LTA Aerostructures (LTAA) rigid airships

Peter Lobner, updated 11 February 2022

1. Introduction

LTA Aerostructures Inc. (LTAA) is a Canadian company that was formed as an investment partnership among US-based US Lighter Than Air Corp. (US-LTA Corp, New York), NEXA Capital Partners and other partners. LTAA was founded in 2014 in Mirabel, Quebec, Canada, with the goal of developing heavy lift cargo airships capable of providing precision vertical lift and delivery of large tonnage into remote areas with limited or no ground infrastructure.

In November 2015, LTAA reported that it planned to build a new $60 million manufacturing facility in Mirabel, near Montreal, Canada, where LTAA's heavy lift cargo airships were to be designed, fabricated, assembled and certified. LTAA's President and CEO, Michael Dyment, stated, "Our 10 tonne lift and 70 tonne lift lenticular airships will for the first time meet the cargo and logistics needs of people in remote areas, as well as in the mining and oil and gas industries that must operate there." At that time, it was expected that the new class of heavy lift cargo airship would enter revenue service in 2019. However, the planned LTAA factory was never built and the company appears to have folded. The former LTAA corporate website, www.lta-aerostructures.ca, no longer is active.

In July 2019, I spoke to a representative from AeroMontréal (https://www.aeromontreal.ca/lta-aerostructures-en.html), a strategic "think tank" created in 2006 to mobilize Quebec's aerospace sector, who confirmed that LTAA no longer is part of their future plans for the region. Instead, Quebec will be implementing a new plan to develop an airship industry in Montreal in collaboration with the French airship manufacturer Flying Whales. In June 2019, Quebec's Economy Minister announced at the Paris Air Show that Quebec intends to buy a minority stake in Flying Whales and construct a production facility in the Montreal area within five years.

The remainder of this section describes the evolution of the LTAA cargo airships that might have been.

2. Business case for Canadian Arctic airships

The initial target markets for these airships included transporting cargo for oil and gas companies exploring in remote regions of northern Canada, and delivering completed housing units, other structures and supplies to improve the living conditions in First Nation communities in these remote regions. On return trips, airships would be able to remove decades of trash for recycling and take Arctic products, such as fish and other locally produced items, to southern markets. The business case for LTA airships is described in the LTAA 2015 general presentation at the following link:

https://nunavuttradeshow.ca/wp-content/uploads/2015/10/7-Dyment-LTA-Aerostructures.pdf

3. Lenticular airship patents

The intellectual property law firm Finnegan (https://www.finnegan.com) reports that they "guided the entire developments of LTA's patent portfolio that includes over 120 patents and pending applications directed to lighter-than-air airship technology. The applications cover airship technologies ranging from hull and empennage configurations, propulsion and power source arrangements, flight control systems, attitude regulation and control, attitude displays, variable buoyancy techniques, solar powered flight, aerodynamic features, and various ornamental designs and configurations."

LTAA's lenticular airship designs were developed by French inventor Pierre Balaskovic, who has long been a champion of lenticular airships. These designs are addressed in patents originally held by LTAA's parent company, US-LTA Corp, New York.

The following three patents establish the basic configuration and characteristics of a lenticular, oblate spheroid-shaped airship of the type shown in the following two diagrams. This particular design was the basis for the French Alizé semi-rigid airship, which I have addressed in detail in a separate article.

- US patent US 7866601 B2, “Lenticular Airship,” published 11 January 2011
- US patent US 8418952 B2, “Lenticular Airship,” published 16 April 2013
- European Patent Specification EP 2173613 B1, “Lenticular Airship and Associated Controls,” published 26 February 2014

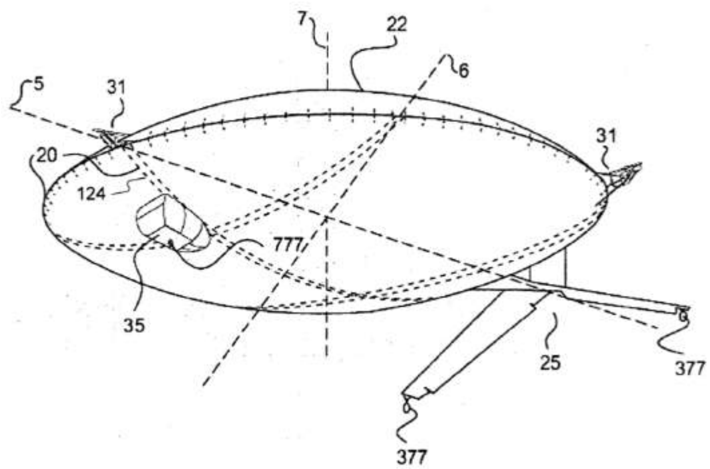


FIG. 1

General arrangement drawing showing support structure (20), hull (22), propulsion assemblies (31), empennage assembly (25), gondola (35), longitudinal frame member (124), landing gear (377 & 777). Source: US 7866601 B2

