Aereon Corporation – Dynairships & Aereon 26

Peter Lobner, updated 12 February 2022

1. Introduction

Aereon Corporation was founded in 1959 by Monroe Drew and John Fitzpatrick in Princeton, New Jersey. The firm was named in honor of Solomon Andrews' 1863 airship *Aereon*, which was a three-hulled craft, also built in New Jersey, that propelled itself without an engine by alternately becoming positively or negatively buoyant to generate forward thrust while porpoising through the air. Andrews' second variable buoyancy propulsion airship was the single-hull *Aereon II*.

Aereon Corporation designed and built the *Aereon III* hybrid airship in the early 1960s. They also developed and patented designs for a family of semi-buoyant and heavier-than-air lifting body aircraft collectively known as Dynairships. The small Aereon 7 and Aereon 26 heavier-than-air aircraft were sub-scale aerodynamic demonstrators for the lifting body design planned for much larger Dynairships. In this article, we'll take a look at the Dynairships. *Aereon III* is addressed in a separate article.

Aereon 340 Dynairship freighter. Source: Aereon

The official Aereon Corporation website went offline in 2016, but has been archived at the following link: http://aereoncorp.com

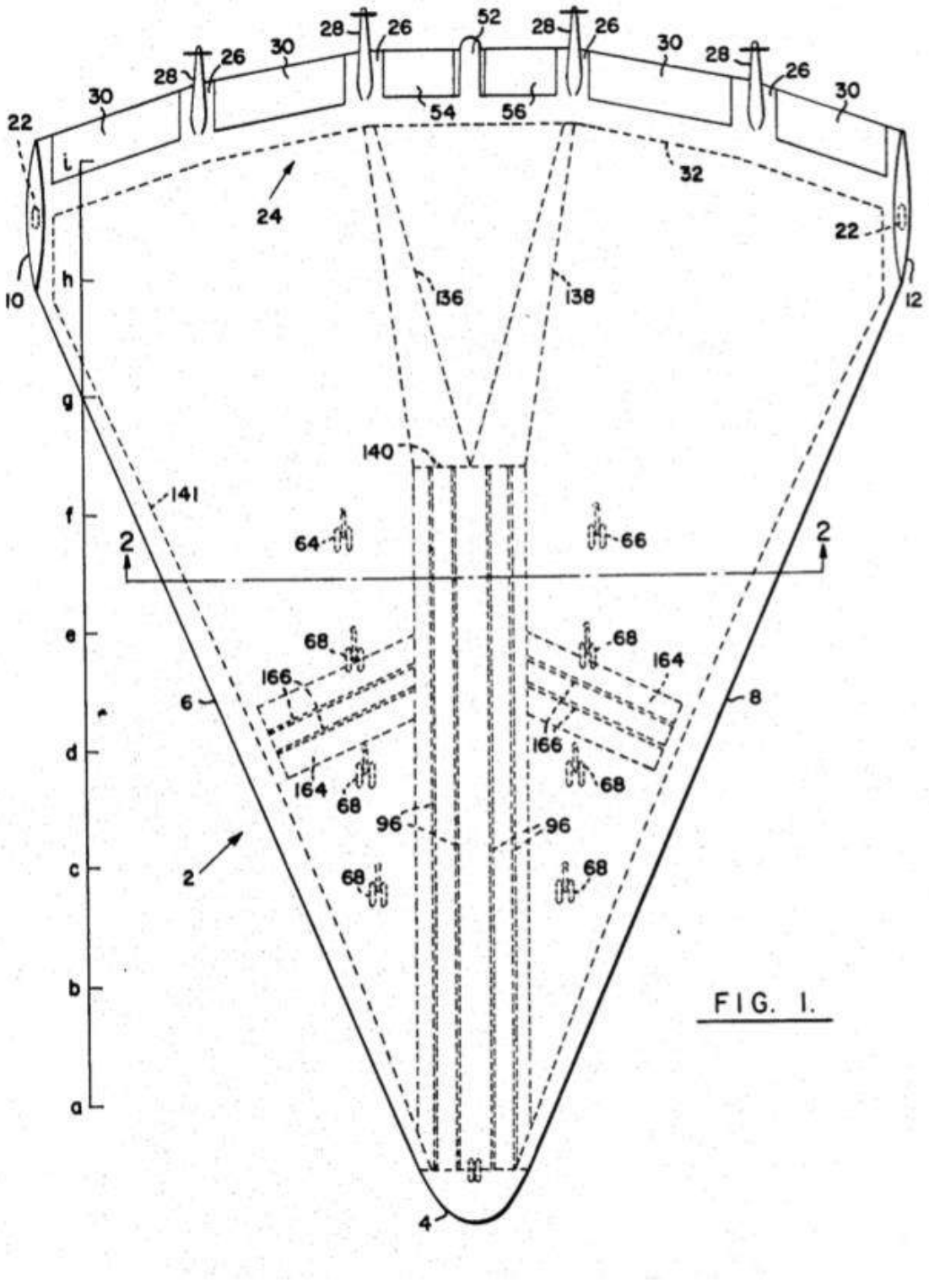
2. The Dynairship freighter patent (1967 to 1969)

The Dynairship was a semi-buoyant, lifting body aircraft designed by the Aereon Corporation for use as a civilian and military cargo transport. The basic concept for the Dynairship is addressed in US Patent 3,486,719A, “Airship,” which was filed on 4 December 1967 and granted on 30 December 1969. The abstract of the patent describes a Dynairship as follows:

> “A cargo-carrying air ship comprises a gas-filled, low aspect ratio deltoid wing. Internally, and lengthwise along the underside of the ship, there is provided a cargo space sealed from the gas space, and provided with a pair of parallel track assemblies along the ceiling of the cargo space, on which ride movable cargo hoists. The ceiling of the cargo space is suspended by cables from suspension points within the gas space, and the suspension points are, in turn, suspended by cables from the upper shell of the hull. Adjustable landing gear, mounted from the suspension points, permit variation of the ships angle of attack on the ground, and a rear propulsion system acting against a convex stern arch effectively compensates for drag. The ship, when filled with helium and unloaded, has a dead weight of the order of the weight of the volume of air displaced by the ship.”

