Tensairity Hot Air Airship

Peter Lobner, 5 August 2019

Background

In 2009, international patent WO2009046554 A1,"Hot Air Airship," by inventor Andreas Reinhard was published. The object of this invention was to provide a motor drive for a hot air airship that simultaneously provides the thermal buoyancy for the airship. Figures 1 and 3 from this patent are reproduced in this section. You can read this patent here:

https://patents.google.com/patent/WO2009046554A1/en

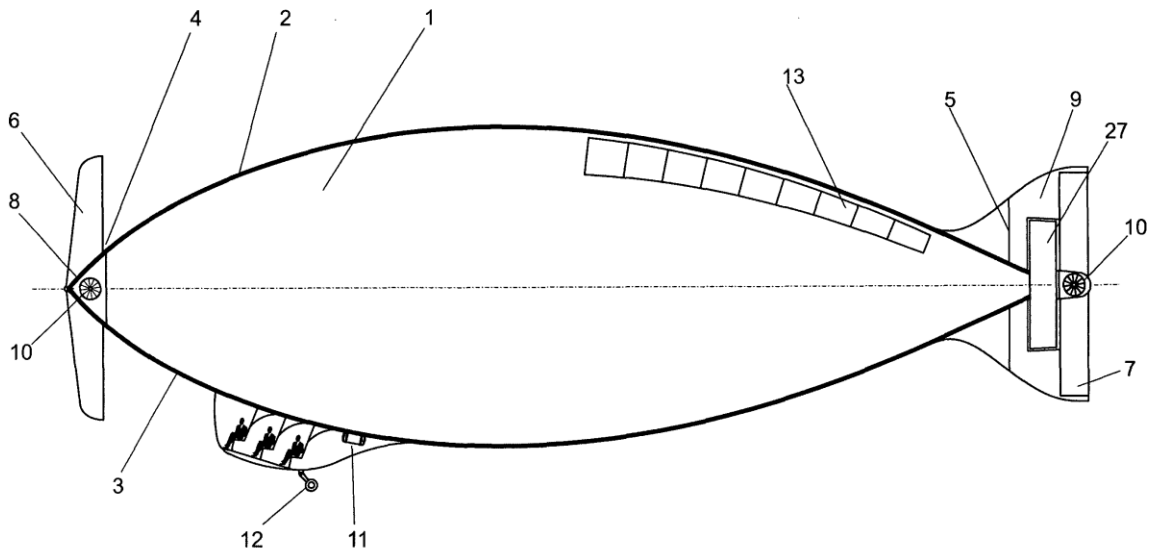


Fig. 1

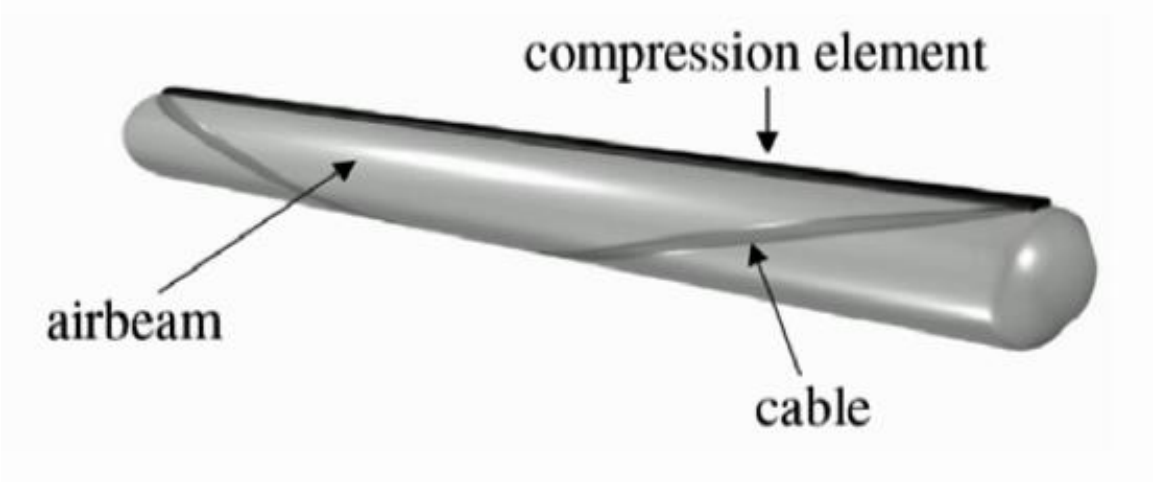
Novel airship structure

The airship has a "Tensairity structure" consisting of an insulating aeroshell (1), one upper and one lower tension-compression rod (2 & 3) which extend over the entire length of the airship, and node elements (4 & 5) at the bow and stern of the airship to tie the tension-compression rods together. A three-passenger gondola is supported by the lower tension-compression rod.