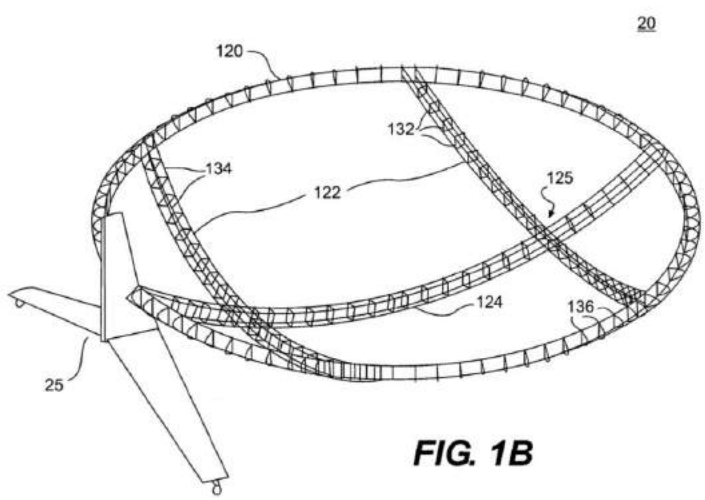
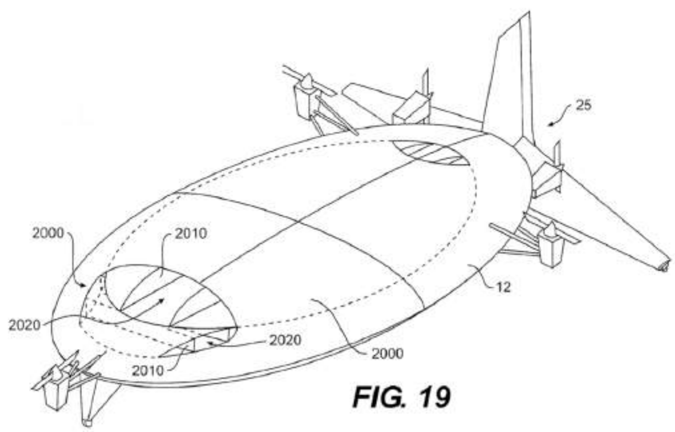


FIG. 1B

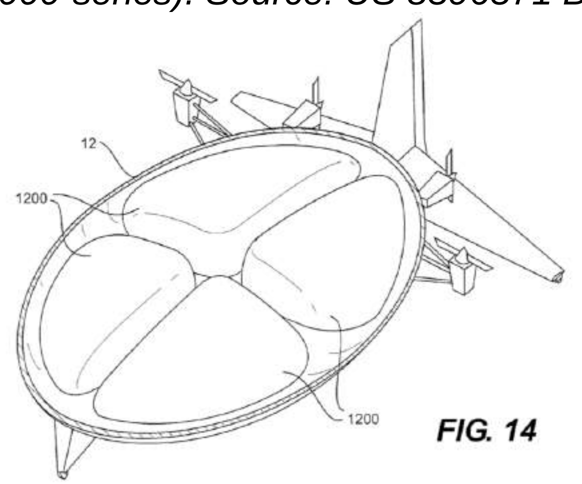
Structural drawing showing empennage assembly (25), keel hoop (120), lateral frame members (122), longitudinal frame member (124). Source: US 7866601 B2

The following patents, listing John Goelet as inventor and US-LTA Corp, New York as the applicant, apply to the lenticular, elongated oblate spheroid-shaped airship shown in the following diagrams and generally similar to the basic LTAA hull shape. This airship has aerodynamic components that are integrated with the hull and are designed primarily to improve the stability of the airship in windy conditions.

- US patent US 8596571 B2, “Airship Including Aerodynamic, Floatation and Deployable Structures,” published 11 January 2011
- International Publication WO 2012/135117 A2, “Airship Including Aerodynamic, Floatation and Deployable Structures,” published 4 October 2012



Hull (12), control surfaces (25) and aerodynamic channels (2000-series). Source: US 8596571 B2



Hull (12) and one example of helium lifting gas cells (1200). Source: US 8596571 B2

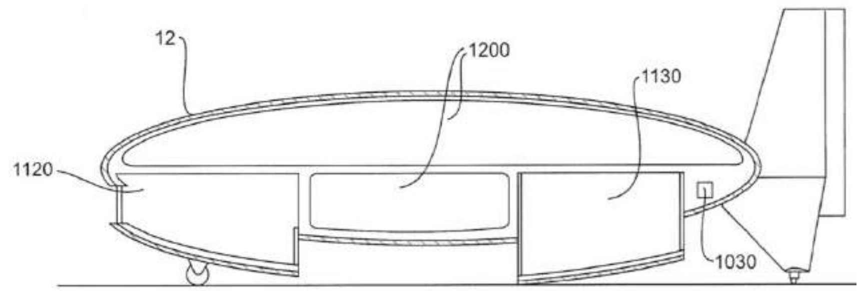


FIG. 16

Hull (12), helium cells (1200), passenger compartment (1120), and freight compartment (1130). Source: US 8596571 B2

This lenticular airship design is further elaborated and evolved in other patents, including:

- US patent US D670638S, “Airship,” published 13 November 2012
- US Patent US 8894002 B2, “System and Method for Solar Powered Airship,” granted 25 November 2014