The main features of the Dynairship were:

- The hull (2) is a low aspect ratio blended delta wing with vertical stabilizers that form endplates (10 & 12) on the wings.
- The craft is semi-buoyant; the large delta wing contains inflated helium lifting gas cells.
- The cargo compartment (94) and cargo rails (96) are sealed from the helium volume and are suspended within the hull by a web of steel support cables that distribute the concentrated load of the cargo compartment over the large area of the upper shell of the fuselage.
- Cargo is carried in containers suspended from the cargo rails.
- Propulsion system (28) is mounted along the wing trailing edge.
- A Dynairship can taxi like a fixed-wing airplane.



Dynairship overhead plan view. Source: Patent 3,486,719

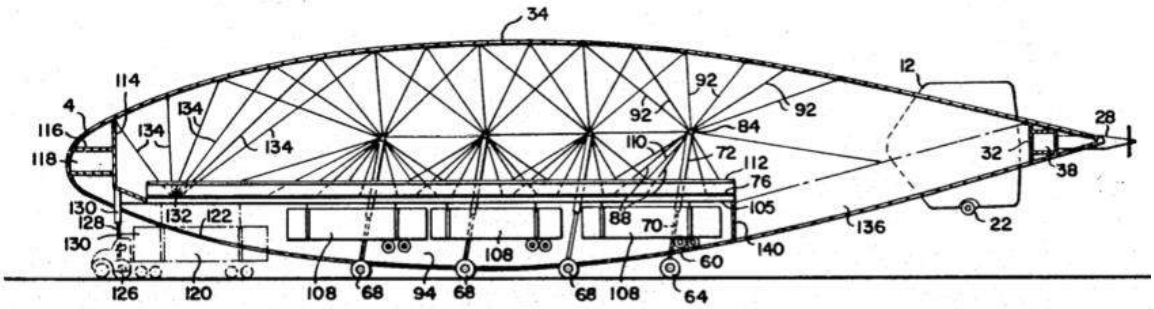


FIG. 3.

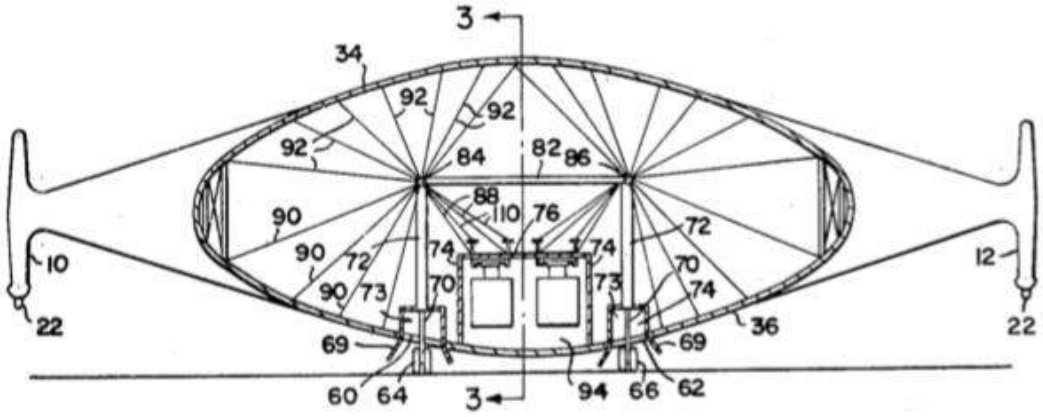


FIG. 2.

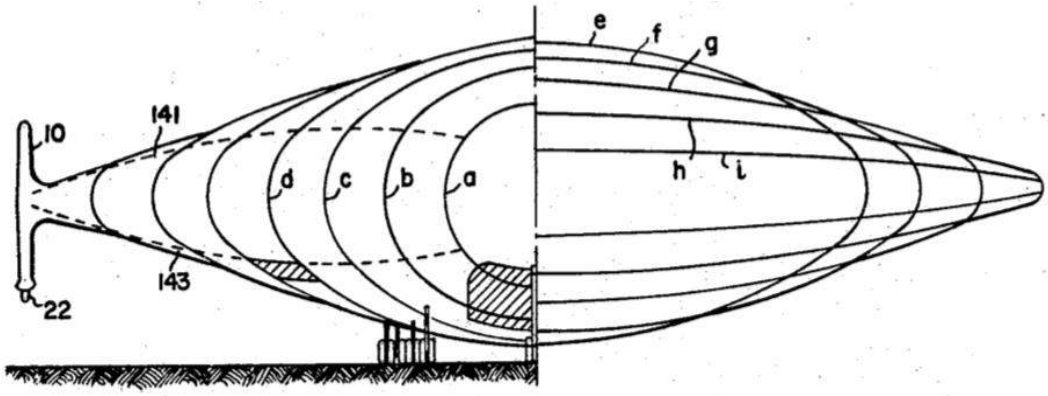


FIG. 5.

Dynairship cross-section views; profile (Fig., 3 top) and transverse (Fig. 2, middle). Front view contour map (Fig. 5, bottom). Source: Patent 3,486,719

Because of its relatively light weight for its size, care had to be taken to ensure that a Dynairship was not upset by the wind. Examples of unique operating provisions described in the patent are:

- The landing gear was adjustable so that the ship was maintained in a nose-down attitude while it is on the ground.
- A taxi control station in the stern was provided so that downwind taxiing and turns could be avoided by taxiing the ship in reverse.
- The landing gear was permitted to swivel freely about vertical axes so that the wheel units act as a cross-wind landing gear, which permit takeoff and landing with the aircraft centerline aligned to the wind and not the runway.
- The aircraft may become too light for safe ground operation in windy conditions. The ship needed to be kept partly ballasted by fuel or cargo, or both, particularly when winds were severe.
- A Dynairship could fly when pressurized by air instead of helium, although cargo-carrying capacity would be reduced.

