P. LEHMANN.

AIRSHIP.

APPLICATION FILED FEB. 7, 1910.

998,538.

Patented July 18, 1911.

Fig. 1.

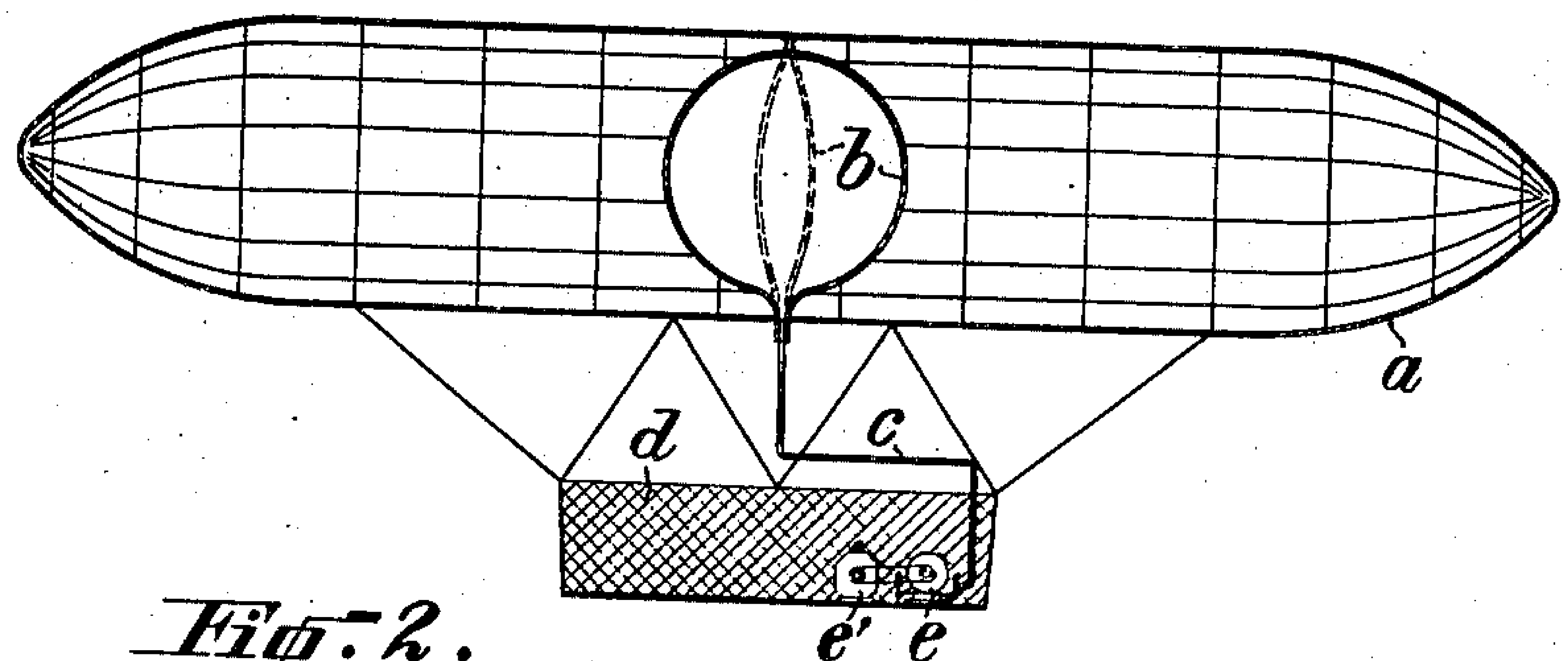


Fig. 2.