In a 2007 paper entitled, “An inflatable wing using the principle of Tensairity,” the authors describe Tensairity as follows:

> “The basic idea of Tensairity is to combine an airbeam with conventional cables and struts to improve the load bearing capacity of inflatable structures. The name “Tensairity,” a combination of tension, air and integrity, reflects the relationship with the structural concept Tensegrity. Developed by R. Buckminster Fuller, Tensegrity structures use a combination of cables and struts purely loaded in tension and compression, where two compression elements only interact with each other by means of the cables. In short, Tensairity is Tensegrity plus air.
>
> The basic Tensairity beam consists of a compression element, a low pressure airbeam, which is tightly connected to the compression element, and two tension elements which run from end to end of the compression element in a spiral way around the airbeam.”

The following diagram from their paper illustrates such a beam.



Example of a Tensairity air beam

You can read the complete paper here:

https://pdfs.semanticscholar.org/5293/5de4a075f4f972b60ad0269ebd542a24d2d1.pdf

Rendering of the Tensairity hot air airship.
Source: http://airshipworld.blogspot.com/2009/04/prospective-concepts-transitions-into.html

Operation of the hot air airship

Fore and aft rudders (6 & 7) are mounted on fore and aft cones (8 & 9) that can be rotated ± 90° about the longitudinal axis of the airship; fore and aft electric powered lateral thrusters for low speed maneuvering (10) also are mounted in the rotation cones. The rudder surfaces (6 & 7) function as lateral rudders in the vertical position or as horizontal wings when rotated 90°, giving them the ability to control the airship in both the horizontal and the vertical planes.

The airship's shrouded main propulsor (27) is driven by a set of small kerosene-burning turbines within the aeroshell. These turbines are arranged to drive a common main propulsion shaft (29) and also power a generator, which supplies electric power for airship systems, the lateral thrusters, and charges a battery. Fresh air ducts direct air from outside the aeroshell to the turbine inlets. The hot exhaust gases can be directed either to the interior of the hot airship or to a heat exchanger that heats the interior air during recirculation and fresh-air modes of operations. After passing through the heat exchanger, the exhaust gasses discharge outside the airship.

For redundancy, electric power can be supplied by photovoltaic cells on the upper surface of the airship (13). A kerosene burner can generate the necessary hot air for buoyancy when the turbines are not available.

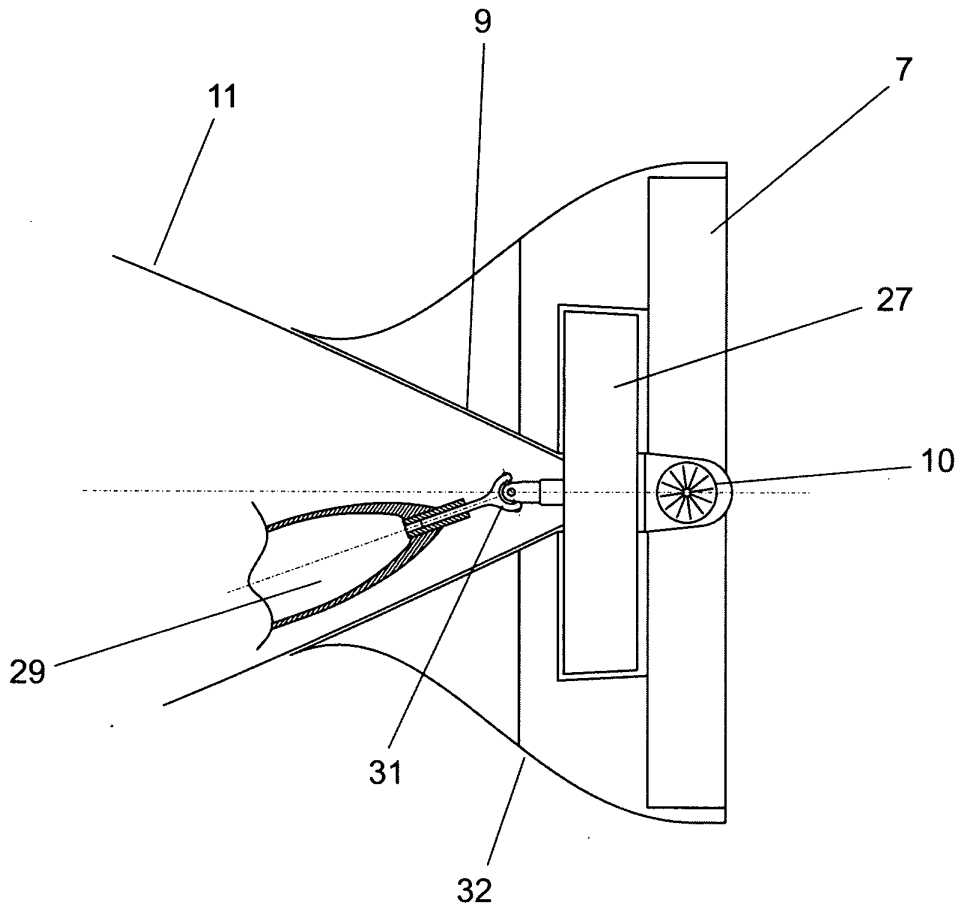


Fig. 3

General arrangement of the main propulsion drive and stern control surfaces.