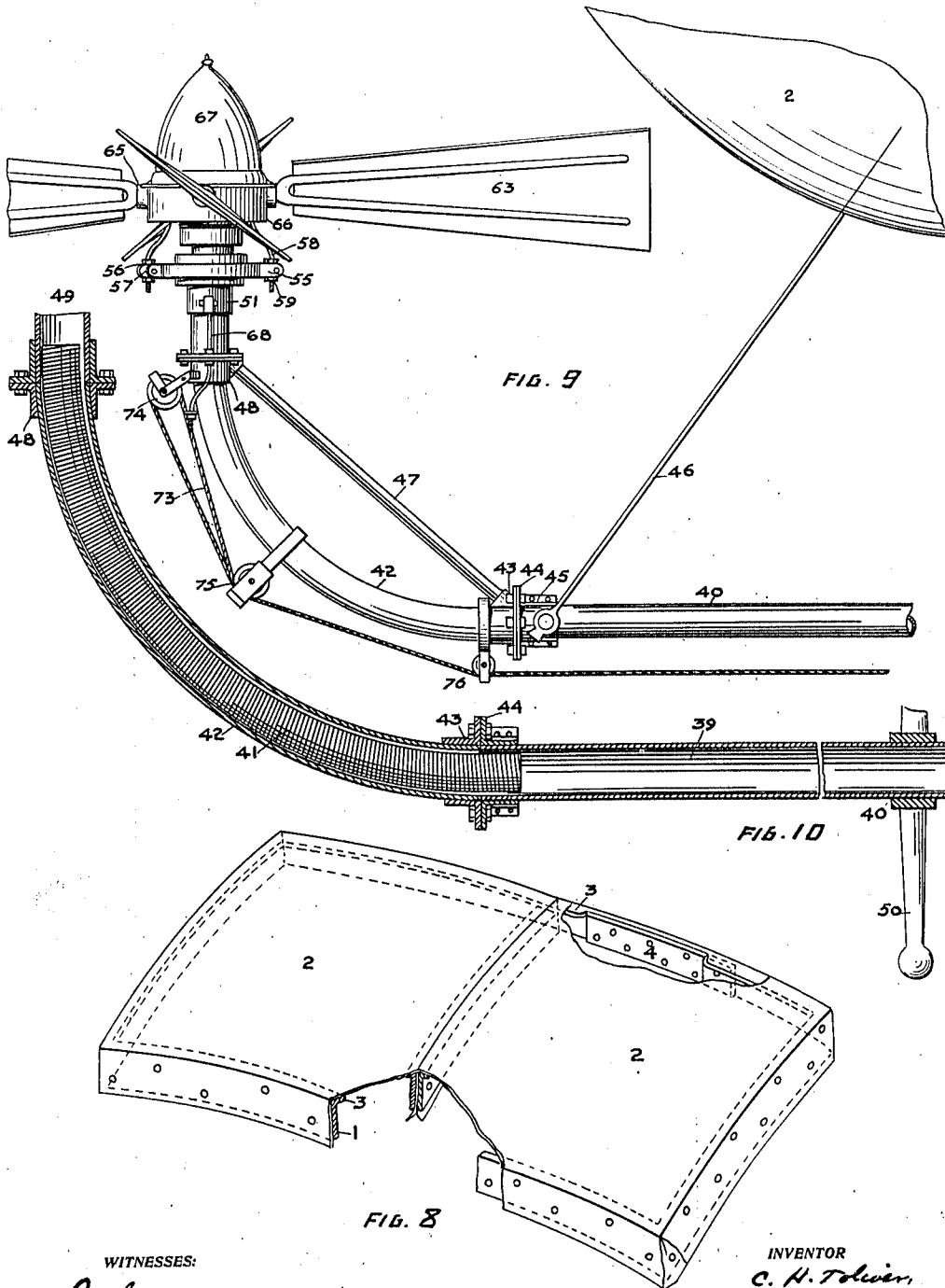
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4 SHEETS—SHEET 3.