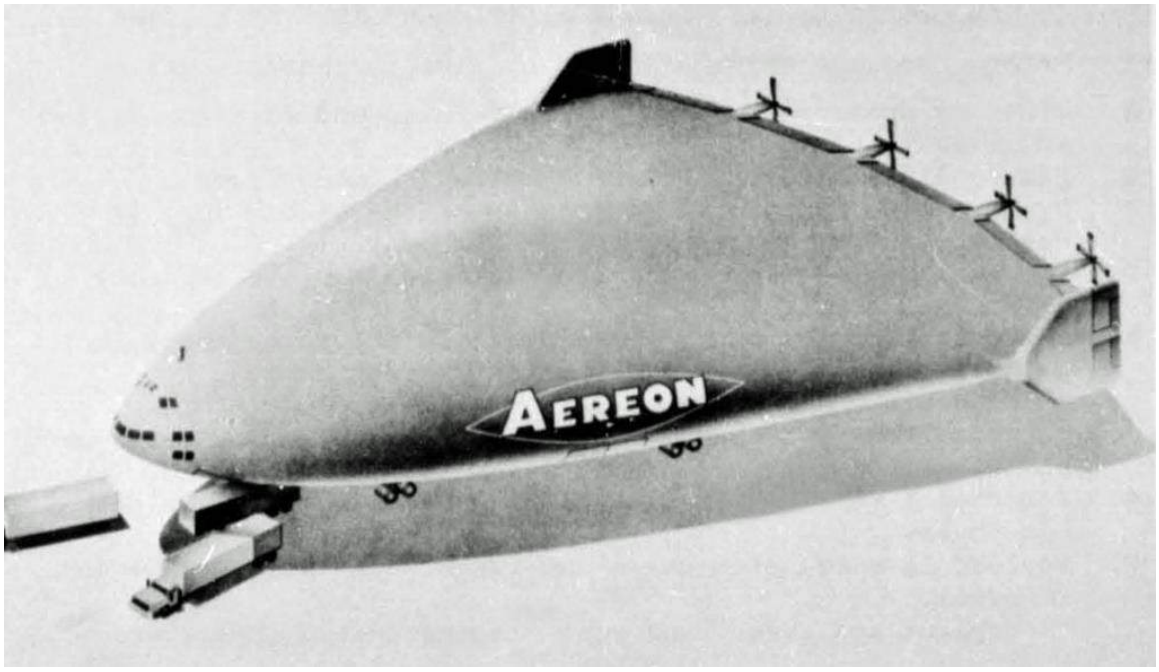
You can read the Dynairship patent 3,486,719A, “Airship,” here: https://patents.google.com/patent/US3486719A/en

3. The Aereon 340 freighter design concept (late 1960s to 1970s)

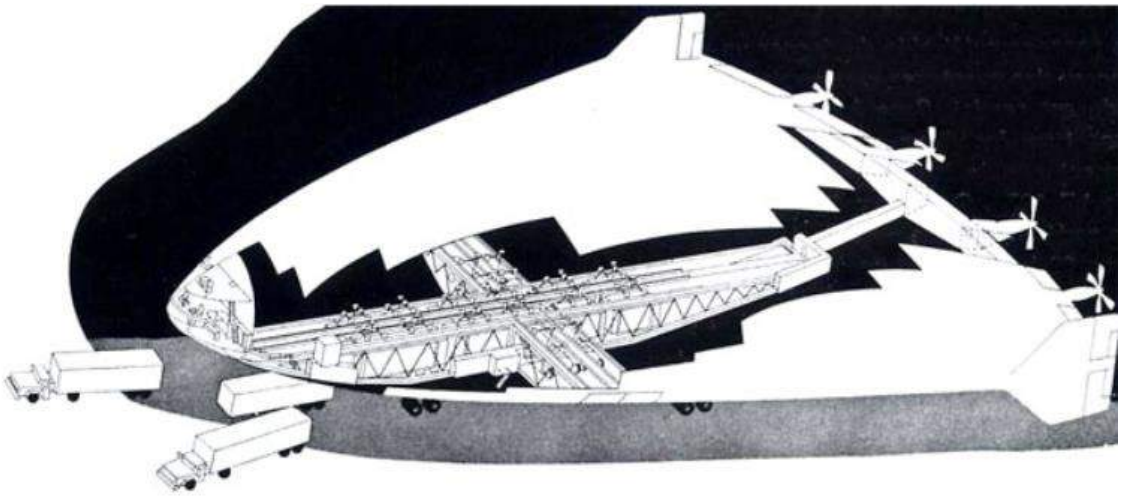
Aereon’s design concept for a full-size commercial freighter based on patent 3,486,719A was the semi-buoyant *Aereon 340*. This Dynairship freighter design had a length of 340 feet (100 m), a wingspan of 256 feet (78 m), and a total lift capacity of 400,000 pounds (180,000 kg). It was powered by four 5,500 horsepower (4,100 kW) Rolls-Royce Tyne turboprop engines mounted along the trailing edge of the delta shaped aerobody.

The Aereon 340 was designed to carry up to six intermodal containers loaded from semi-trailers using built-in lifting and handling equipment in the cargo bay. The intermodal containers were suspended from a structural framework that distributed the cargo loads via the network of catenary cables into the upper surface of the aerobody.