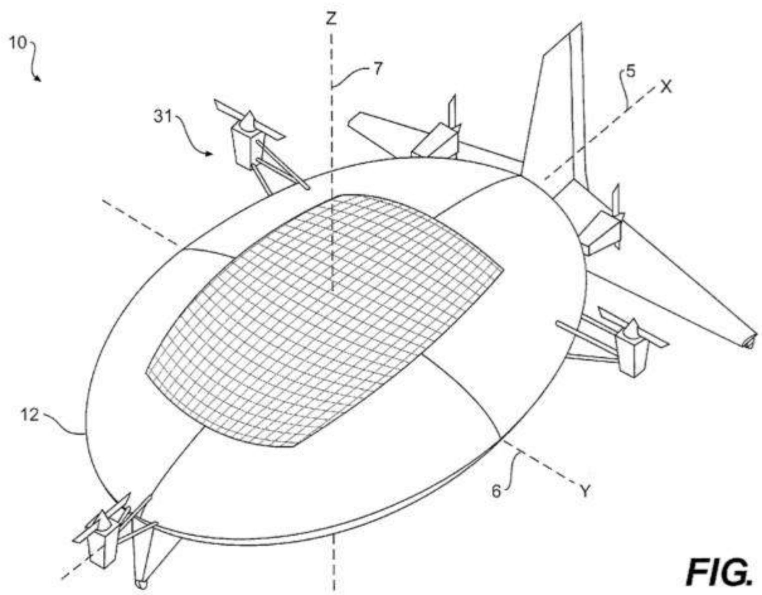


FIG. 1

General arrangement showing solar panels on the top of the hull (12) and propulsion assemblies (31). Source: US 8894002 B2

A variable buoyancy control system for a solar-powered lenticular airship with a similar overall layout is presented in US patent US 8899514 B2, “System and Method for Varying Airship Aerostatic Buoyancy,” published 2 December 2014,

This patent describes the configuration of the lenticular airship and the arrangement of lifting gas cells into outer (lower pressure) volumes and inner (higher pressure) volumes and the use of a computer system, pumps and valves to manage the airship’s overall buoyancy by moving helium between the outer and inner volumes.

To increase lift:

> “….the computer is configured to increase lift ….by operating….the valves coupled with at least one inner bladder to vent the lighter-than-air gas from the…inner bladder to the outer bladder so as to increase a volume of the lighter-than-air gas retained in the outer bladder.”

To decrease lift:

> “…the computer is configured to decrease lift…by operating…at least one of the valves coupled with …(an) internal bladder and the pump to increase the internal pressure of the….internal bladder using the lighter-than-air gas from the outside bladder so as to reduce a volume of lighter-than-air gas retained in the outer bladder.”

This method of implementing variable buoyancy control in an airship appears to be functionally similar to the Control of Static Heaviness (COSH) system patented by Worldwide Aeros Corp. (Aeros), demonstrated in flight in 2013 on their prototype airship, the *Dragon Dream*, and implemented in all subsequent Aeroscraft airship designs.

The lenticular airship design representative of the LTA-10 and LTA-70 airships is described in Canadian patent application CA2929507A1, entitled “Cargo Airship,” published on 23 July 2015 (also designated WO 2015/108607 A3). This is a rigid hybrid airship, with the structure defining the lenticular shape of the airship while providing support for the numerous systems associated with the airship.

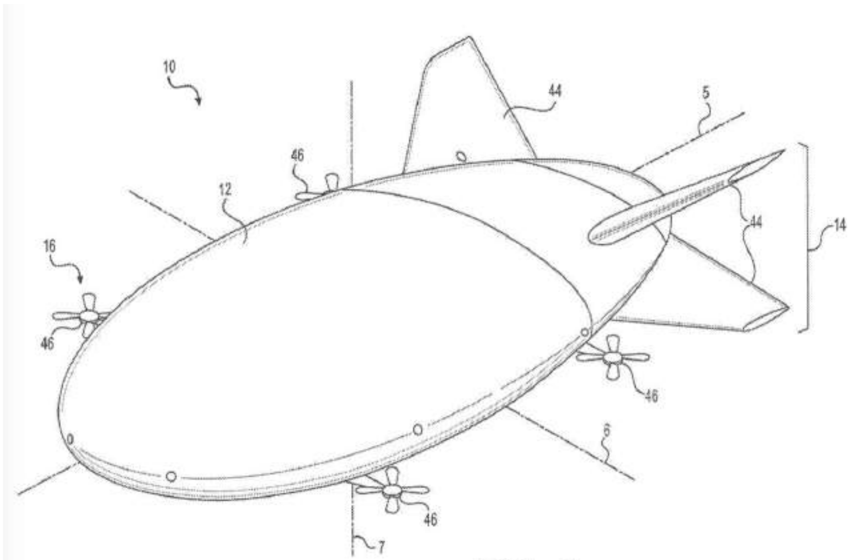


FIG. 1

General configuration of the airship showing the lenticular hull (12), placement of four vectorable thrusters (48) and four large stabilizing fins (44). Source: CA2929507A1

