L. C. BADEAU.

STEERING APPARATUS FOR AIRSHIPS.

APPLICATION FILED JUNE 24, 1910 RENEWED FEB. 20, 1915.

1,155,031.

Patented Sept. 28, 1915.

2 SHEETS—SHEET 1.

Fig. 1.

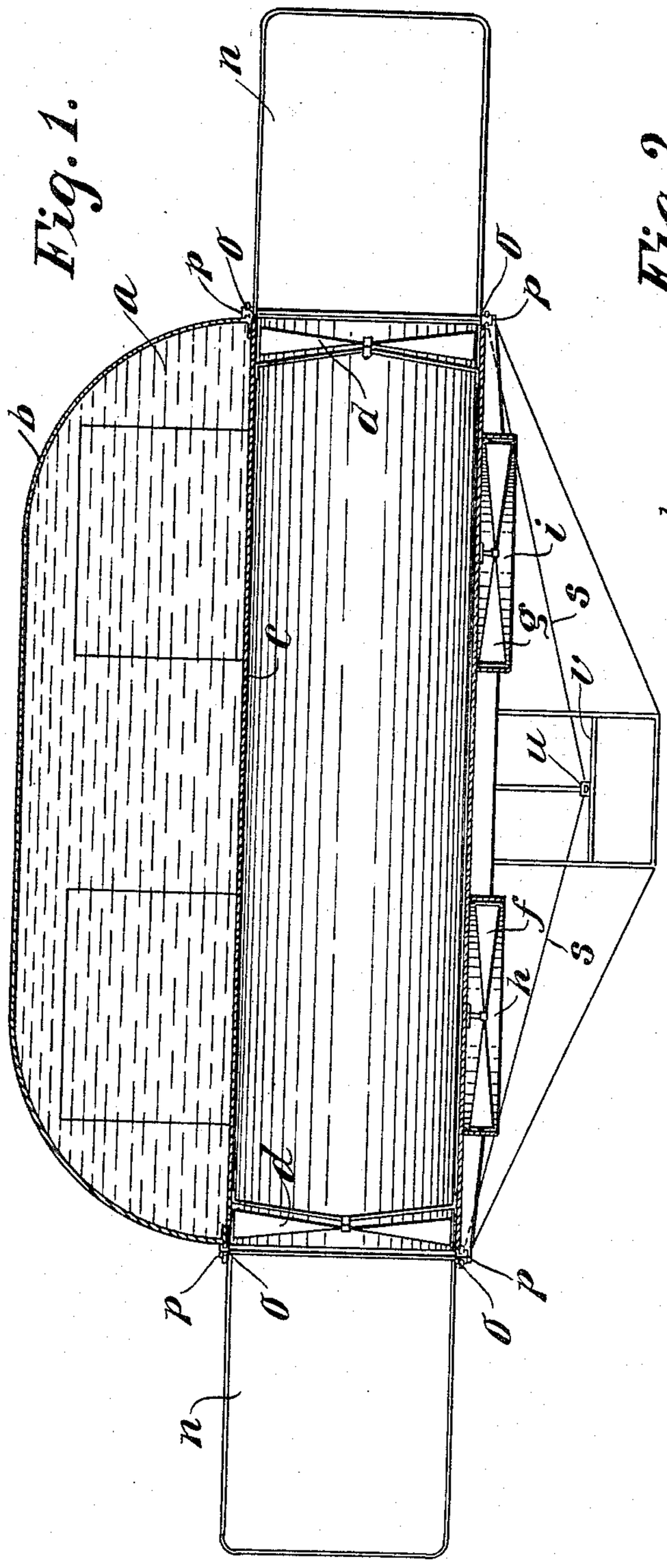
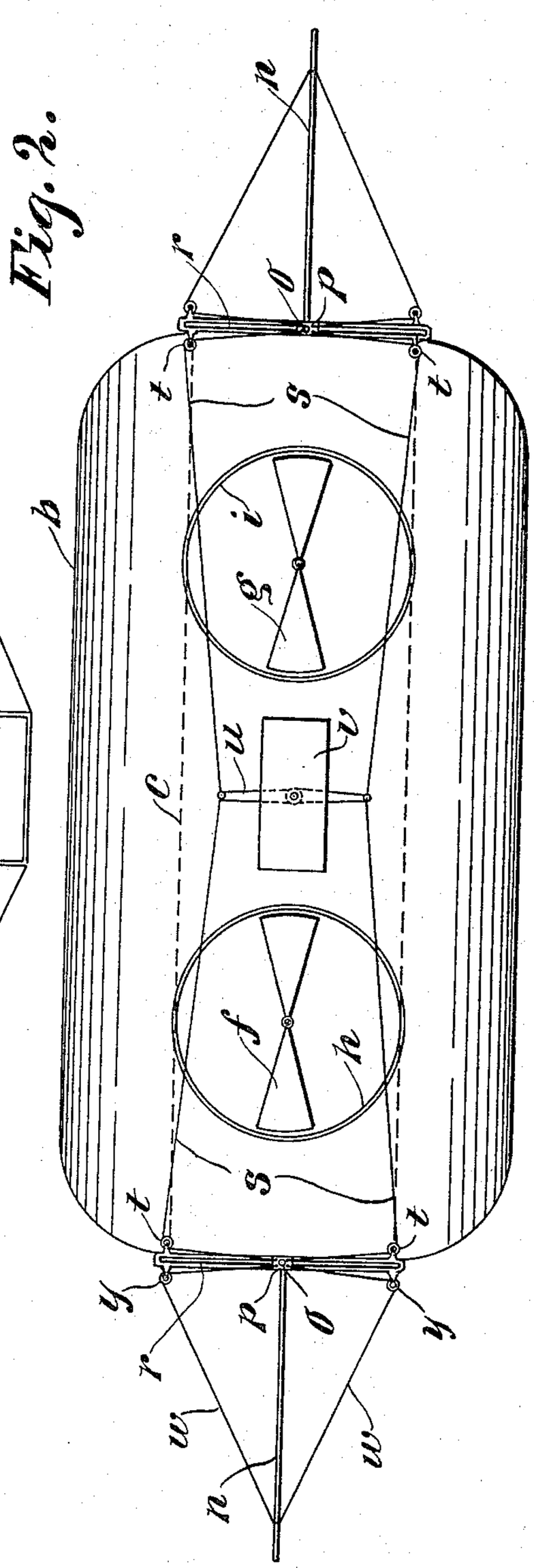