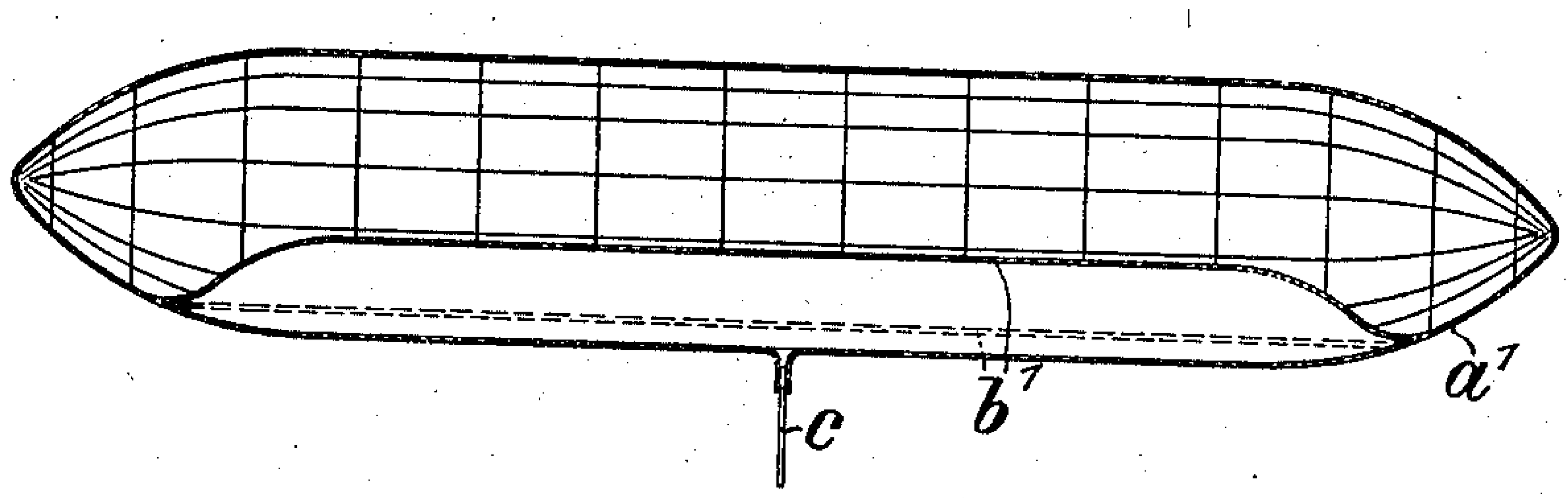


Fig. 3.

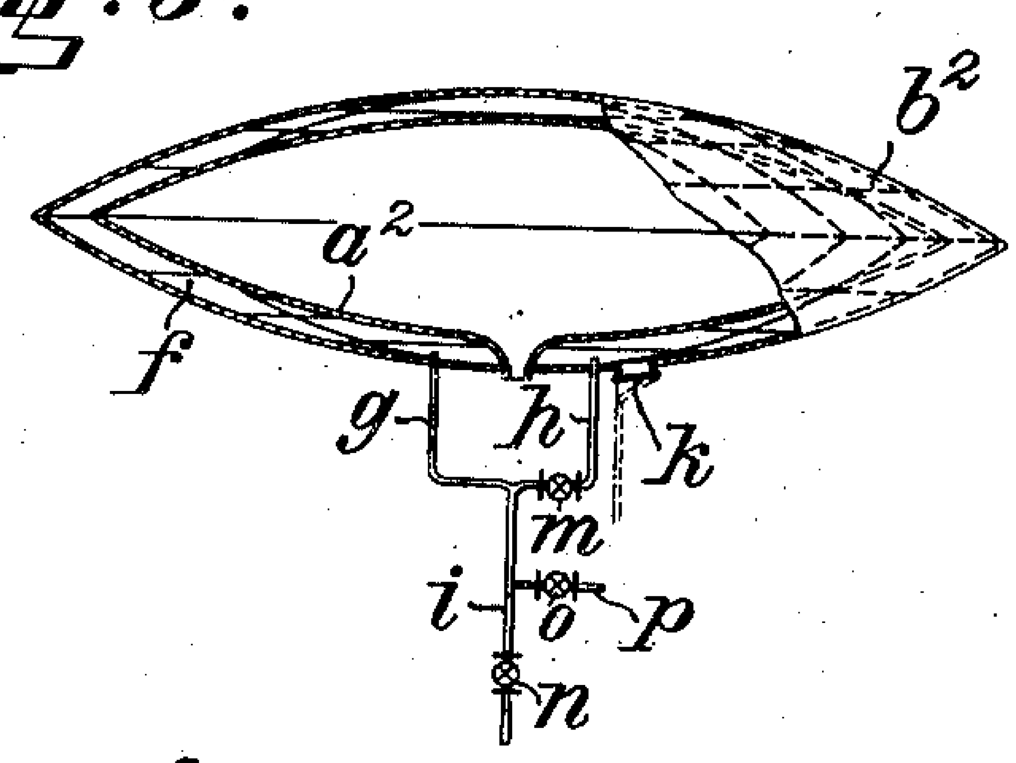
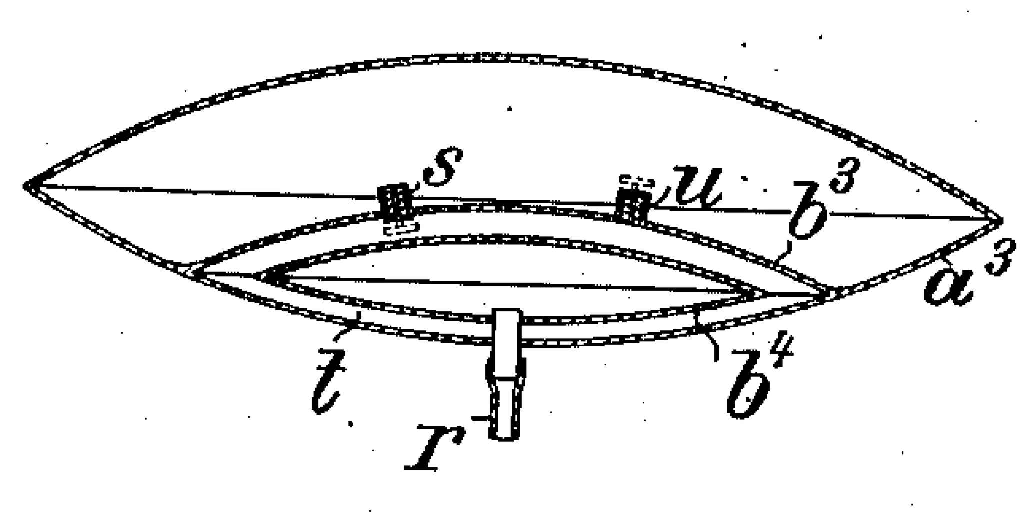