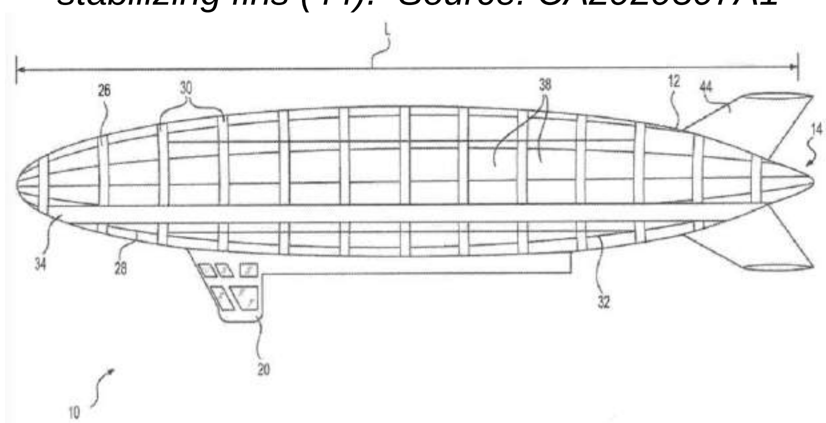


FIG. 2

General configuration of the rigid structure of the airship, including the gondola (20), support structure (26), frame members (28), structural rings (30), longerons (32) and the main structural beam (34) that distributes loads evenly throughout the support structure. Source: CA2929507A1

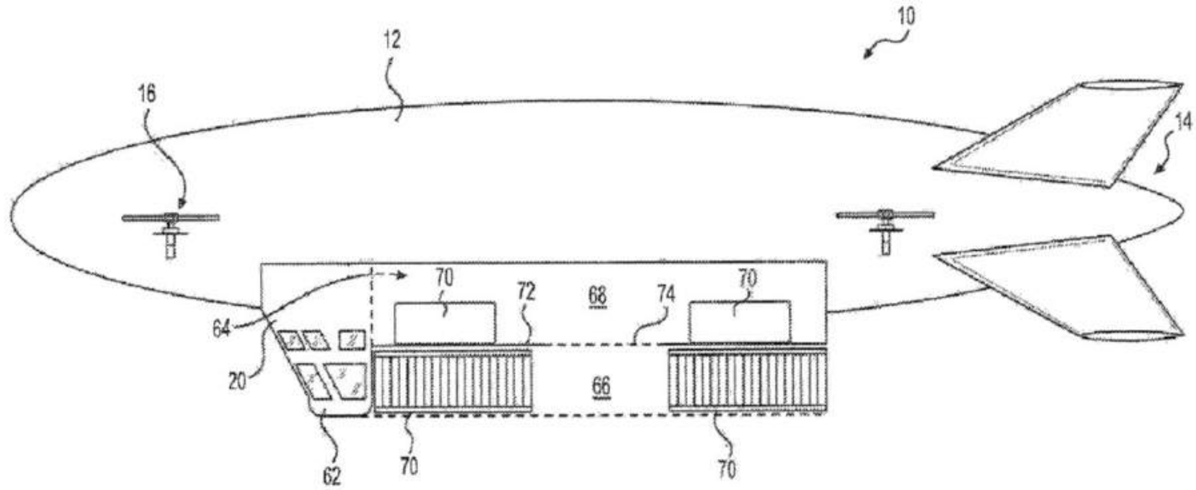


FIG. 11

Side view of the airship showing the lenticular hull (12), the gondola (20), the cargo bay (64), which includes provisions for an internal upper cargo bay (68) and an external lower cargo bay (66), and modular cargo containers (70). Source: CA2929507A1

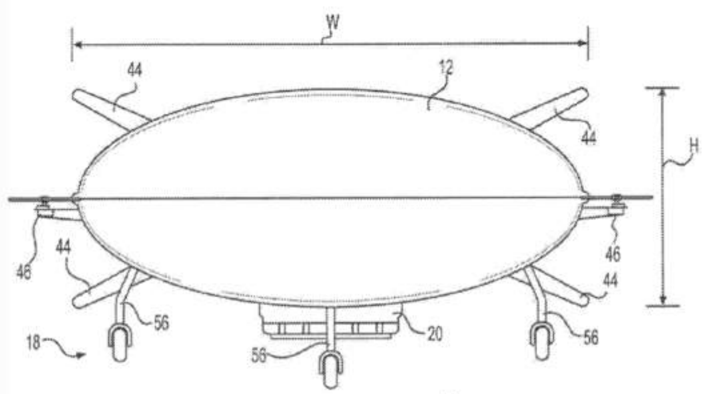


FIG. 3

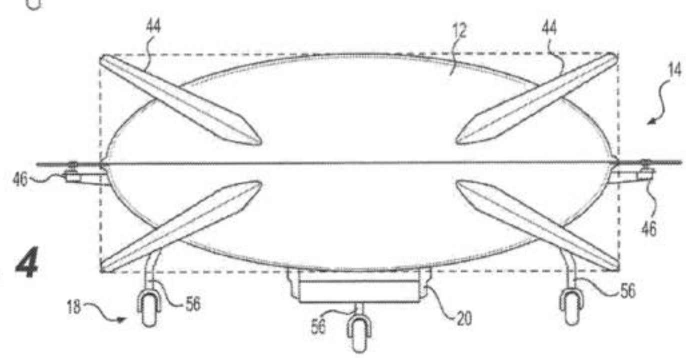


FIG. 4

Front view (Fig. 3) and back view (Fig. 4) of the airship showing the lenticular hull (12), the gondola (20), the stabilizing fins (44), the vectorable thrusters (46) and the landing gear (56).
Source: CA2929507A1

