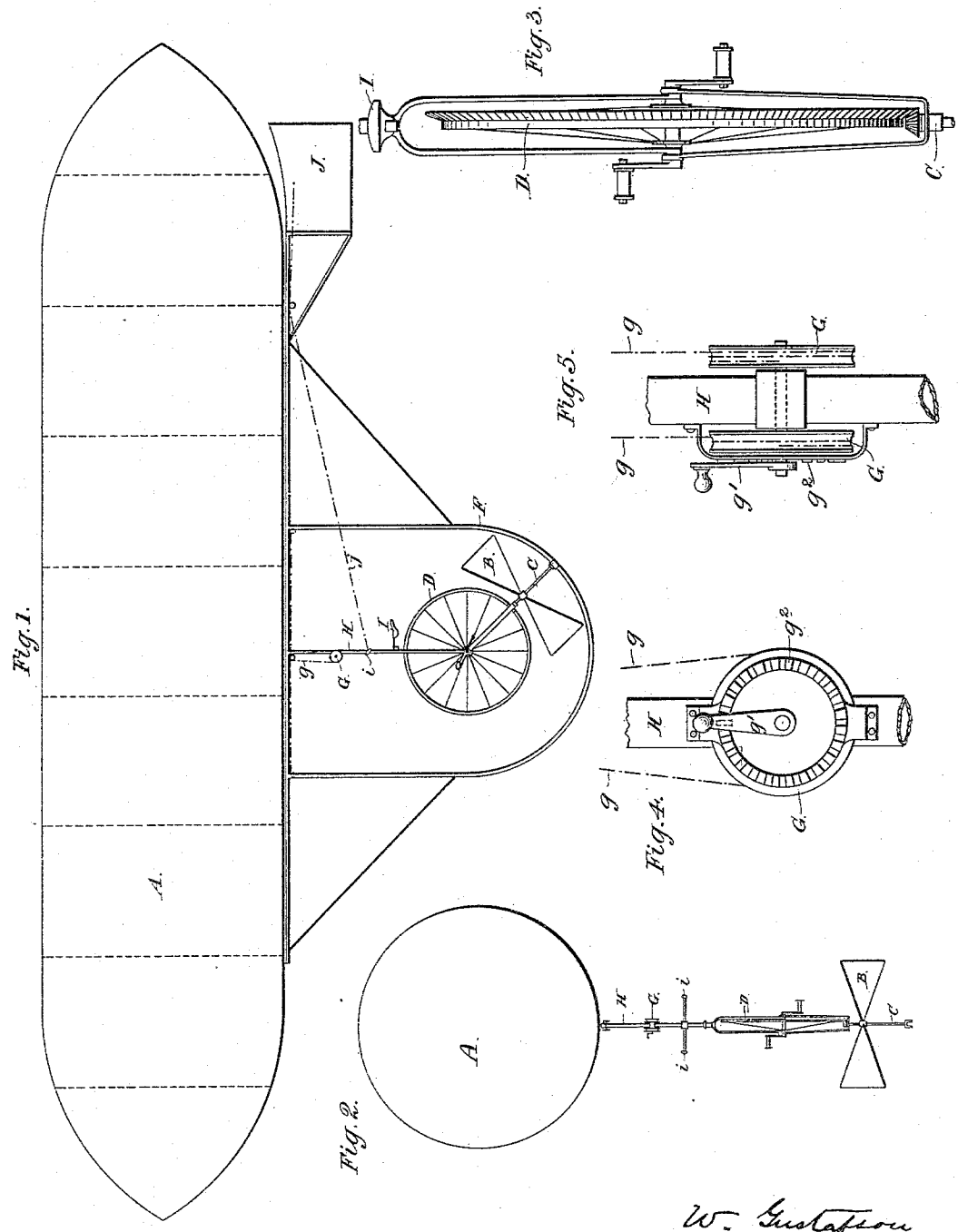
(No Model.) 2 Sheets—Sheet 1.

W. GUSTAFSON.

AERIAL NAVIGATION.

No. 378,364. Patented Feb. 21, 1888.



Witnesses
Sidney L. Johnson.
Charles W. Morris Jr.

