H. NAATZ.

REINFORCEMENT OF THE SUPPORTING BODIES OR ENVELOPS OF AIRSHIPS.

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1,100,762.

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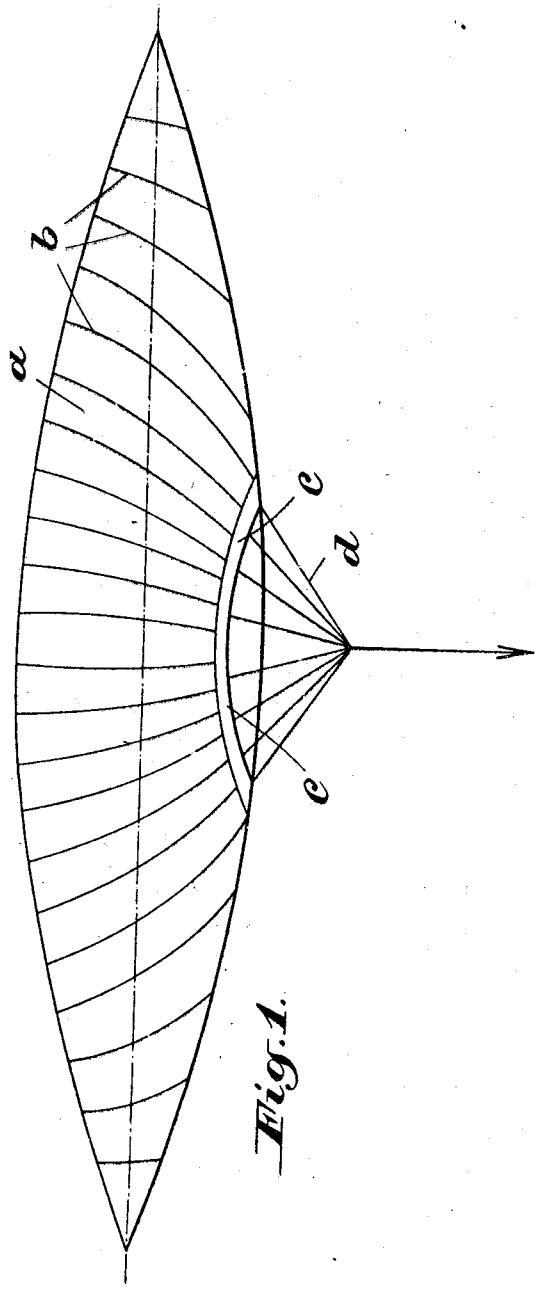


Fig. 1.

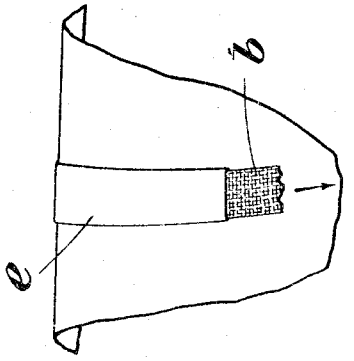


Fig. 2.

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REINFORCEMENT OF THE SUPPORTING-BODIES OR ENVELOPS OF AIRSHIPS.

1,100,762. Specification of Letters Patent. Patented June 23, 1914.

Application filed April 29, 1913. Serial No. 764,391.

To all whom it may concern:

Be it known that I, HERMANN NAATZ, of Bitterfeld, Germany, a subject of the King of Prussia, and whose post-office address is 12 Kirchstrasse, Bitterfeld, Kingdom of Prussia, German Empire, have invented new and useful Improvements in the Reinforcement of the Supporting-Bodies or Envelops of Airships, of which the following is a specification.

This invention relates to the reinforcement of the gas containing envelops or supporting bodies of airships and has for its object to prevent such bodies becoming deformed by strengthening them transversely.

It is well known that considerable difficulty exists in making the overhanging ends of airships retain their proper shape, as under the influence of the various internal pressures, they have a marked tendency to assume a curve. Assuming, as is usual, that the ends are hollow bodies which are exposed to bending stresses by their buoyancy, it follows from the accepted theory of strains that the circumferential surface of these bodies is exposed to three stresses *i. e.* tensional stress, lengthwise of the ship; tensional stress across the ship, and thrust. It will further be found that the thrust, more especially in the case of non-rigid airships, exercises the greatest influence on the deformation of the supporting body.