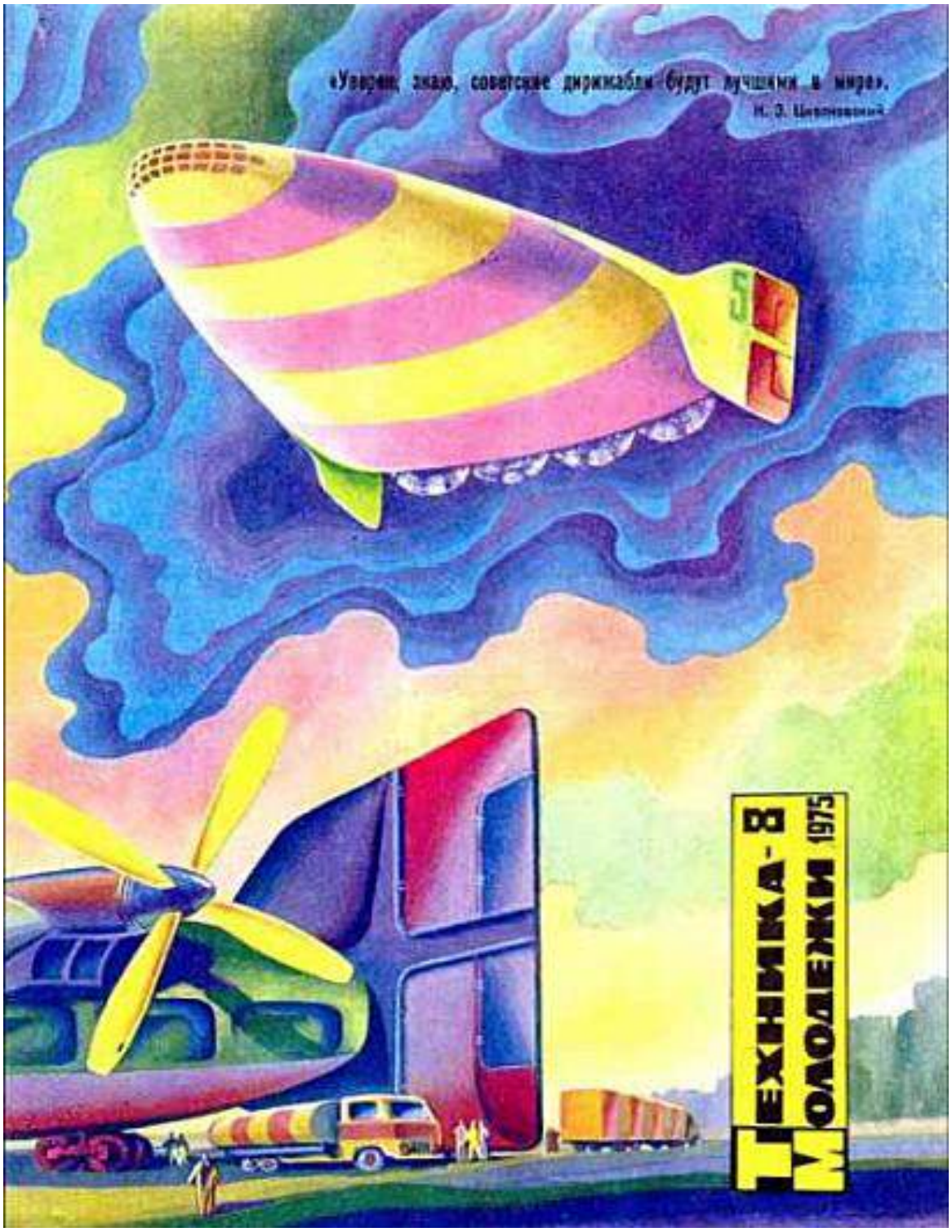
The Aereon 340 was trimmed to be aerostatically slightly heavier-than-air prior to takeoff. This would have enabled the Aereon 340 to taxi, takeoff and land from an airport like a conventional airplane.



General arrangement of an Aereon 340 freighter shown loading intermodal cargo containers. Source: Paper "The Dynairship", By William McElwee Miller, Jr.

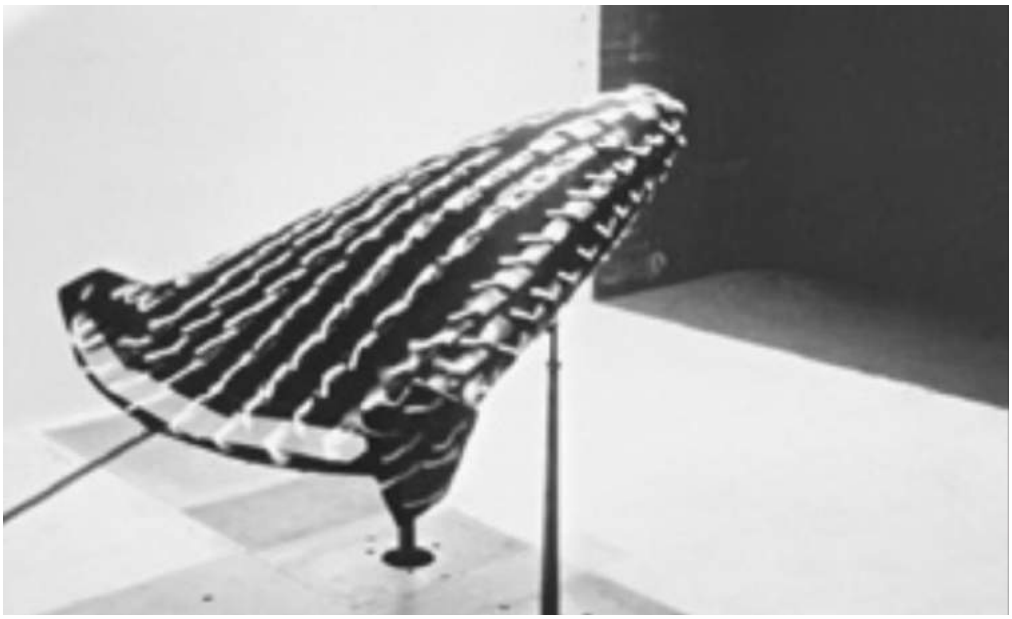


Cut-away drawing showing the internal arrangement of the large cargo hold of the Aereon 340. Source: Nigel Kaley, "Modern Airships: A review of 40 years of airship development," 2003



Aereon Dynairship (likely a 340) on the cover of a Soviet magazine, Technology Youth, August 1975. Source: Naval Airship Association, Noon Balloon, Spring 2013

The Aereon 340 design was tested in the Forrestal wind tunnel at Princeton in 1967 and was found to be stall-free up to angles of attack of more than 30°. This flight characteristic would allow safe take-offs and landings at extremely low speed.