W. Gustafson
Inventor. by
Foster & Freeman.
Atty

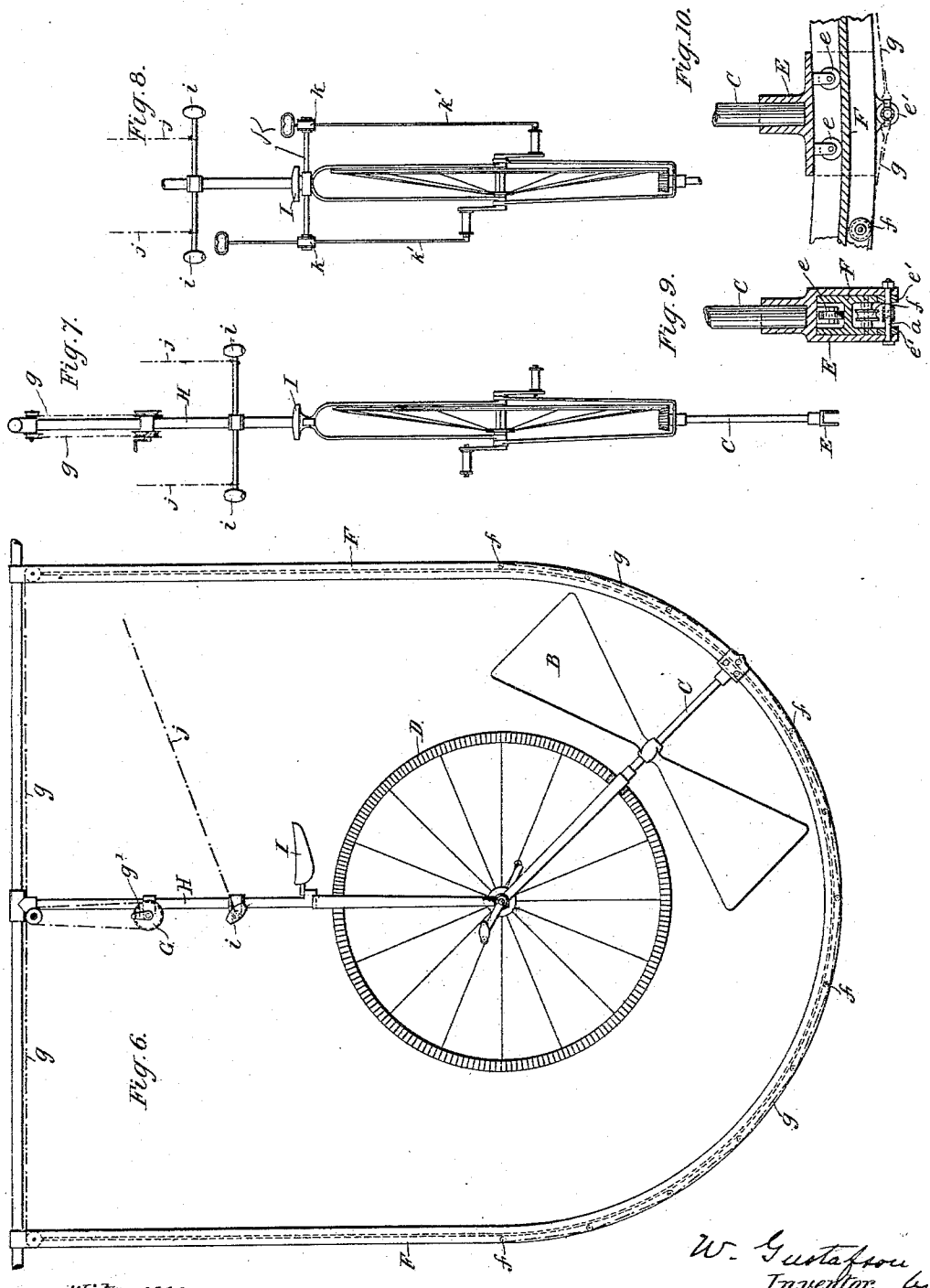
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UNITED STATES PATENT OFFICE.

WALD GUSTAFSON, OF LONDON, ENGLAND.

AERIAL NAVIGATION.

SPECIFICATION forming part of Letters Patent No. 378,364, dated February 21, 1888.

Application filed June 27, 1887. Serial No. 242,673. (No model.) Patented in England June 8, 1887, No. 8,255; in France June 15, 1887, No. 184,251, and in Belgium June 16, 1887, No. 77,828.

To all whom it may concern:

Be it known that I, WALD GUSTAFSON, a citizen of the United States, residing at Cromwell Grove, West Kensington Park, London, England, have invented a certain new and useful Improvement in and Connected with Aerial Navigation, (for which I have obtained Letters Patent in England June 8, 1887, No. 8,225; in France June 15, 1887, No. 184,251, and in Belgium June 16, 1887, No. 77,828,) of which the following is a specification.

This invention relates to that class of apparatus in which the lifting-power of a gas lighter than the ordinary atmosphere is employed.

