A. BOERNER.

AIRSHIP.

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1,160,095. Patented Nov. 9, 1915.

Fig. I.

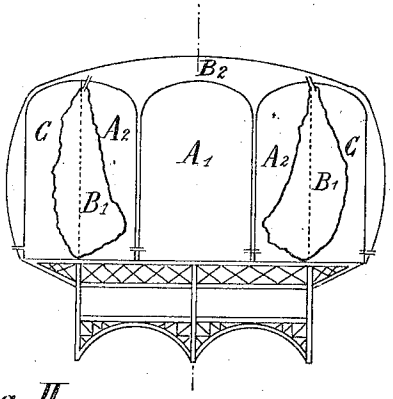


Fig. II

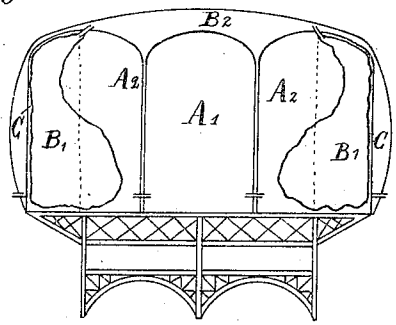
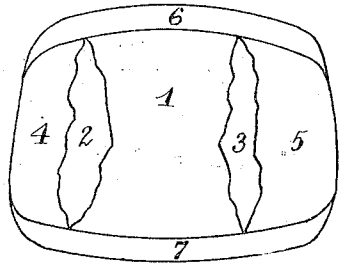


Fig. III



Witnesses:
C. D. Swett.
H. F. Ruth

Inventor:
Arno Boerner
by F. Dillmar
Attorney

UNITED STATES PATENT OFFICE.

ARNO BOERNER, OF PARIS, FRANCE.

AIRSHIP.

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To all whom it may concern:

Be it known that I, ARNO BOERNER, a subject of the Empire of Germany, residing at Paris, Seine, France, 122 Avenue de la République, have invented certain new and useful Improvements in Airships, of which the following is a full, clear, and exact description.

The present system employs primarily, in air-ship navigation, three gases confined in three chambers for the purpose of securing buoyancy, safety and ballast control. As an example, hydrogen may be used for the "lifting gas," as "insulating gas" nitrogen may be used: and for the purpose of the practical utilization of said lifting gas, an air-chamber is used whose capacity depends on the height of ascent which is had in view. With these means, by the use of the propulsive force for vertical steering, for the purpose of equalizing the disturbance of the balance, from whatever cause this originates, the loss of gas by changes in atmospheric pressure and variations in the atmospheric temperature are avoided: also the use of ballast becomes superfluous. By the present air-ship system, longitudinal and transverse single balloons holding different gases are primarily provided, under cover of a common envelop. The longitudinal rows are separated into sections, so that the three transverse balloons form one section. The individual balloons are arranged in quadrangular form in order to avoid the intermediate spaces which occur, as such, in cylindrical balloons, and are bound together at their angles, by cords or rings and bolts, so that the whole balloon system appears as a unitary body.

In the drawing herewith Figure 1, is a diagrammatic end elevation of my invention, partly broken away. Fig. 2 is a similar view but broken away on different lines from what is done in Fig. 1. Fig. 3 is a diagrammatic view and shows a modification of the balloon system shown in Figs. 1 and 2.

The distribution of the three gases in this balloon system takes place as follows: The central row or series, A^1, is filled with the lifting gas, hydrogen, for example, and the balloons attached to the right and left, are provided with double covers. The bag or inner cover is somewhat larger than the outer cover, so that the strain on the material is avoided.

In the longitudinal direction, the inner cover is fastened to the outer cover for a breadth of five centimeters, and gas-tight, so that the outer cover is divided into two chambers, A^2 and C. The inner cover forms in itself the chamber B^1, which is connected to the chamber B^2.

From whatever cause the balloon gas is expanded, it is to be borne in mind that the chambers B^2 and A^1 remain constant in volume. All the chambers A^1 are connected to A^2 by a system of tubes or pipes. Chamber C, is furnished with a safety valve, through which the volume of gas in chamber C, can escape. By attaching this chamber to the fans or pumps, the volume is restored to the normal, according to well known methods. If the three balloon-gases are expanded then the excess of volume of the chamber A^1 is forced automatically or spontaneously into chamber A^2. By the overflow from chamber B^2 into B^1, and by the yielding of the walls of the material, the chamber C, containing air, will lose its contents, which, if the volume of the gas is reduced, for instance, by cooling, will again enter through the valves, as seen in Figs. 1 and 2.