Aereon Dynairship wind tunnel test.
Source: NAA Noon Balloon, Spring 2017

Aereon patent US 3,761,041A, “Lifting body aircraft,” granted 25 September 1973, describes improvements to the Dynairship’s flight control system to improve takeoff and landing distances and improve pitch control in flight. Patent Figure 1 shows an alternative configuration for the control surfaces along the trailing edge of the lifting body fuselage and a redesign of the former slab tail assemblies into a combined upper vertical tail and lower portion that is canted out to function as a combined aileron / elevator.

The patent describes the operation of the revised tailplane configuration:

> “Surfaces 20 and 22, located at either end of the trailing edge, carry substantially horizontal outboard pitch control surfaces 24 and 26 respectively. These are the surfaces (that) are normally deflected upwardly to produce a positive pitching moment and thereby maintain a positive angle of attack. They are located aft of the center of lift. It will be noted that the airfoil surface area

forward of these control surfaces is relatively small. The drooping configuration of surfaces 20 and 22 is provided to compensate for excessive rolling moment due to sideslip..... The axes of rotation of control surfaces 24 and 26 may be somewhat sloped with respect to the horizontal, but the surfaces are nevertheless substantially horizontal in that they perform the function of horizontal control surfaces."

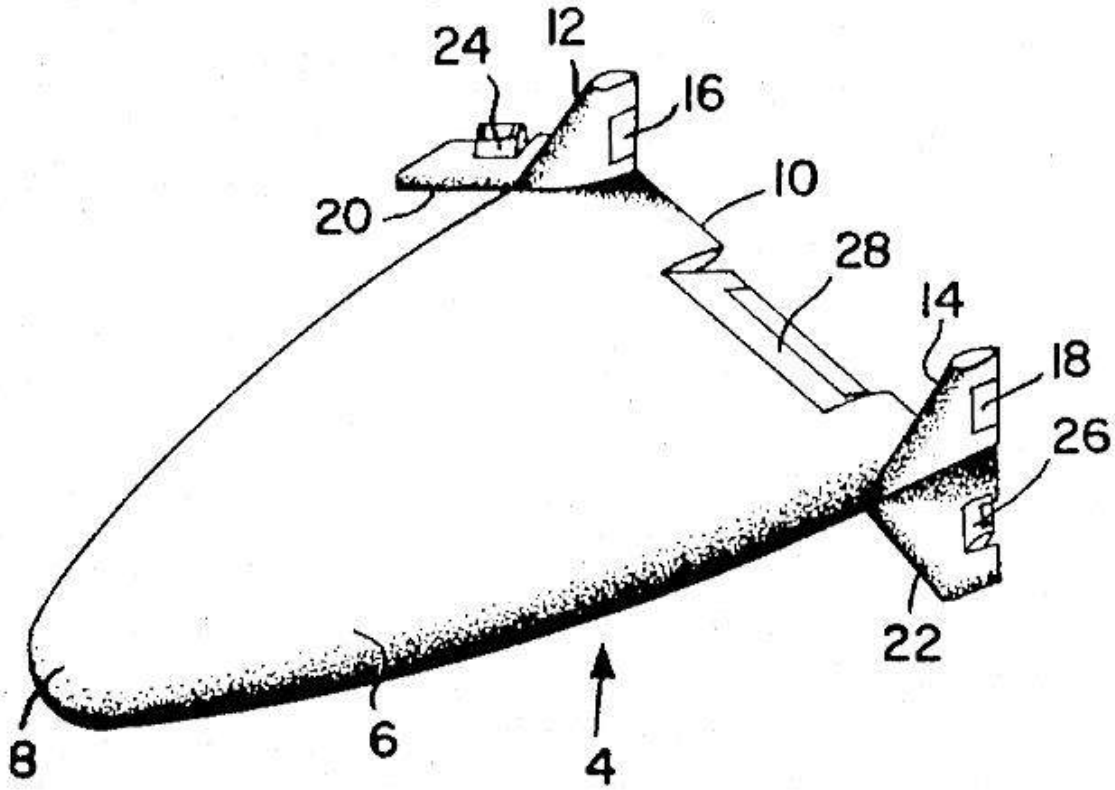
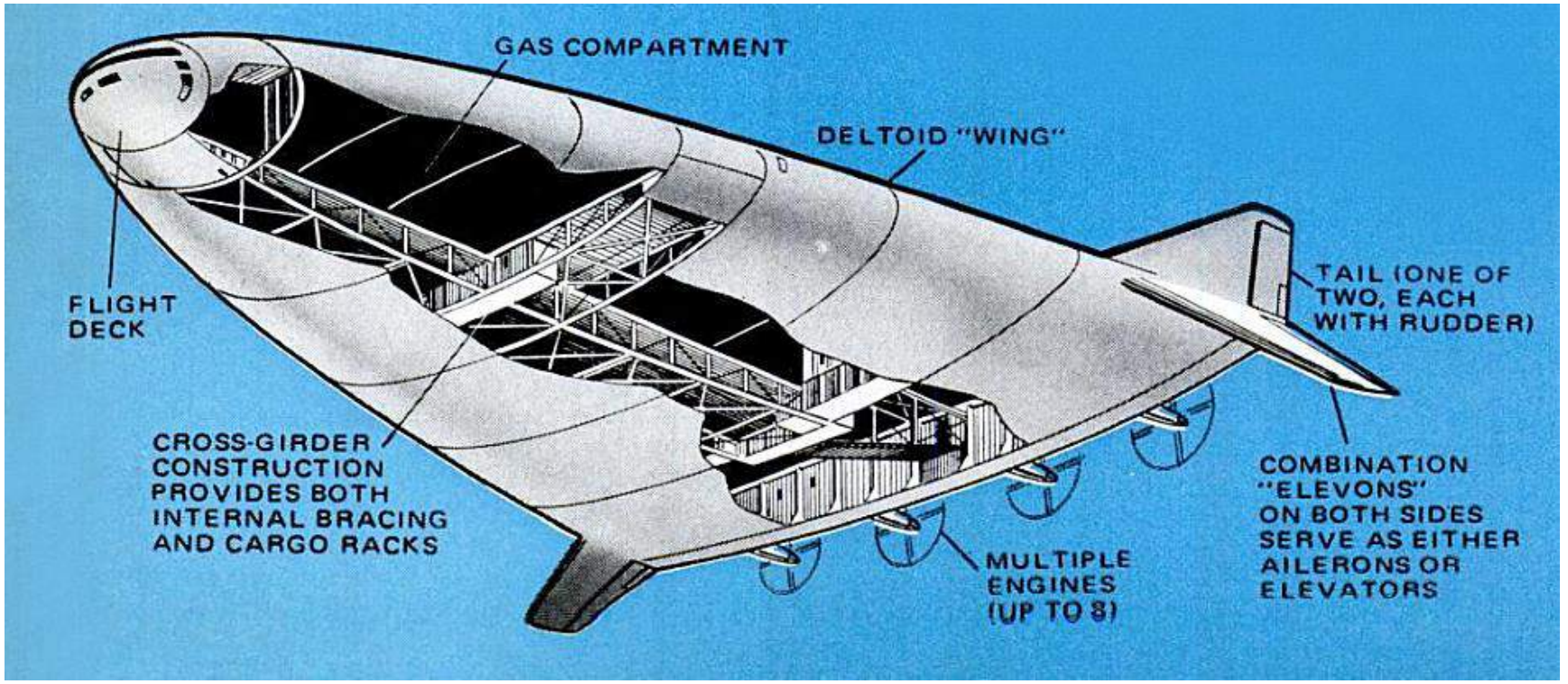