The invention consists in the hereinafter-described arrangement and combination of parts whereby aerial navigation may be more perfectly carried out than has hitherto been the case, for aerial navigation, as it at present exists, is practically a failure, because the known ratio of motor power exceeding resistive force is so small that in order to really overcome the principal obstacles to air navigation—*i.e.*, head wind or air currents or the air itself—the aerostat used has been far too large for the motor which has always been employed. Given an aerostat of a certain size and of the best shape, (approximately cylindrical, with conical ends, being the best, as offering least surface for resistive force to act upon,) a motor proportionately far too small has always been carried and has therefore been of no real practical use. Now, the reason why larger motors have not been carried is that the lifting capacity of gas has never been properly utilized, as a greater or less amount of ballast has always been carried, instead of using the lifting-power for the carriage of a powerful motor. Given a certain quantity of gas (inclosed, as is usual, for the purpose of aerial navigation) sufficient to lift a certain weight to a certain height, it will follow that the same amount will lift a greater weight to a proportionately less height, and it will follow that it will lift the greatest weight where the air is densest, which obviously is close to the earth's surface or sea-level.

Now, in order that my invention may be clearly understood, reference is made to the accompanying drawings, which form part of this specification, and in which—

Figure 1 represents a general view of the apparatus, in side elevation. Fig. 2 represents a cross-sectional view of same with some of the parts omitted. Fig. 3 represents an end view (on an enlarged scale) of the driving apparatus. Fig. 4 represents a side view (on an enlarged scale) of the device for regulating the position of the propeller. Fig. 5 represents an end view of the same. Fig. 6 represents in side elevation the driving apparatus and surrounding frame. Fig. 7 represents an end view of same with certain parts omitted. Fig. 8 represents an end view with handles connected to the treadle, with some parts omitted. Fig. 9 represents a cross-section (on a larger scale) of the propeller-shaft and frame-work of the lower end of the shaft, and Fig. 10 represents a side sectional view of same.

In all the figures like letters of reference are used to designate like parts of the apparatus.

The gas-receptacle A, Fig. 1, may be one undivided cavity or sack; but I prefer to make it in compartments carried on a light but strong frame, the size of said receptacle being such as to contain sufficient gas to just lift or float the entire intended load, or to be sufficiently larger to allow of variously-caused expansion. In case of a large aerostat it might be advisable to use gas sufficient not only to float the entire weight but to relieve the propeller of the task of keeping the aerostat at a certain height. In other words, the aerostat will, from the increased amount of gas, derive a certain degree of ascensional power, so that the propeller will be set free to work steadily ahead instead of ahead and upward at the same time. Any desired upward motion can be attained by means of the propeller B, which is mounted on shaft C and operated by the driving-wheel D, which may be actuated by foot-power, as represented in Figs. 1, 2, 3, 6, and 7, or by hand or hand and foot power, as represented in Fig. 8.

The arrangements shown of the seat, the handles and pedals for hand and foot powers, are obviously appliances for the action of the motor known as the "human motor," and are therefore component parts of the human motor. Any other motor will work the driving-wheel D in accordance with such motor's construction and adaptation to this purpose. The human motor is in position when occupying seat I, from whence he works; but other mo-

tors may either be attached to supporting-shaft H or to any support which may be built around said shaft or within, or, if necessary, without, the surrounding frame. In case more than one person wishes to act as human motor, parts can be duplicated on any scale of enlargement necessary, the gas supply being regulated accordingly.

It is entirely optional to use either human or other motor, or both, in the case of all aerostats of whatever size, except in the case of the toy aerostat, which can be worked by any proportionate motor.

In the case of a large aerostat—say large enough to accommodate a hundred people (the comparison being like that of a steamer to a row-boat)—it is probable that the aerostat will no longer be propelled by power of human motor alone, but by human-motor power in combination with other motor power, or by other motor only.

The shaft C, upon which the propeller is mounted, is hung from the axis of the driving-wheel, around which it freely swings, and is extended radially beyond the propeller, where it has a bearing upon a supporting guide-frame, F, which is semicircular in form and is arranged in a vertical plane concentric with the wheel D, so that the shaft C and its propeller may be adjusted around the driving-wheel through an arc of at least one hundred and eighty degrees, thus enabling the aerostat to be moved forward or back and up or down, according to the position of the propeller relatively to the driving-wheel.

The socket or foot-step E of shaft C, Figs. 9 and 10, embraces the H-shaped frame F, upon which it is free to slide to such point between the horizontal and the vertical position as may be desired. The inner side of the socket E carries wheels or rollers *e e*, bearing upon the central web of the frame, and on bolt *a* are wheels *e' e'*, bearing upon the edges of the side flanges of the frame opposite the rollers *e*, all of which travel on the frame F as the position of the propeller is changed. The cords *g g* are also attached to bolt *a*, Fig. 9, and pass over guide-wheels *f*, Figs. 6, 9, 10, attached to frame F, to operating-pulleys G G. This construction permits the position of the propeller to be changed at will, all that is necessary being to turn handle *g'*, Figs. 4, 5, 6, thereby winding up one cord *g* and unwinding the other. Handle *g'* may be held in position by means of a friction-spring of a character analogous to that employed on fishing-reels; but I prefer to use the construction represented in Figs. 4 and 5, in which said handle is shown as engaging with the serrated disk g^2, attached to supporting-shaft H, which in turn is supported by the stay-piece or backbone of the receptacle A.