Fig. 3 shows a balloon system without the three-row system: then the distribution of gas is as follows:—Chamber 1, contains the "lifting-gas," hydrogen, chambers 2, 3, 6 and 7, contain the "insulating gas," nitrogen, chambers 4 and 5, contain air to balance against the gas. It is clearly evident that so long as chambers C are not empty that neither lifting gas nor insulating gas is lost. In accordance with this purpose, the chambers which contain hydrogen are filled with 60% of the total balloon volume: those containing nitrogen with 15% of the total volume of the balloon, and the air chambers with 25%, total 100. With this proportion the balloon has a height of ascent of about 3000 meters, without loss of gas, and the losses of the up-drive or lifting tendency, through nitrogen are reduced to about 1/100. If about 1500 liters of rising gas are lost through the material of the balloon per hundred square meters, in 24 hours then the loss of updrive in the present system is only about 15 liters, for the 1500 liters of rising gas must pass into the insulating chamber (nitrogen).

The diffusion-coefficient of the hydrogen amounts to 5.5, and the nitrogen is only 1.0, so that instead of 1500 liters, only 300 liters

will escape, for the nitrogen chambers will be saturated with no more than 5% of hydrogen, so the 300 liters contain only 5% of rising gas, for nitrogen does not come as such into consideration. The loss of updrive is also 5% of 300—15 liters over against 1500 in a single gas chamber.

The insulating gas diminishes the loss of updrive during the travel of the air ship very substantially, and has the great advantage of avoiding the risk of explosions. If the cover is damaged by fire, nitrogen flows out, which immediately extinguishes the flame. Hydrogen can explode only when oxygen is present at the same time: and as the nitrogen prevents the approach of the air to the hydrogen, there is wanting a base for the explosion.

The filling of the balloon with 3 gases has the advantage in working together with the direct application of the propulsive force to vertical steering, that gas losses and the use of ballast, by temperature variations for example, can be avoided.

The 3 chamber system, as such, is a non-rigid balloon system, which, it is true, rises and falls to the elastic height with constant weight, but only through variations of atmospheric pressure, without the use of ballast, or gas loss. With variations of temperature the application of the forward driving force to the equalization of the disturbance of balance (equal weight) is necessary. There occurs also in this case a double action in the whole of the balloon. If, for example, the air ship meets a stream of cold air, it will momentarily obtain an excess of updrive: the consequence is a sudden ascent so far as the elastic height, until this excess is destroyed by loss of gas: the second reaction follows, for the temperature of the gas falls in accordance with the temperature of the stream of cold air, and accordingly produces a diminution of updrive, which must be equalized by the use of ballast.

Both reactions are only disadvantageous on account of the difference of time in which they occur, for, in reality they neutralize each other. For as in the first reaction the gas is irrevocably lost, the second reaction requires the equivalent in loss of ballast. If now we destroy, in this case, the foregoing excess of updrive, of the first reaction, by dynamical force, while applying the forward driving force, by suitable means for the updrive and forward drive, we are in a position to avoid the consequences of the first reaction, (in this case loss of gas). This is only necessary up to the time when the gas is cooled; for instance in the case where the application of dynamical force is necessary for the ascent. For the balance is reëstablished by the fact that the excess of updrive caused by the atmosphere cooling, is compensated by a corresponding cooling of the balloon gases which causes an equally great diminution of updrive. So, neither the harmful consequences of the first reaction (loss of gas), nor those of the second reaction, (use of ballast) have any influence.

A further advantage is of importance, the subdivision of the balloon system into sections, by which it is possible to bring about the balance (equality of weight) of the horizontal position by displacement of gas.

What I claim and desire to secure, is—

In an air ship system employing gases of different kinds, central compartments containing lifting gas, ballonnets at each side thereof and connected therewith, outside compartments containing insulating gas, surrounding at the top and sides said lifting gas compartments and ballonnets, ballast compartments adjoining the inner side walls of the insulating compartments, flexible ballonnets communicating with the insulating compartments and forming gas tight partitions between the said ballast compartments and the lifting gas ballonnets.

In testimony whereof I affix my signature.

ARNO BOERNER.

In the presence of—

W. Bongé,

Chas. P. Pressly.