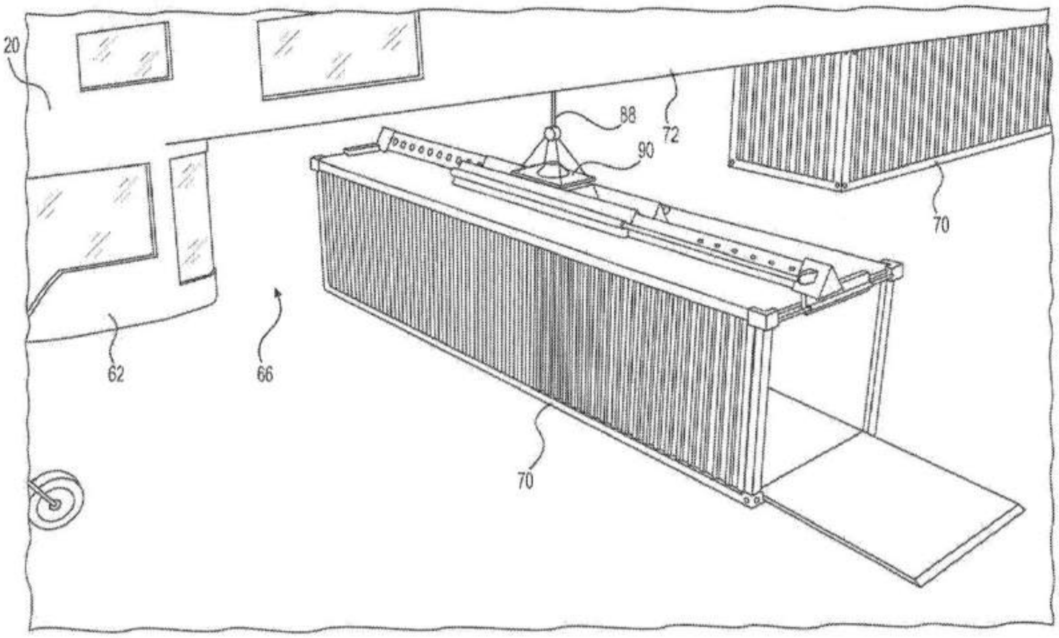


FIG. 17

Cargo handling system shown lifting an ISO standard cargo container (70), a hoist (88), and a cargo attachment member for the cargo (90)
Source: CA2929507A1

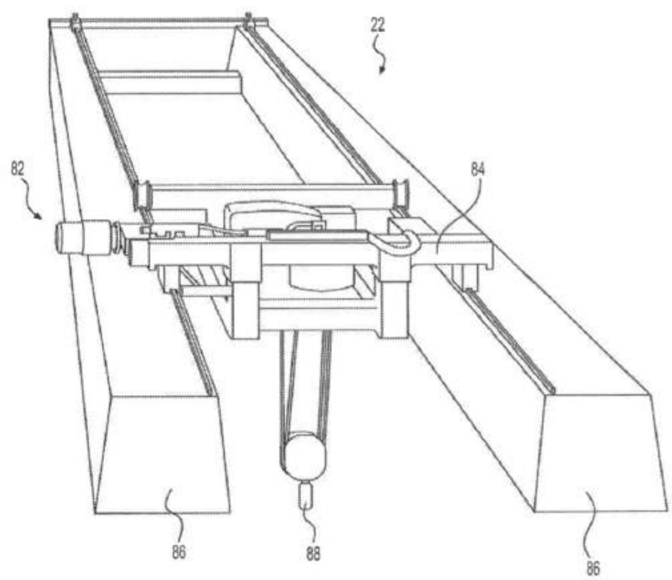


FIG. 16

Cargo handling system (22) showing one hoisting mechanism (82) consisting of a two-rail crane (84), crane rails (86), and hoist (88).
Source: CA2929507A1

4. LTA 10 & LTA 70 airship general features

General features of LTAA’s two airship designs, as described at the September 2015 Nunavut Trade Show & Conference, include the following:

- Rigid airship, advanced carbon/lattice-based composites, including stabilizers
- Patented “lenticular” form, streamlined for performance in high Arctic wind conditions
- Variable buoyancy control system
- Durable ice resistant coatings and snow removal technologies
- Heavy lift capability
- Flexible cargo handling: accommodates ISO intermodal containers, non-standard containers, palletized freight, large outsized freight items and winch-suspended sling loads
- Precision hovering load exchange, including hovering in windy conditions.
- Designed for Arctic operation: year-round in an operating temperature range from +110 to -50 degrees F.
- Engines with thrust vectoring capability
- Cruise speed 65 kph (40 mph); maximum speed 130 kph (81 mph)
- Retractable landing pods
- Minimum or no ground infrastructure required
- Improved operational availability

<u>Load exchange process</u>

With the variable buoyancy control system described in US patent US 8,899,514 B2, it appears that the LTA 10 and LTA 70 airships have the means to adjust their buoyancy when picking up or dropping off cargo and/or passengers.