FIG. 1.

Further coordination among the control surfaces is described in the patent, which you can read here:
https://patents.google.com/patent/US3761041A

An Aereon freighter incorporating the revised tailplane configuration is shown in the following diagram.



Cut-away drawing of a later version of the Aereon freighter shows the lower portion of the tail canted out to function as an "elevon" (combined aileron / elevator) as per Patent US 3,761,041A.
Source: Popular Mechanics, July 1977

4. The Aereon sub-scale Dynairship remote controlled flying models (1968 to mid-1970s)

Aereon built a series of small, gasoline engine powered, remotely-controlled, heavier-than-air flying models to confirm the basic aerodynamic characteristics of their lifting body design for the Dynairship. A series of four-foot models were tested from spring-1968 to 1969. The seven-foot Aereon 7 flew a 14-flight test program in mid-1970 before it was destroyed on its last test flight.

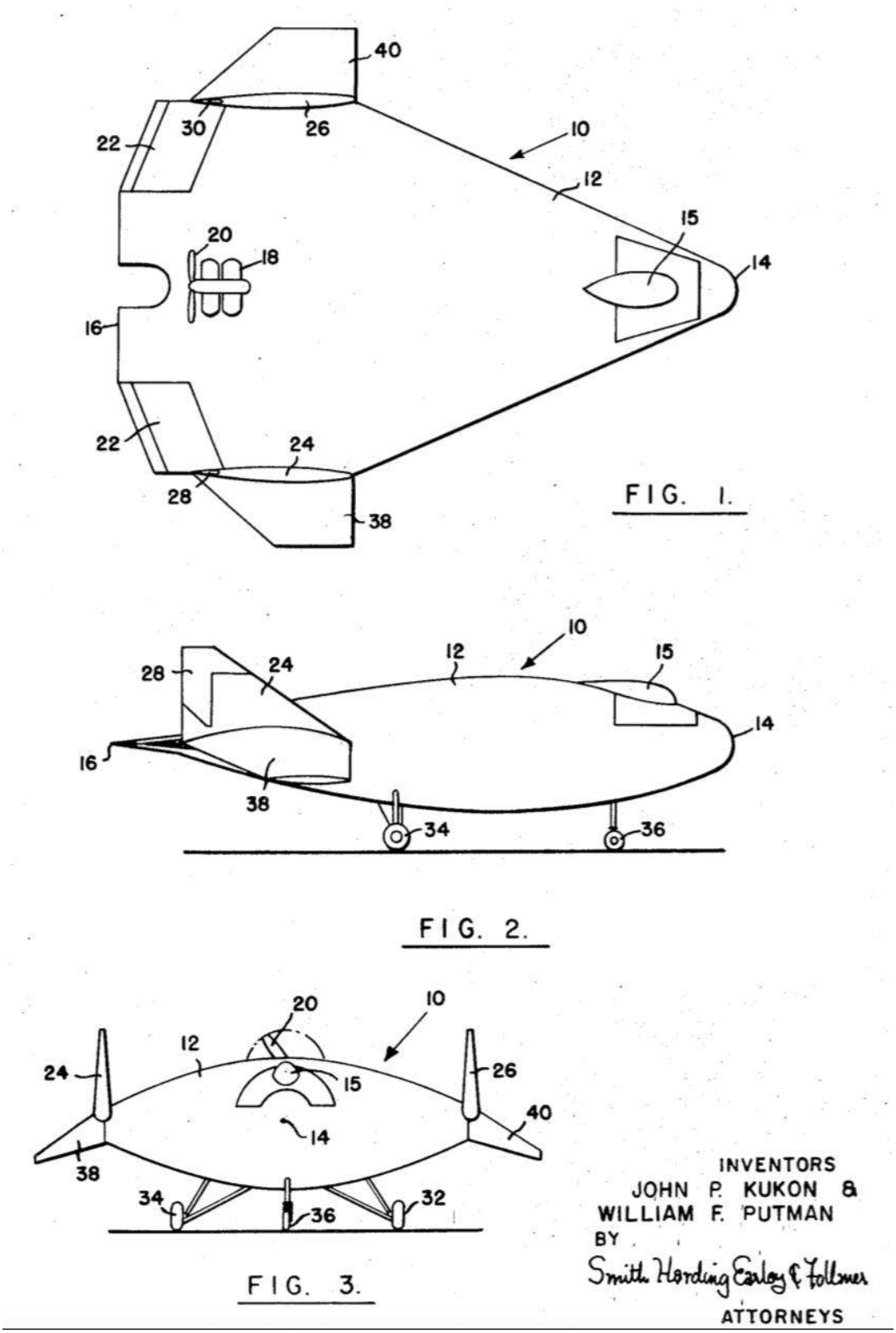
5. The *Aereon 26* piloted sub-scale demonstrator (1969 to 1971)

