APEX Balloons thermal airship

Peter Lobner, Updated 21 December 2020

1. Introduction

APEX Balloons, founded by Jon Radowski in Phoenix, AZ, designs, builds, maintains and operates hot air balloons for advertising, scientific research, aerial photography, recreation, surveying, and other uses. APEX also developed an experimental thermal airship with novel design features for stiffening the hot air envelope.

APEX noted that, “A hot air airship may be the ideal platform for applications requiring low-level station-keeping with minimal environmental disturbance…..Helium blimps have a narrow weight range to maintain, cannot carry heavy payloads without awkward ballasting and re-ballasting, and must maintain a forward airspeed to generate enough dynamic lift to remain airborne when flying ‘heavy.’”

APEX thermal airship. Source: APEX Balloons

Development on the APEX experimental thermal airship ended several years ago, primarily because there was not enough commercial interest to warrant further development and type certification, even though the design was much improved over the current state of the art in thermal airships.

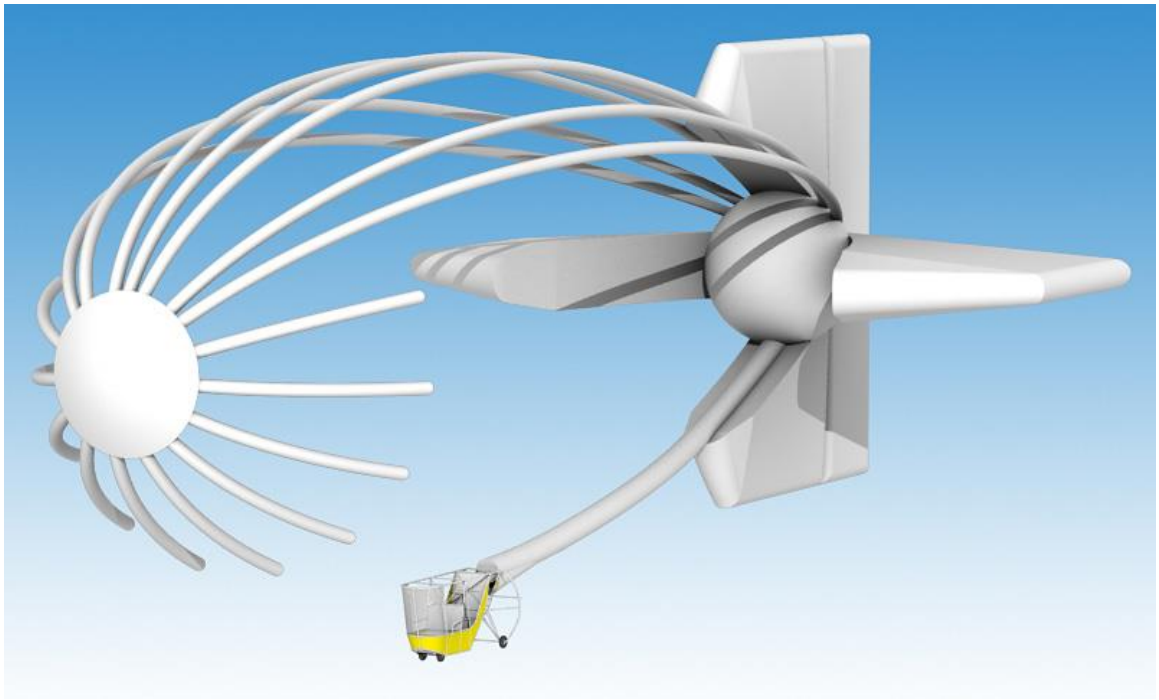
The APEX web page for their thermal airship is here:
https://www.apexballoons.com/airships/

2. The APEX thermal airship design

At first glance, the APEX thermal airship looks like a conventional, non-rigid blimp with a small, single-seat gondola. A 1.3L, 80-shp engine attached to the gondola drives a three-bladed, 65-inch (1.65 m) diameter composite propeller and a generator to power the airship's electrical system.

The main envelope is fed fresh air for combustion by an electric fan powered from the airship's electrical system. This fan provides a constant supply of fresh air to the propane burners and helps provide some of the internal pressure needed for the airship's envelope to maintain its proper shape.

A unique design feature of an APEX thermal airship is that the envelope has an internal system of inflatable fabric battens that are pressurized by the "propulsion slipstream;" the fast airflow captured by a scoop immediately behind the propeller. These inflatable fabric battens, which are shown in the following diagram, run from the tail to the nose of the airship.



Air distribution from the "propulsion slipstream." Air is captured by a scoop immediately behind the gondola and distributed to the inflatable fabric battens and tail surfaces. Source: APEX Balloons

The inflatable fabric battens stiffen the airship’s structure to make it less likely that the nose of the airship will “cave in” due to aerodynamic loads at higher airspeeds. This is a problem faced by all current hot air airships to some degree, with the exception of Dan Nachbar's semi-rigid Personal Blimp. APEX’s system of pressure tubes also inflates the tail fins and rudder in the same manner.

Pressure delivery to the pressure tubes is a function of propulsion engine throttle. This means higher pressure and higher hull stiffness are available when operating at higher airspeeds. When the propulsion motor is turned off, one-way fabric check valves in the nose and tail hemispheres keep the fins and battens inflated for a period of time.

Electric fan underneath the burners and two fabric overpressure valves in the bottom of the envelope are designed to expel combustion exhaust gases. This is done to prevent an accumulation of exhaust gases in the bottom of the envelope, which could cause a burner pilot light flameout due to oxygen deprivation.

An internal fabric bulkhead allows for pitch control using the fore and aft burners. This bulkhead also limits the internal movement of hot air ("sloshing") during a pitch change, which is a problem witnessed in some early streamlined hot air airships.