It is assumed that the variable buoyancy control system has the ability to establish near-neutral buoyancy in flight and in hover, and that the airship will land from a hover with the assistance of vectoring thrusters and/or alr ballonets. Once on the ground, the airship would be made heavier-than-air so it is stable while cargo is being loaded and/or unloaded. The nose landing gear is designed to be secured to the ground to serve as the pivot point around which the airship moves to point into the wind.

Taking into account the new overall weight of the airship after the load exchange, the variable buoyancy control system will reestablish near-neutral buoyancy on the ground immediately prior to takeoff and then takeoff will be executed with the vectoring thrusters and/or alr ballonets.

LTAA has noted that airships returning from destinations in the Canadian Arctic can be loaded with trash and other cargo that should be removed from the sensitive Arctic environment.

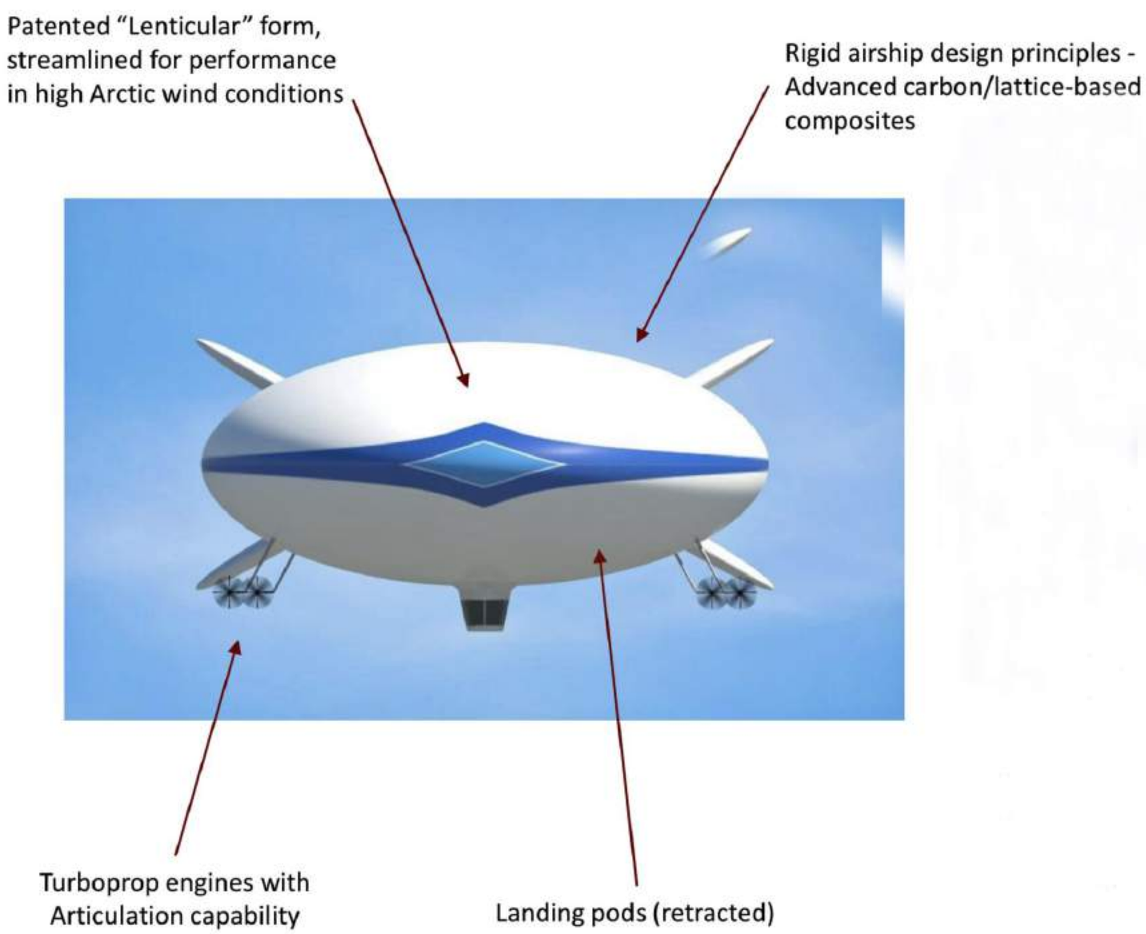
A “precision hovering load exchange” will be more challenging because the airship must maintain a precise airborne geo-location throughout the load exchange transaction. The speed of this transaction will be governed by the size of the load and the rate at which the variable buoyancy control system can change the overall buoyancy of the airship so that suspended loads can be safely delivered at the destination and other loads picked up for delivery to another site.