Fig. 4.



Witnesses:
M. L. Brose
H. B. Younkin

Inventor
Paul Lehmann
by John Lotka
Attorney

UNITED STATES PATENT OFFICE.

PAUL LEHMANN, OF SCHÖNEBERG, NEAR BERLIN, GERMANY.

AIRSHIP.

998,538. Specification of Letters Patent. Patented July 18, 1911.

Application filed February 7, 1910. Serial No. 542,419.

To all whom it may concern:

Be it known that I, PAUL LEHMANN, a subject of the German Emperor, and resident of Schöneberg, near Berlin, Germany, have invented certain new and useful Improvements in Airships, of which the following is a specification.

My invention relates to improvements in air-ships, and more particularly to air-ships with aerostats.

A well-known method of preserving the normal external shape of non-rigid balloons or air-ships consists in using inflatable and collapsible air-bags or ballonnets, into which air is pumped to compensate for loss of gas, and from which air is discharged in order to prevent the bursting of the gas-bag when the gas expands, by reason of increase of temperature or reduced external air-pressure. This method has been successfully employed for the purpose indicated, which is highly important with regard to the control of the air-ship; it does not however, in the manner heretofore adopted, afford means for materially altering the effective weight of the aerostat, and does not therefore, enable the altitude of the air-ship to be controlled by inflation and deflation of the ballonnets. By pumping air from an air-bag in a non-rigid aerostat the aerostat is not caused to ascend, for the reason that the aerostat contracts to an extent proportionate to the amount of air discharged, so that the cubic content of the aerostat is reduced. This reduction neutralizes the reduction in actual weight, and the altitude is not altered. Similarly, if air is pumped into the air-bag the aerostat expands, and in doing so displaces an amount of air proportionate to the amount of air pumped in, so again the effective weight is not materially altered.

The object of my invention is to enable the altitude of air-ships provided with aerostats to be controlled by means of induction and eduction of air, and I attain this object by combining a rigid aerostat with a non-rigid air-chamber, or a non-rigid aerostat with a rigid air-chamber in a particular novel manner specified in the appended claims. In a system of this nature, eduction of air reduces the weight without a compensating change of cubic content, and induction of air increases the weight under the same conditions, so that the air-ship can be caused to rise and fall by the means described.

Several constructions embodying the arrangement indicated are shown in the annexed drawings.

Figure 1 is a longitudinal section of an air-ship with rigid aerostat and non-rigid air-chamber, Fig. 2 is a sectional view illustrating a modification of the same combination. Fig. 3 is a side-view, partly in section, of an air-ship with non-rigid aerostat and rigid air-chamber and Fig. 4 illustrates a modification of an air-ship with a flexible or expansible air-chamber and an aerostat partly rigid and partly non-rigid.

Referring to Fig. 1, the rigid aerostat *a* incloses an elastic air-bag *b* suspended from the top of the aerostat cover and connected by a pipe *c* to an exhauster *e* in the car *d*, or to equivalent apparatus for eduction and induction of air. The exhauster *e* may be driven by a motor *e'*, for instance an internal combustion engine. The air-bag is filled with air before the aerostat is filled with gas lighter than air. By eduction of air from the air-bag the gas-chamber of the aerostat is enlarged, and the buoyancy of the air-ship increased; by induction of air the gas-chamber is reduced, and the buoyancy reduced. No great relative reduction of pressure in the air-bag is produced by the eduction of air therefrom, inasmuch as the eduction is accompanied by ascent of the air-ship to regions of lower air-pressure, so that the internal and external pressures remain approximately equal. Similarly, induction of air only slightly increases the relative internal pressure, owing to the descent of the air-ship into denser air.

In Fig. 2 the air-bag b^1 extends along the bottom of the aerostat a^1. Many modifications of the combinations described are, of course, possible; the drawings are merely diagrammatic illustrations of examples.