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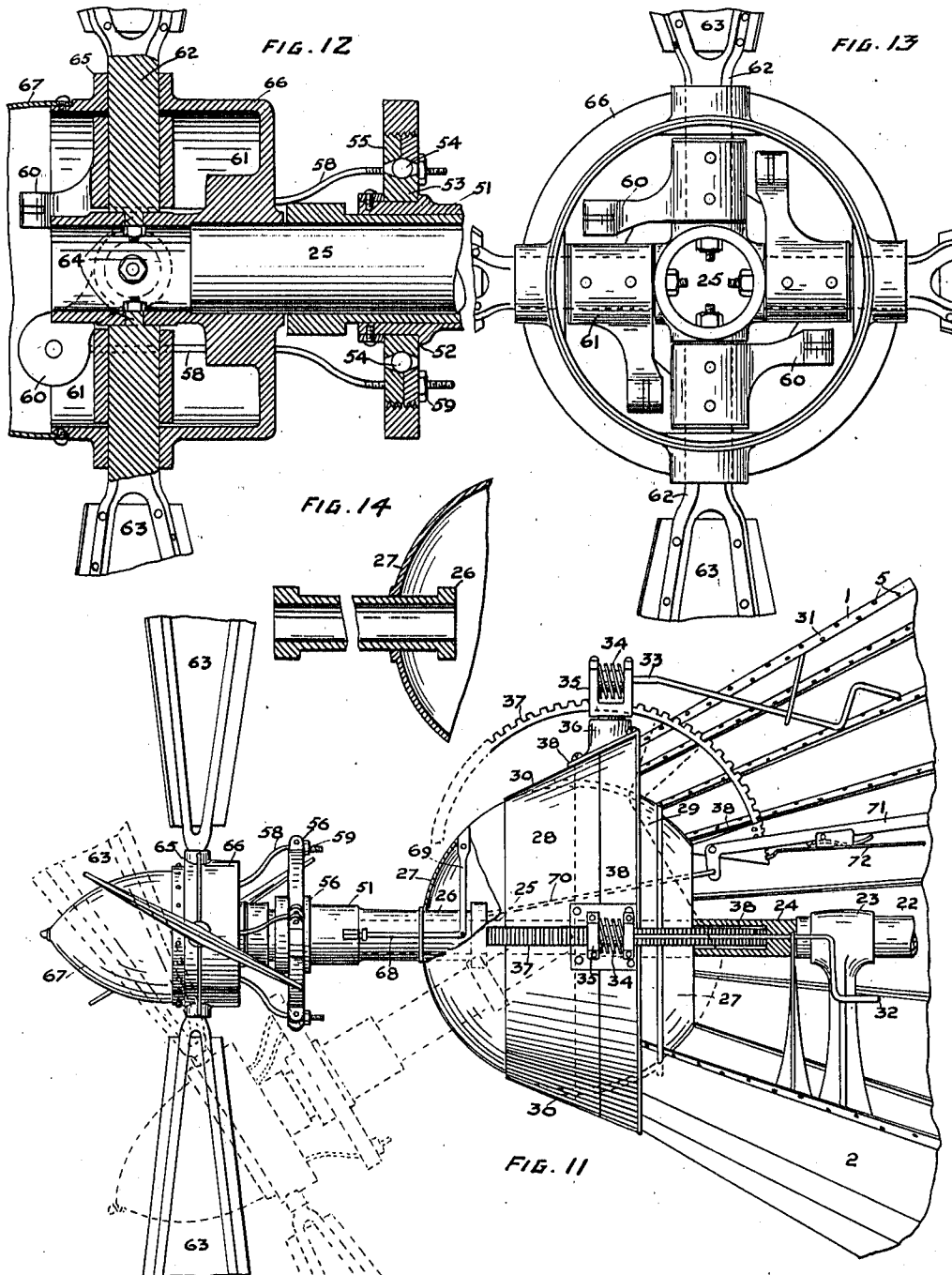
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4 SHEETS—SHEET 4.

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UNITED STATES PATENT OFFICE.

CHARLES H. TOLIVER, OF SAN DIEGO, CALIFORNIA.

AIRSHIP.

1,020,118.

Specification of Letters Patent.

Patented Mar. 12, 1912.

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To all whom it may concern:

Be it known that I, CHARLES H. TOLIVER, a citizen of the United States, residing at San Diego, in the county of San Diego and State of California, have invented new and useful Improvements in Airships, of which the following is a specification.

This invention relates to improvements in air-ships, the objects of the invention being, first, to provide an improved construction of the body of the ship, in order that such body, while self supporting and non-collapsible, may be of great strength in proportion to its weight, and also can be built up conveniently, and so as to permit of the ready and certain detection of any aperture which would permit of the escape of the buoyant gas; second, to provide one in which the compartments for the carriage of passengers or freight, and those for the reception of the engines, the conning chambers, and the communicating passages, may be conveniently and effectively arranged relatively to the buoyant gas chamber, and the floors of such compartments may be suspended in the most efficient manner possible to support the heavy bodies contained therein; third, to provide improved means for propelling such a ship, either forward or backward, up or down, or in any intermediate direction, and also for steering it.