The LTA 10 airship

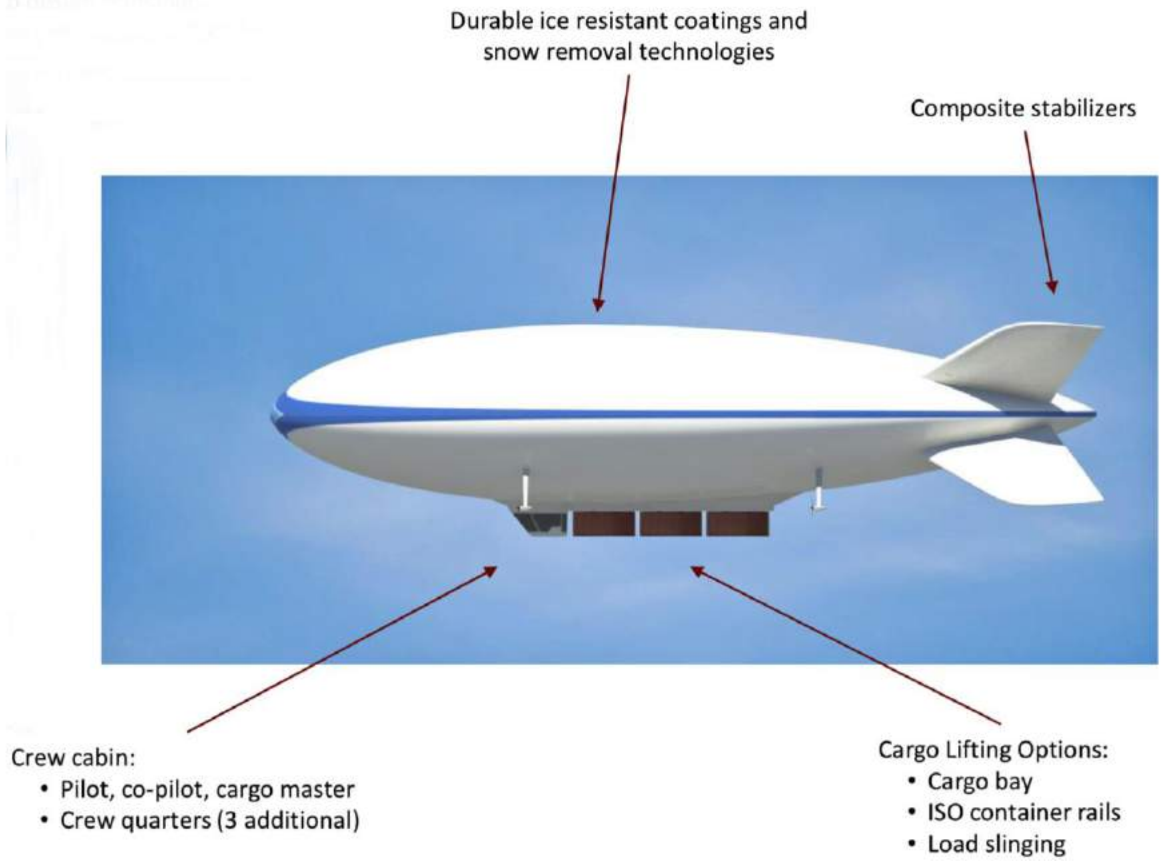
The LTA-10 is aimed at transportation and logistics roles in northern Canada, including governments and First Nation logistics and commercial mining, oil and gas exploration logistics. The LTA 10 airship is 80 meters (262 feet) long, with a maximum width of 40 meters (131 feet). It is designed to carry 10 metric tons (11 short tons; 22,000 pounds) of cargo. Planned propulsion will be by four vectorable PT-6 turboprop engines. Operating range would be1,287 km (800 miles).

The LTA 70 airship

The LTA-70 is designed to provide heavy-lift cargo services in northern Canada for mining production and extraction activities and facilities construction, including wind farms and other power plants. The LTA 70 airship will be 152 meters (499 feet) long, with a maximum width of 76 meters (249 feet). It is designed to carry 70 metric tonnes (77 short tons; 154,324 pounds) of cargo. Propulsion will be by six vectorable electric motors powered by diesel / solar / fuel cells. Operating range would be 4,074 km (2,531 miles).