Fig. 2.



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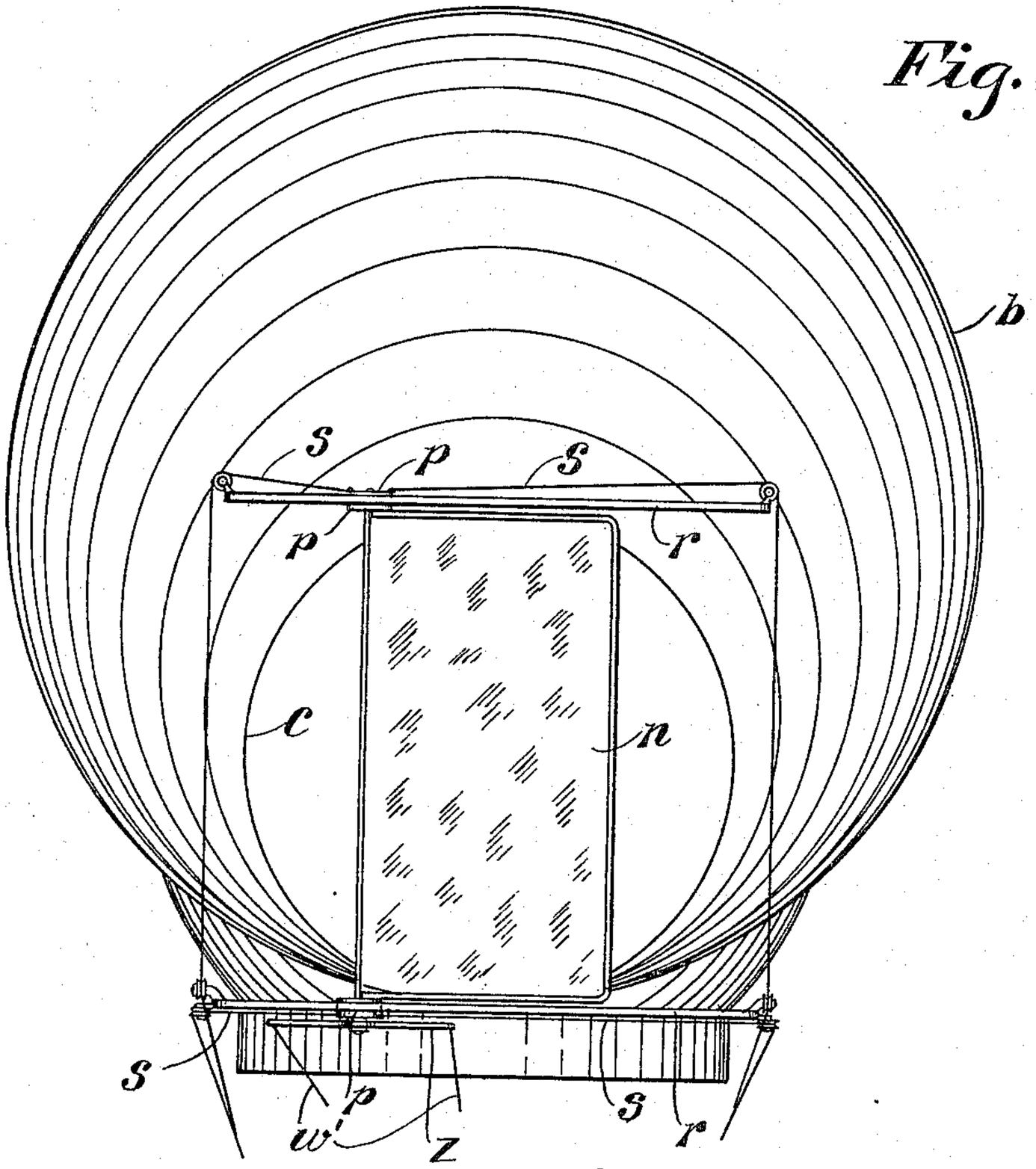
2 SHEETS—SHEET 2.