The proof-of-concept aircraft for the Dynairship was the piloted sub-scale *Aereon 26*, which lacked lifting gas and operated as a heavier-than-air craft throughout its test program to further validate the aerodynamics of the Dynairship. The basic design of the *Aereon 26* is described in US Patent 3,684,217A, “Aircraft,” which was filed on 30 September 1970 and granted 15 August 1972. The patent abstract describes the aircraft as follows:

> “This invention relates to aircraft and particularly to delta-shaped lifting bodies having high sweep angles…….Such lifting bodies possess favorable stall characteristics and are capable of relatively high cruising speeds and relatively low landing speeds. They can be made to carry a large payload efficiently, and may be operated heavier than-air, or, with helium, either lighter-than-air of slightly heavier-than-air.”

The *Aereon 26's* shape was called an "aerobody,” essentially a lifting-body of deltoid planform, elliptical cross-sections, and small stub winglets for added stability. Among the advantages claimed for this hull form were proximity of the aerodynamic center, center of buoyancy, and center of gravity and a minimal need for trim-control devices, thus facilitating the transportation of "a full range of tonnages at various speeds without major trim requirements.”

You can read US Patent 3,684,217A, “Aircraft,” here: https://patents.google.com/patent/US3684217A



Aereon 26 general configuration. Source: US Patent 3,684,217A

The *Aereon 26's* structure was composed of welded aluminum tubes (some salvaged from the wrecked *Aereon III*), covered with aircraft cloth and aluminum sheet. After completion, the aircraft was transported by road to the National Aviation Facilities Experimental Center (NAFEC) near Atlantic City for flight testing.

Aereon 26 ground test, Red Lion, NJ, 1969.
Source: Aereon Corp.

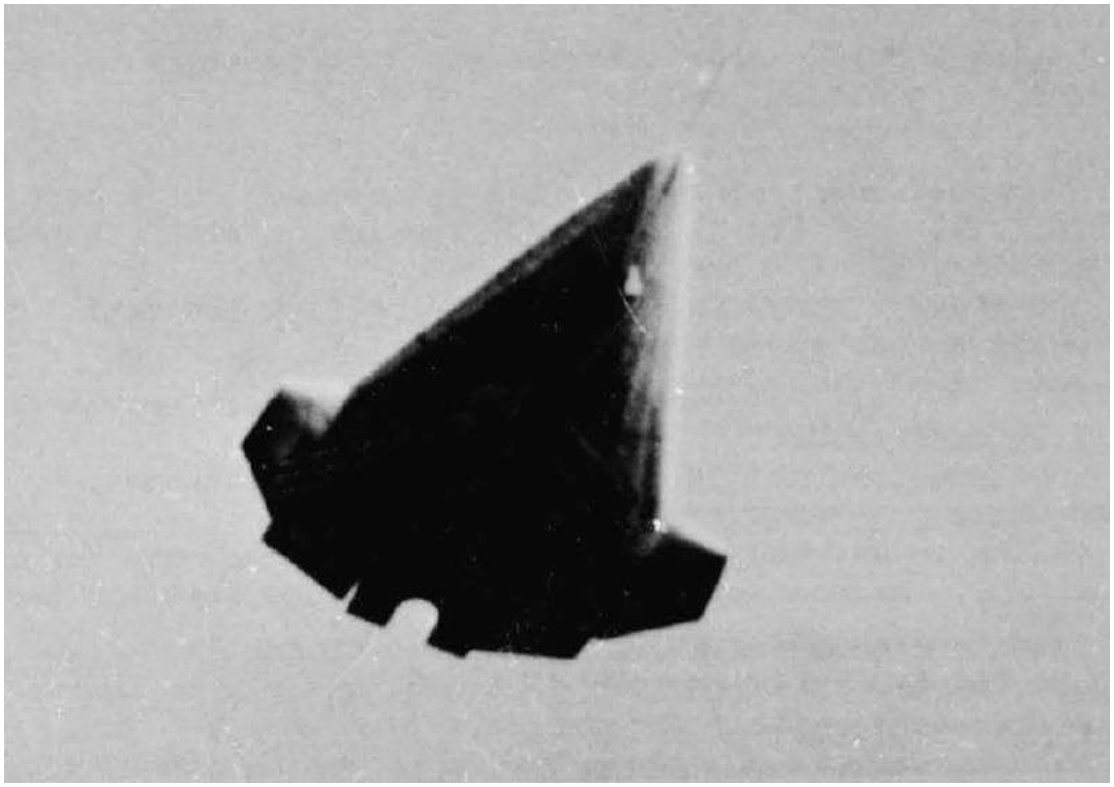
Aereon 26 taxi test, NAFEC, 1971.
Source: The Atlantic, 8 Mar 2011

The *Aereon 26* made its first flight, piloted by John Olcott, at NAFEC on 7 September 1970, but proved to be underpowered and was unable to climb out of ground effect. After a series of modification and brief test flights of new propellers and vortex generators added to the aerobody, testing resumed at NAFEC on 1 March 1971. The aircraft was able to fly and maneuver successfully on several flights before the limited operating life of its used engine expired, ending the test program.

The key finding from the *Aereon 26* test program, as reported by William Miller, was that the aerobody was an aerodynamically feasible concept and a basis existed for realistic studies of much larger aircraft. Following the apparent success of the *Aereon 26* project, Aereon Corporation's board voted unanimously to proceed with developing the Dynairship for civilian and commercial purposes.

John McPhee recounted the story of the test program by in his book "The Deltoid Pumpkin Seed" (ISBN 0-374-51635-9).

March 1971 - Takeoff from the FAA Test Center, NJ.
Source: https://alchetron.com/AEREON-26



Aereon 26 in flight.
Source: Paper "The Dynairship", William McElwee Miller, Jr.