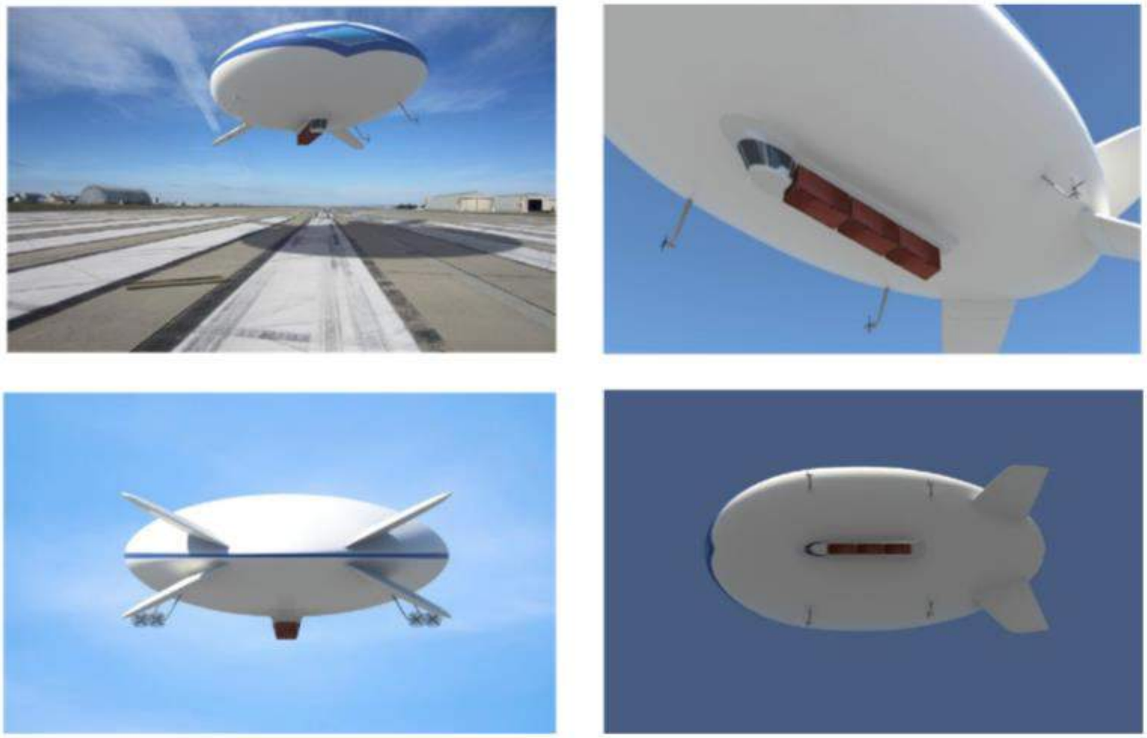


Bow view of an LTA-70 airship.
Source: LTA Aerostructures



Profile view of an LTA-70 airship.
Source: LTA Aerostructures

ISO cargo module handling on an LTA-70.
Source: LTA Aerostructures



Four views of an LTA-70 airship and its cargo module.

Rendering of an LT-70A airship operating in the Arctic.
Source: LTA Aerostructures

5. For additional information

- “LTA Aerostructures invests $90 million in Greater Montreal,” Press release, 15 July 2014: https://skiesmag.com/press-releases/ltaaerostructuresinvests90millioningreatermontreal/
- Mike Dyment, “LTA Aerostructures – General Presentation,” Heavy Lift Cargo Airships for Northern Operations, Nunavut Trade Show & Conference, 24 September 2015: https://nunavuttradeshow.ca/wp-content/uploads/2015/10/7-Dyment-LTA-Aerostructures.pdf
- “LTA Aerostructures Flyer” Issue 2, April 2016: https://silo.tips/download/flyer-issue-2-april-canada-us-announce-collaboration-on-arctic-issues-in-this-is

Patents

- US Patent US 7866601 B2, “Lenticular Airship,” filed 18 October 2007, published 11 January 2011: https://patents.google.com/patent/US7866601B2/en?oq=US7866601B2
- US Patent US D670638S, “Airship,” filed 20 July 2010, granted 13 November 2012: https://patents.google.com/patent/USD670638S1/en?oq=US+D670638S
- US Patent US 8894002 B2, “System and Method for Solar Powered Airship,” filed 14 July 2011, granted 25 November 2014: https://patents.google.com/patent/US8894002B2/en?oq=US+8894002+B2
- US Patent US20120018571A1, “System and method for solar-powered airship,” filed 14 July 2011, granted 25 November 2014: https://patents.google.com/patent/US20120018571A1/en?oq=US20120018571
- US Patent US 8418952 B2, “Lenticular Airship,” filed 3 January 2012, published 16 April 2013: https://patents.google.com/patent/US8418952B2/en?oq=US8418952B2

- US Patent US 8596571 B2, “Airship Including Aerodynamic, Floatation and Deployable Structures,” filed 26 March 2012, granted 3 December 2013: https://patents.google.com/patent/US8596571B2/en?oq=US8596571B2
- US Patent US 8899514 B2, “System and Method for Varying Airship Aerostatic Buoyancy,” filed 20 September 2013, published 2 December 2014: https://patents.google.com/patent/US8899514B2/en?oq=US+8899514+B2
- US Patent US D743867S1, “Airship,” filed 5 May 2014, granted 24 November 2015: https://patents.google.com/patent/USD743867S1/en
- Canadian Patent CA 2856901 C, “Lenticular Airship,” filed 15 October 2007, issued 29 August 2017: https://patents.google.com/patent/CA2856901C/en?oq=•CA+2856901
- Canadian Patent Application CA 2929507 A1, “Cargo Airship,” filed 3 November 2014, published on 23 July 2015: https://patents.google.com/patent/CA2929507A1/en?oq=CA+2929507+A1
- European Patent Specification EP 2173613 B1, “Lenticular Airship and Associated Controls,” filed 7 August 2008, granted 26 February 2014: https://patents.google.com/patent/EP2173613B1/en?oq=EP+2173613B1
- International Publication WO 2012/135117 A2, “Airship Including Aerodynamic, Floatation and Deployable Structures,” filed 26 March 2012, published 4 October 2012: https://patents.google.com/patent/WO2012135117A2/en?oq=WO2012%2f135117A2
- International Application WO 2015/108607 A3, “Cargo Airship,” filed 3 November 2014, published 26 November 2015: https://patents.google.com/patent/WO2015108607A3/en?oq=WO+2015%2f108607+A3

Other *Modern Airships* articles

- *Modern Airships - Part 1*: https://lynceans.org/all-posts/modern-airships-part-1/
- *Modern Airships - Part 2*: https://lynceans.org/all-posts/modern-airships-part-2/
- *Modern Airships - Part 3*: https://lynceans.org/all-posts/modern-airships-part-3/