Fig. 3.



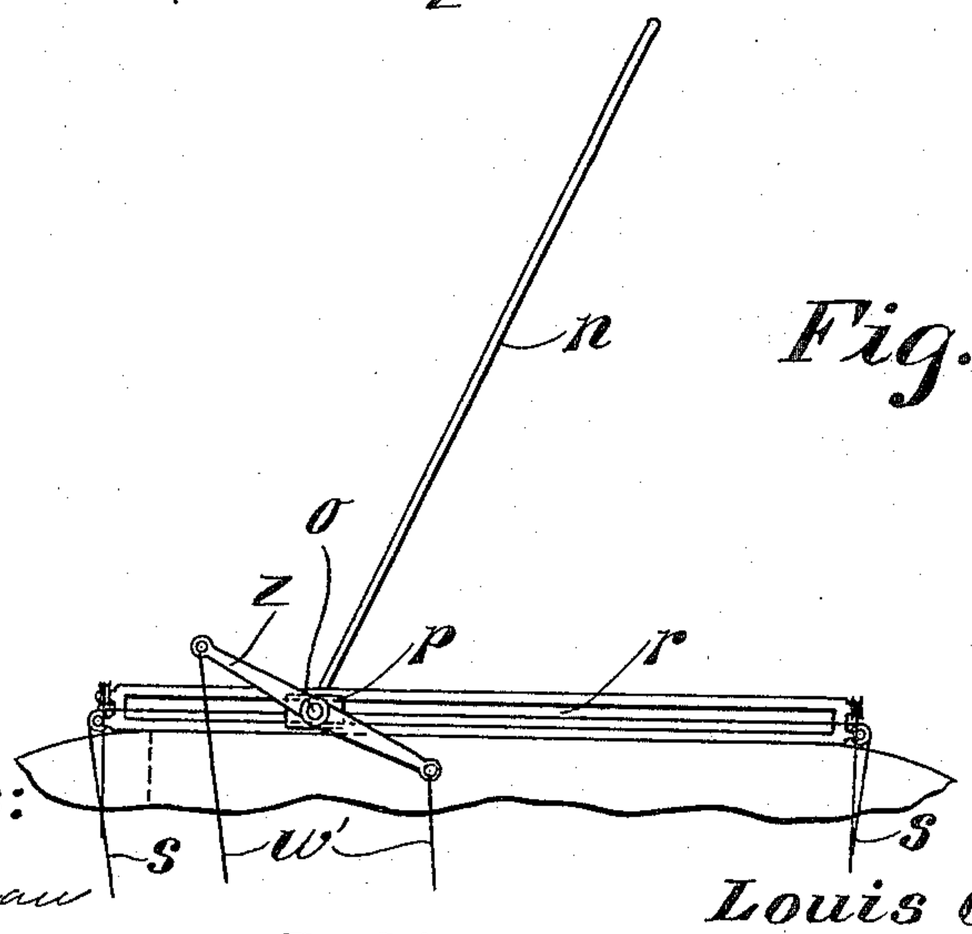


Fig. 4.

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STEERING APPARATUS FOR AIRSHIPS.

1,155,031. Specification of Letters Patent. Patented Sept. 28, 1915.