In the accompanying drawings, Figure 1 is a broken side view of the air-ship; Fig. 2 is an enlarged central longitudinal section thereof; Fig. 3 is an enlarged central cross section; Fig. 4 is a detail broken perspective view of the cabin supports; Fig. 5 is an enlarged detail perspective view of adjacent small units; Fig. 6 is a similar view showing a modified form of the units; Fig. 7 is an enlarged side view of a central ring; Fig. 8 is a broken detail perspective view of two shell units connected; Fig. 9 is a side view of one of the side propellers; Fig. 10 is an enlarged longitudinal section of the shafting therefor; Fig. 11 is a broken side view of a terminal propeller and the controlling mechanism therefor; Fig. 12 is a sectional view of the same; Fig. 13 is an end view of the same; Fig. 14 is a detail broken sectional view of the globular bearing for the terminal propeller.

In general form my improved air-ship is cylindrical in the center and conoidal at the ends. Its shell is composed of units, which, for the main or central cylindrical portion

of the shell, are uniform in size and shape, while for the terminal conoidal portions thereof they vary in size and shape according to their position.

In the modification shown in Figs. 5 and 8, each shell unit is formed of a frame 1, of metal and a skin 2 of flexible material, preferably silk coated with paint or the like. The metallic frame 1 of each unit is preferably formed of an L-bar having a narrow flange 3, said bar being bent into a quadrilateral, which for the central portion of the ship is square and the ends are connected by a plate 4. Over the frame thus formed is secured a piece 2 of silk or other flexible material which rests against the narrow flange 3, its edges being bent over and secured to the wide sides of the L-bar. These shell units, so formed, can readily be examined separately for punctures or defects in the silk, by inspecting them from a dark room so that the light from the outside shines through any perforations and immediately reveals the same. From these units the shell is built up; first by connecting units together to form a complete transverse ring of the air ship, and then by adding other units in successive rings. The units are connected by riveting the L-bars together as shown at 5, so that the edges of the silk intervene between the bars, and the units are placed with four corners meeting as shown in Figs. 5, 6 and 8, and this is the case not only with the square units of the mediate portion of the ship, but also with the tapering units used for its terminal portions. This method of construction provides a shell of great strength in proportion to its weight, offering great radial and longitudinal resistance to collapse having ribs extending longitudinally and circumferentially throughout the entire shell, and which as it is being built, can be minutely scrutinized to discover the least defect or perforation through which the buoyant gas could escape.

In the modification shown in Fig. 6, each unit 6 is made entirely of metal of the same general form as those already described, so that it has on each of its four sides an inwardly extending flange, which flanges, of adjacent units, are riveted together in like manner as the bars 1. To additionally resist the pressure of the contained buoyant gas, as well as to equally distribute the strain throughout the entire circumference

of the ship, the unit frames are, at each point of juncture of four shell units, connected by a tie wire 7 with a central ring 8, the inner ends of the wires being enlarged and threaded, and secured by nuts 9.

The chambers of the air-ship are all located as low as possible, and comprise the passenger cabins or freight holds, the engine rooms, and the connection passage. There is here illustrated only one passenger cabin, shown at 10, but it will readily be seen that the number of such cabins may vary and will generally increase with the length of the ship. Of the engine rooms, two, 11, are located at the extreme ends and are used also as conning chambers, and two, 12, are located at the inner ends of the conoidal portions of the shell. A narrow central passage 13, extends the full length of the ship, and connects the engine rooms 11, 12 with each other and with the cabin or cabins 10. The inner engine rooms 12 and the cabins 10 are sustained by wires 14 extending upward obliquely, both forwardly and rearwardly, said wires being connected at their upper ends to the corners of shell units forming the upper surface of the shell, and at their lower ends to flat steel bars 15 which support the floors 16. The walls of the cabins and engine rooms are formed of shell units similar to those of the outer shell. The engine rooms 11 at the ends of the ship are partitioned from the gas chamber 17 by a bulkhead 18 similarly constructed. The passenger cabins 10 are provided with windows 19 on each side of the floor, for inspection of the country passed over, and these windows are hinged at their outer edges so that they can be raised to the position shown in the left of Fig. 3, to permit the passengers to enter and leave the cabin, on foot, when the ship is resting upon the ground, or by a boat if resting on water.