The diagram of stresses changes for each pressure in the balloon, but at a given pressure follows a certain law which can be determined. By ascertaining the value of the stresses at every point of the circumferential surface and by finding the so-called main directions and by drawing them over the whole surface lines continuously occupying the above mentioned main directions at the points at which they intersect, there will be produced the well known trajectories of stresses. First the curve of buoyancy and the curve of weight are constructed and the curve of differences is then derived from these. This curve when integrated renders the curve of transverse stress and the latter by integration gives the curve of moments. One assumes that the balloon has a certain pressure and then finds that the transverse longitudinal stresses have a certain value. The transverse stresses in these are influenced to a certain extent by the curve of differences and the longitudinal stresses are influenced by the curve of moments. The curve of transverse stresses finally gives the thrust. One then knows what value the three stresses (longitudinal, transverse and thrust) have at every point of the balloon, and according to the known laws of mechanics then determines the "main-directions." After this has been done for a sufficient number of points on the envelop, and between these curves other ones assimilated to the first have been drawn, one finally obtains the trajectories. These trajectories change their directions with changes in the pressure in the balloon, because the trajectories as set forth above are subject to the longitudinal and transverse stresses as well as to the thrust. Therefore, when the pressure is changed, the longitudinal and transverse stresses also change, while the thrust remains constant, being only subject to the curve of buoyancy and of weight. As the main directions are thereby altered, the trajectories of stresses also change. It is a matter of experience what pressure is the most advantageous for a balloon to be built, and the number of bands and their distances from each other can merely be chosen from practical observation. These trajectories of stresses will show the direction of the greatest stress and consequently also the direction of the greatest deformation. Based on these considerations the present invention consists in providing the balloon or supporting body with strengthening members or in the form of bands or bars extending in the direction of the said trajectories of stresses and in that way preventing any deformation in the shape of the envelop.

Figure 1 is a diagrammatic side elevation of a balloon, and Fig. 2 is a detail illustrating the tubular casings fixed to the envelop and containing loosely guided adjustable bands.

Fig. 1 illustrates an airship, the supporting body of which has overhanging ends. In this construction the balloon or supporting body *a* has bands *b* extending in the direction of stress trajectories of the transverse directions, while the lines of the stress trajectories for the longitudinal direction extend at a right angle to the same and are not shown in the drawing. *c* is the belt or boom to which are suspended both the bands *b* and the weight of the car *d*. If the fabric itself were to be made in such manner that

the direction of its threads coincided with the trajectories, the deformation would not be done away with to a sufficient extent, as the fabric would still retain greater expansion in the direction of trajectory than in the other directions. But when a certain superfluous component in this direction is taken up by a separate part, the deformation of the supporting body can be given such a direction that in case of an expansion, it would be converted into a regular body *i. e.*, one which shows complete symmetry with respect to a main axis, and for that reason are used the separate supporting bands *b* which extend in the direction of the trajectories of stresses.

Fig. 2 shows a convenient example of a connection of the said separate supporting bands with the envelop of the supporting body for so called: "non-rigid" ships. In this figure *c* is a tubular casing connected to the envelop of the balloon in the direction of the trajectories and within this tubular casing is loosely inserted the band *b* which constitutes a supporting band. According as the length of the band is adjusted, the body will be more or less restricted in the direction of the trajectories, so that by this longitudinal adjustment it is possible to bring about the action described to the desired extent.

As in case of the so-called rigid air-ships the frame-work of the supporting body is exposed to stresses in the same way as the casing of non-rigid ships, since in case of rigid ships there is also a circumferential surface constituted by a flat figure, which is exposed to the similar strains, the invention can be equally advantageously applied in this case also.

What I do claim as my invention, and desire to secure by Letters Patent of the United States, is:—

1. In a transverse reinforcement for the supporting bodies of airships, the combination of a supporting body with a load supporting belt and transverse bands extending from said load supporting belt around said supporting body in curves corresponding with the direction of the trajectories of stresses, for reinforcing said supporting body.

2. In a transverse reinforcement for the supporting bodies of airships, the combination of a supporting body with a load supporting belt secured thereto, adjustable transverse bands secured to said load supporting belt and extending around said supporting body in curves corresponding with the trajectories of stresses, for reinforcing said supporting body and means for guiding the transverse bands loosely on the envelop of the supporting body.

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

HERMANN NAATZ.

Witnesses:
FELIX DINGLINGER,
GEORGE HEINSDOFF.