Application filed June 24, 1910, Serial No. 568,758. Renewed February 20, 1915. Serial No. 9,745.

To all whom it may concern:

Be it known that I, LOUIS C. BADEAU, a citizen of the United States, and a resident of Greater New York, State of New York, have invented certain new and useful Improvements in Steering Apparatus for Air-ships, of which the following is a full, clear, and exact description, such as will enable those skilled in the art to which it appertains to make and use the same.

This invention relates to steering apparatus for air-ships; and, while in the accompanying drawings the improvements are shown applied to an air-ship of the so-called "dirigible balloon" type, they may be applied as well to many other forms and types of machine for aerial navigation.

The object of the invention is to provide improved steering means whereby practically perfect control of the horizontal movements of the aerial craft may be attained. The improvements are designed particularly for air-ships having longitudinal propeller-tubes, and a further object of the invention is to cause the rudder to act upon practically the entirety of the column of air entering or leaving such propeller-tube, without at any time closing part or all of the open end of the tube.

The invention constitutes in part a division of my co-pending application for patent, Serial Number 536,024, filed January 3, 1910, and consists primarily of a vertical air-ship rudder pivoted at its inner end and having its pivotal axis adapted for lateral translation.

The preferred form of the invention comprehends, in an air-ship, a longitudinal propeller tube and the rudder as described mounted at the open end thereof; and in the best form of the invention a rudder is located at both ends of such propeller tube.

The invention also consists in steering mechanism for air-ships including a rudder which is pivoted to swing laterally and also mounted for lateral sliding movement, whether the rudder be pivoted at the outer or the inner end or intermediately.

Various other features of the invention will be described hereinafter and pointed out in the appended claims.

The invention is illustrated in the accompanying drawings by means of the preferred embodiments thereof; and in said drawings:

Figure 1 is a vertical longitudinal section through the air-ship; Fig. 2 is a bottom plan thereof; Fig. 3 is an end view; and Fig. 4 is a bottom plan of one end of the propeller tube.

The letter *c* indicates a longitudinal propeller-tube, which may be associated with an inclosed gas space *a* to be filled with a suitable gas of less specific gravity than air. This gas space is shown as formed between the propeller tube *c* and an outer tube or container *b*. Preferably, the propeller-tube *c* is placed eccentrically within the outer tube *b*, the ends of which latter are drawn over and onto the ends of the smaller tube and connected thereto to form a gas-tight joint. The smaller tube is preferably thus fastened to the larger tube with their lowest points in parallelism, for the purpose of giving rigidity to and lowering the center of gravity of the balloon, thus counteracting in great degree any tendency toward rolling or rocking in a transverse sense. However, the particular relation of the tubes *b* and *c* is not material to the present application.

The inflatable body or balloon may be constructed of textile fabric, like silk or canvas, or any other suitable material, and may be properly braced and reinforced to withstand external as well as internal pressure; but these are matters that do not concern the present invention.

The propeller-tube *c* is open at both ends and forms an air-shaft or -tunnel, in which one or more vertical propellers *d*, *d*, preferably one immediately within each end of the tube, are mounted for moving the air-ship forward or backward. In addition, if desired, there may be provided horizontal propellers *f*, *g*, mounted, respectively, in short, vertical tubes *h*, *i*, which are open at their lower ends below the balloon body and communicate with flues, such as shown in my co-pending application referred to, leading to and through the top of the tube *b* without in any way interfering with the propeller-tube *c*. If desired, as in my co-pending application, horizontal, tiltable planes may be located at both sides of the balloon body.

The letter *n* indicates a vertical rudder disposed centrally opposite the open end of the propeller-tube *c*. In the best construction, there are two rudders, located one at each end of the propeller-tube, as shown. Each rudder is pivoted at its inner end, as indicated at *o*, for lateral swinging move-

ment. The inner, pivoted ends of the rudders are also adapted for lateral translation; and to this end, they are preferably pivoted to upper and lower laterally slidable blocks *p*. These blocks are preferably guided by transverse slotted guides *r*, above and below the end of the propeller-tube and suitably secured to the frame-work of the air-ship.

The rudders may be operated synchronously or individually, or the lateral movement of the pivots may be synchronous and the turning movement independent, or vice-versa. In Fig. 2 I have shown operating cords *s*, extending laterally in opposite directions from the blocks *p*, to which they are secured, passing around pulleys *t* adjacent the ends of the guides *r*, and connected to a common operating lever *u*, located conveniently at the operator's car or seat *v*. Cords or the like *w* are secured to the rudders near their outer ends, and thence pass rearward and outward to pulleys *y*, and thence inward to the blocks *p*, to which they are secured. It follows, therefore, that the operation of shifting the blocks laterally in opposite directions, automatically turns the rudders in opposite directions, so that the air-ship may be steered by a drifting action.