The propellers for moving the air-ship comprise the terminal propellers 20, one at each end, and the mediate propellers 21, a pair at the wider end of each conoidal portion of the ship. Each of the end propellers, and each pair of the mediate propellers, has its own engine room. The engines themselves are not here shown, as they may be of any suitable type. Considering first the construction of the end propellers 20, the driving shaft 22 from the engine is supported in a suitable bearing 23, and is connected to a short flexible shaft 24, which in turn is connected to a rigid propeller shaft 25, which rotates in a sleeve 26 formed integral with a hollow globular bearing 27. Said bearing 27 is rotatable in any direction in a conical socket 28, like the common ball and socket joint, the bearing 27 being retained in place by a globular collar 29 secured by bolts 30 to said socket 28. The socket 28 is

itself secured to the ends of the converging ribs or sides 31 of the shell units. To move the globular bearing 27 in any direction, there are provided two crank handles 32, attached to shafts 33 of worms 34, mounted in yokes 35, revolvably mounted in step bearings 36 secured on the outside of the socket 28. Through these yokes pass quadrantal racks 37 attached to the bearing 27 by plates 38. By turning either crank handle, the bearing 27 can be moved through any angle, not greater than a right angle, in the plane of the quadrantal rack, and by a combined movement of both crank handles the bearing can be angularly moved in any plane through the axis of the ship, so that the shaft of each terminal propeller is permitted an amplitude of movement of 45° on either side of the axial line of the air-ship and in any plane therethrough, and this movement can take place while the propeller is in operation.

The driving shaft 39 of each mediate propeller is inclosed in a sleeve 40, and is connected with a flexible shaft 41 in a quadrantal sleeve 42. Said sleeve is connected with the sleeve 40 by flanged collars 43, 44, the collar 44 of the sleeve being rotatable in a bearing 45 braced from the shell of the air-ship by a bar 46. The bar 47 connects the collar 43 with a collar 48 on the outer end of the quadrantal sleeve 42. The outer end of the flexible shaft is connected with a short rigid propeller shaft 49. The sleeves 40 and 42 for the driving and flexible shafts 39, 41 can be rotated about the axis of the driving shaft while the shaft itself is rotating, by any suitable means, and for this purpose there is here shown a hand-wheel 50 secured on the sleeve 40. To reverse the propellers there is mounted upon the sleeve 26, forming the bearing for the terminal propeller shaft, a collar 51, having a groove 52, in which is secured a ring 53 forming a race for balls 54, held in place by an outer composite ring 55. Said outer ring is formed with short radial yokes 56, in which are secured sockets 57 through which pass the inner ends of links 58 secured by nuts 59. The outer ends of the links are attached to arms 60 of sleeves 61, secured to the stems 62 of the propeller blades 63, said stems rotating in inner and outer bearings 64, and 65, formed in a hollow hub 66 secured upon the propeller shaft 25. A cap 67 closes the outer end of said hub. To the collar 51 is attached a rod 68 jointed to a lever 69, which is also connected by a link 70 with the short arm of a lever 71, pivoted upon one of the plates 38, said lever 71 being adapted to be held in any position of rest by means of a spring-actuated latching lever 72. By means of said lever 71 the collar 51 may be moved on the sleeve 26 to rock the arms 50 and reverse the propeller blades or turn

them to any desired angular position. A similar arrangement is provided in regard to the blades of the mediate propellers, the only difference being that in this case the rod 68 is attached to a cord or cable 73 which passes around a pulley 74 and thence by pulleys 75, 76, to the engine room. By moving the cable in either direction, the collar 51 may be correspondingly shifted, and the blades angularly moved to reverse, or otherwise modify, the direction of their action.

I claim:—

1. In an air-ship, the combination of a driving shaft, a flexible shaft connected thereto, a rigid propeller shaft connected with the other end of the flexible shaft, a propeller thereon, a globular bearing for said propeller shaft, a socket for said globular bearing in which it can be rotated in any direction and means for turning said globular bearing in any direction in said socket, substantially as described.

2. In an air-ship, the combination of a driving shaft, a flexible shaft connected thereto, a rigid propeller shaft connected with the other end of the flexible shaft, a propeller thereon, a globular bearing for said propeller shaft, a socket for said globular bearing in which it can be rotated in any direction and means for turning said globular bearing in any direction in said socket comprising two worms secured on said socket at points thereon in axial planes at right angles to each other, quadrantal racks secured to said globular bearing and engaging said worms to be moved thereby, and means for rotating the worms, substantially as described.

In testimony whereof I have hereunto set my hand in the presence of two subscribing witnesses.

CHARLES H. TOLIVER.

Witnesses:

W. D. FISHBURN,
E. O. BUSENBURG.