Conveniently placed above the seat I is the rudder-handle *i*, to which are attached the cords *j* to rudder J, Fig. 1. When it is desired to use hand-power, either alone or in conjunction with foot-power, a supporting-arm, K, may be attached beneath seat I and provided with pivoted guides *k*, through which pass rods *k'*, attached to the treadle, as clearly shown by Fig. 8.

It will be understood that by using a gas-receptacle which is only sufficient to secure flotation motion upward or forward must be secured by means of the propeller, and this is consequently set at the desired angle, which will be varied from time to time as it is wished to ascend or go forward, backward, or downward.

I am aware that it has been proposed to drive the propeller of an aerostat by a treadle mechanism in proximity to which is arranged a seat for the driver, and hence I do not claim to be the first to have invented this combination of devices, broadly considered; but by my invention the driving devices have been much simplified with a corresponding reduction of weight, which is of great importance.

What I claim is—

1. In an aerostat, the combination, with a suitable driving-wheel, of a propeller, a semicircular supporting guide-frame arranged in a vertical plane concentric with said wheel, on which the propeller-shaft is adjustable, and means, substantially as described, for adjusting said propeller-shaft on the guide from a horizontal position on one side of said wheel to a horizontal position on an opposite side thereof, substantially as set forth.

2. In an aerostat, the combination, with a suitable driving-wheel, of a propeller, a propeller-shaft connected with the axis of said wheel and extending radially therefrom beyond the propeller, a guide-frame arranged in a vertical plane concentric with said wheel beyond the propeller, a socket or foot-step for the propeller-shaft movable along said guide-frame, and means, substantially as described, for adjusting the propeller around the driving-wheel, substantially as described.

3. In an aerostat, the combination, with a suitable driving-wheel, of a propeller, its shaft C, a segmental H-shaped supporting-guide, F, a socket in which is mounted the end of shaft C, movable upon said guide, and anti-friction rollers carried by the socket engaging with bearing-faces on opposite sides of the guide, substantially as described.

4. In an aerostat, the combination, with a suitable driving-wheel, of a propeller, its shaft C, a segmental H-shaped supporting-guide, F, a socket, E, in which is mounted the end of the shaft C, anti-friction rollers *e e*, carried by the socket and engaging with the central web of the frame, and anti-friction rollers *e' e'*, also carried by the socket and engaging with the edges of the side flanges of the frame opposite rollers *e*, substantially as described.

5. In an aerostat, the combination, with a suitable driving-wheel, of a propeller and its shaft adjustable around said wheel, a segmental

guide concentric with the said wheel, upon which the propeller-shaft is partially supported, guide-wheels *f*, mounted in a channel in said guide, and an adjusting-cord supported on said wheels and connected with the propeller-shaft, substantially as described.

6. In an aerostat, the combination, with a suitable driving-wheel, of a propeller and its shaft adjustable around the same, an H-shaped segmental supporting guide-frame, two cords connected with the propeller-shaft and extending oppositely therefrom, guide-rollers for said cords, and winding-pulleys to which the ends of said cords, mounted in the channel formed between the flanges of the said frame, are connected, substantially as described.

7. In an aerostat, the combination of a supporting-shaft, H, a driving-wheel provided with pedals supported thereby, an operator's seat, I, supported on said shaft above the driving-wheel, a propeller and its shaft driven by said wheel, and means, substantially as described, for adjusting the propeller around said wheel, substantially as described.

8. In an aerostat, the combination of a supporting-shaft, H, a driving-wheel provided with pedals supported thereby, an operator's seat above the driving-wheel, a propeller driven by said wheel and adjustable relatively thereto, flexible connections for moving said propeller, and suitable adjusting devices, substantially as described, situated above in front of the seat I and within reach of the operator, for moving said flexible connections, substantially as described.

9. In an aerostat, the combination of the support H, driving-wheel D at the lower end thereof, a propeller driven by said wheel, a seat, I, above the driving-wheel, flexible connections for moving the propeller around its driving-wheel, an adjusting device, G, supported on said shaft H within convenient reach of the operator on seat I, for moving said flexible connections, a rudder, and a rudder-shifting device, also supported on support H in proximity to seat I, substantially as described.

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

WALD GUSTAFSON.

Witnesses:
PHILIP M. JUSTICE,
ALLEN N. JONES.