In Fig. 3 the non-rigid aerostat a^2 is inclosed within a rigid air-case b^2 consisting of a light frame of bamboo or aluminium, covered with silk made impervious by rubber or with other gastight material. When fully inflated the aerostat-cover impinges on the inner surface of the air-case b^2. The chamber f between the aerostat and air-case communicates by means of pipes g and h with a pipe i leading to an exhauster or equivalent apparatus.

To make the air-ship rise, air is pumped from the chamber f through the pipes g, h, and i, causing the aerostat a^2 to expand and the weight of the air-ship to be reduced. No great relative reduction of pressure results from such withdrawal of air, inasmuch as the eduction of air is accompanied by an ascent of the air-ship into regions of lower atmospheric pressure, so that the external and internal pressures remain approximately equal. For the purpose of descent, air is pumped into the chamber f; the increase of internal pressure is soon neutralized by the descent of the air-ship into regions of denser air.

It will be understood that the exhauster (e in Fig. 1) is capable of operation not only as a suction apparatus for the eduction of air, but as a pressure or forcing apparatus for the induction of air.

There may be a plurality of aerostats a^2 within a single rigid air-case b^2. The external air-case has the advantage of protecting the aerostat or aerostats from injury and from wind-pressure, and also reduces the influence of external temperature-changes on the gas in the aerostat. In order to further reduce the effect of sun-rays on the gas in the aerostat, the air-case is preferably provided with a valve, as at k in Fig. 3, enabling fresh air to be blown through the air-case by means of the pump or like apparatus (e) operated as a pressure device to force air into the chamber f through the pipe g, pipe h being meanwhile closed by means of a valve m. To prevent undue contraction of the case by cold, exhaust-gases from the motor, or air heated by means of these exhaust-gases, may be blown through the air-case from pipe p and valve o (Fig. 3), the pipe i being meanwhile closed by means of a valve n.

In the modification shown in Fig. 4 the rigid chamber b^3 in the non-rigid aerostat a^3 incloses an air-bag b^4, which, when fully inflated, impinges on the inner wall-surfaces of the chamber b^3. I desire it to be well understood that this chamber b^3 is entirely rigid, that is to say, its bottom wall is rigid as well as its top wall. A pipe r leads from the air-bag b^4 to an exhauster or the like.

For producing ascent, air is sucked from the air-bag b^4. When the pressure in the rigid chamber b^3 has fallen to a certain value, a valve s in the wall of the chamber opens, and admits gas from the aerostat to the space t surrounding the air-bag. The internal pressure in the space t is thus prevented from falling materially below that of the gas in the aerostat, said gas having a tendency to expand owing to the ascent of the air-ship. The valve s will therefore allow the pressure in the space t to become less than that in the aerostat proper a^3, but not beyond a certain limit governed by the spring or other device tending to close said valve; in other words, the valve s will prevent the difference of pressure between the chambers a^3 and t from more than temporarily exceeding a predetermined limit. The valve s may be so designed and adjusted that it opens periodically, say at each change of altitude amounting to 50 meters, and then closes again when the difference of pressure has fallen to the prescribed limit, owing to the transfer of a sufficient amount of gas from the chamber a^3 to the space t; the pressure to which the air-chamber is at any time exposed is under such conditions only small.

For producing descent, air is pumped into the air-bag. At a certain pressure a valve u opens and enables the gas in the chamber b^3 to be expelled into the aerostat. The valve u may, for example, be adjusted to open automatically after descent through 50 meters.

It will be clear that the arrangements described enable the altitude of an air-ship to be controlled without discharge of gas and ballast (other than air). The air-ship can thus be maneuvered in the air for an indefinite period, provided there is no leakage of gas. This means for controlling altitude may, of course, be combined with other, auxiliary means for that purpose.

In each of the constructions shown, the air-chamber and the gas-chamber (one of them rigid and the other non-rigid, or expansible) extend from the central portion of the air-ship symmetrically forward and rearward, so that an evenly balanced structure is obtained.

What I claim is:—

1. In an air ship, the combination with an outer chamber having a rigid outer wall, of a non-rigid expansible and contractible chamber located within the said outer chamber, one of said chambers containing gas, and means for forcing air into the other chamber or for exhausting air therefrom to below atmospheric pressure, whereby the interior dimensions of the rigid chamber may be varied without varying its external dimensions.

2. In an air ship, the combination with a rigid buoyant chamber, of a non-rigid expansible and contractible chamber located within said rigid chamber, and means for

forcing air into said non-rigid chamber or for exhausting air therefrom to below atmospheric pressure, whereby the interior dimensions of the rigid chamber may be varied without varying its external dimensions.

In testimony whereof, I have signed this specification in the presence of two subscribing witnesses.

PAUL LEHMANN.

Witnesses:
WOLDEMAR HAUPT,
HENRY HASPER.