In Figs. 3 and 4, *s* are the cords or flexible connections for shifting the blocks *p* laterally, and these cords may be connected to each other and common to the two rudders, as in Fig. 2, or they may be independent, that is, with no connection between the blocks at the two ends of the propeller tube, so that the blocks may be shifted independently. A double crank arm *z* secured to the pivot of the rudder and cords *w'* secured to the ends thereof constitute an embodiment of means for turning the rudders independent of the lateral translation of the pivots. The cords *w'* pertaining to the two rudders may be independent of each other, or they may be connected, so that the rudders will be caused to swing in unison.

It will be understood that the propellers may be driven by suitable motors and through suitable transmission, which it is not thought necessary to illustrate here.

In the operation of the invention, the rudders may be merely turned laterally. Either may be turned or both. If the latter, they may be turned oppositely and substantially into parallelism, thus controlling the direction of the craft by means of a drift. Or the pivots of the rudders may be shifted laterally, in addition to, or synchronously with, the turning of the rudders. The combination of the two movements is the valuable feature of the invention, since it produces a turning effect of maximum influence upon the air-ship, and prevents the turning of the rudder from closing the end of the propeller-tube in any degree.

Having thus described my invention, what I claim as new, and desire to secure by Letters Patent, is:

1. A machine for aerial navigation comprising in combination, means for supporting the machine in the air, means for propelling the machine through the air, a vertical rudder for acting on the air to alter the course of the machine, a laterally movable support substantially without deflecting effect upon the air to which the inner end of said rudder is pivoted on a vertical axis, and means for laterally moving said support in either horizontal direction and swinging said rudder in the opposite direction.

2. A machine for aerial navigation having a propeller, a vertical rudder adjacent and in line with the propeller, a vertical pivot for said rudder at its end adjacent the propeller, a support substantially without deflecting effect upon the air by means of which the pivoted end of said rudder may be moved bodily laterally in either horizontal direction, and means for laterally shifting the pivoted end of the rudder in one direction and swinging the rudder in the opposite direction.

3. In an air-ship, the combination of propelling means, vertical rudders in line with said propelling means, one in front and one in rear thereof, laterally movable supports to which the inner portions of said rudders are pivoted on vertical axes, means for laterally moving said supports, and means for swinging said rudders, whereby the supports may be moved laterally and in opposite directions and each rudder swung oppositely to the direction of movement of its support.

4. In an air-ship, the combination of a forward rudder and a rearward rudder, propellers disposed between said rudders, and means whereby said rudders may be bodily shifted laterally in opposite directions and simultaneously swung about vertical axes adjacent their inner ends in a direction opposite to the direction of bodily shifting.

5. In an air-ship, the combination of a horizontal guide, a support movable horizontally on said guide, a vertical rudder, and a vertical pivot supporting said rudder on said support and constraining the rudder to swing in horizontal directions only.

6. An air-ship having a longitudinal tube, front and rear vertical rudders opposite the ends of said tube, mountings for said rudders whereby they are bodily movable laterally in opposite directions and are also adapted to swing laterally about vertical axes adjacent their inner ends, and operating means for laterally shifting and swinging said rudders, so that the rudders act upon substantially the entirety of the column of air entering or leaving the tube.

7. In an air-ship, the combination of a longitudinal propeller tube, propellers therein, vertical rudders at both ends of said tube, laterally movable supports on which said rudders are pivoted on vertical axes adjacent their inner ends, means for laterally shifting said supports in either direction with reference to the ends of the tube, and means whereby the rudders may be swung in directions opposite to the direction of bodily shifting.

8. In an air-ship, a longitudinal propeller-tube, horizontal guides at the ends thereof, supports slidable in said guides, and vertical rudders at both ends of the propeller tube pivoted to said supports to turn on vertical axes only.

9. In an air-ship, a longitudinal propeller tube, horizontal guides at the ends thereof, supports slidable in said guides, and vertical rudders at both ends of said propeller tube pivoted at their inner ends to said supports to turn on vertical axes only.

10. In an air-ship, a horizontal guide, and a vertical rudder mounted to slide bodily laterally on said guide and also to turn laterally.

In witness whereof I have set my hand this 22d day of June, 1910, at the city, county and State of New York, in the presence of two subscribing witnesses.

LOUIS C. BADEAU.

Witnesses:
J. F. BRANDENBURG,
B. W. COULDOCK.