William McElwee Miller, Jr. with the Aereon 26.
Source: flyingmag.com, 2June 2010

Aereon 26 stored in a hanger for 40 years.
William McElwee Miller, Jr. (r) in June 2011. Source: Hal Brown via https://searey.us/splash/?Photos&p=SZP1D0000

On 18 December 2019, Freeflight Aviation announced that the *Aereon 26* was being moved from storage to the Air Victory Museum at the South Jersey Airport in Lumberton, NJ. Following are three photos of the move from their Facebook post.

Aereon 26 being moved to the Air Victory Museum at the South Jersey Airport in Lumberton, NJ.
Source: Freeflight Aviation Facebook post 18 December 2019

The Air Victory Museum announced their new *Aereon 26* exhibit on 21 December 2019. You can watch a short (2:44 minute) walkaround video of the Aereon 26 at the museum here: https://www.youtube.com/watch?v=1AM8oQ2tXG4

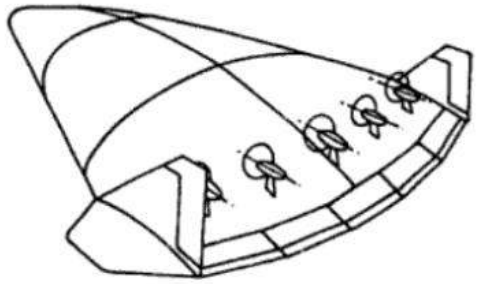
Aereon 26 on display at the Air Victory Museum at the South Jersey Airport in Lumberton, NJ.
Source: Screenshots from video.

Aereon 26 interior tubular framework.
Source: Screenshots from video.

Aereon 26 engine is supported by the interior tubular framework.
Source: Air Victory Museum

6. Further evolution of the large Dynairship

The Aereon 340 was just the first of the large Dynairship design concepts. The design continued to evolve into the 1990s.



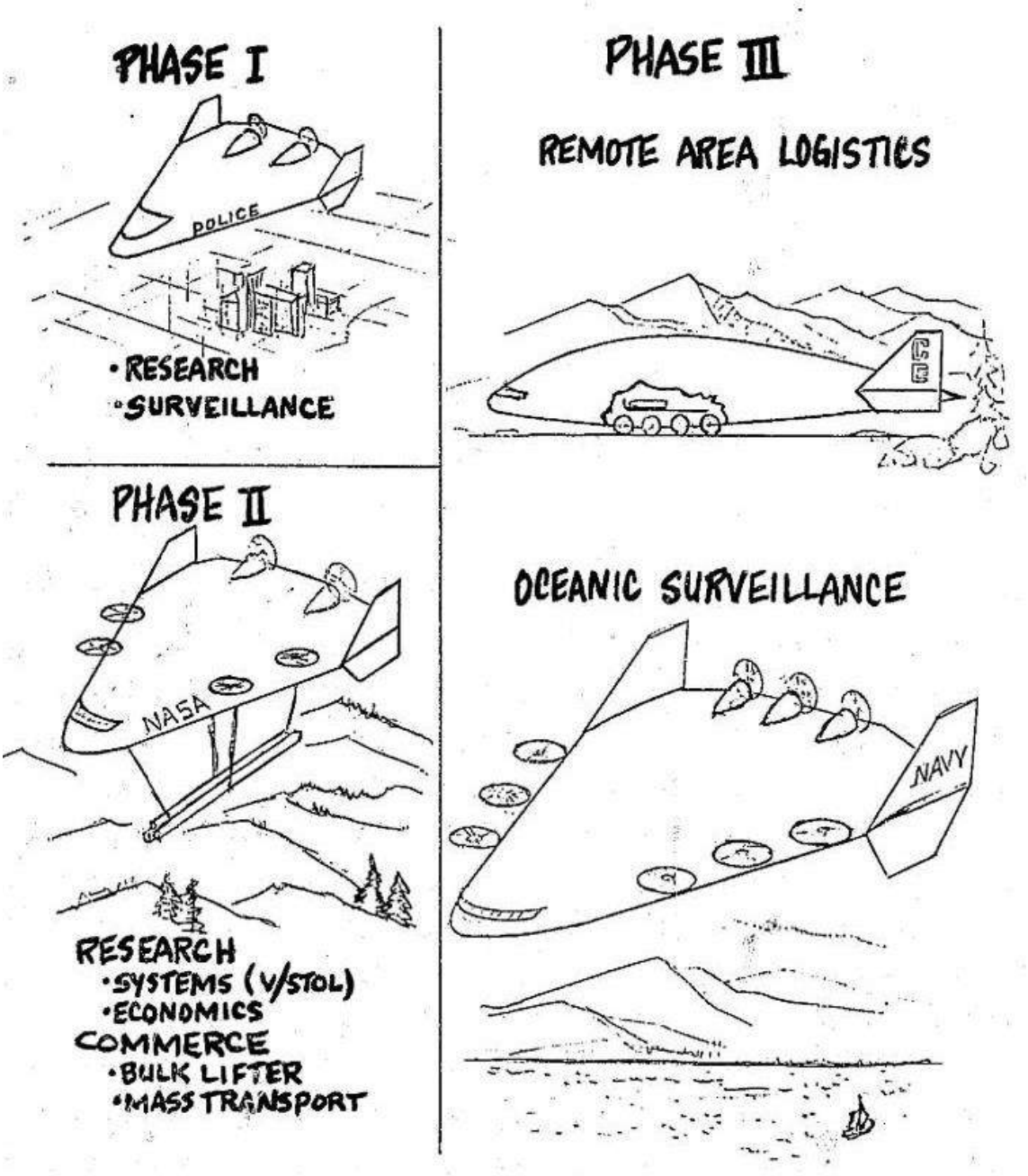
Dynairship. Source: Airship Technology, Khoury, Fig15.8 b

In 1974, Aereon Corporation proposed three new versions of the semi-buoyant Dynairship with the characteristic lifting body fuselage:

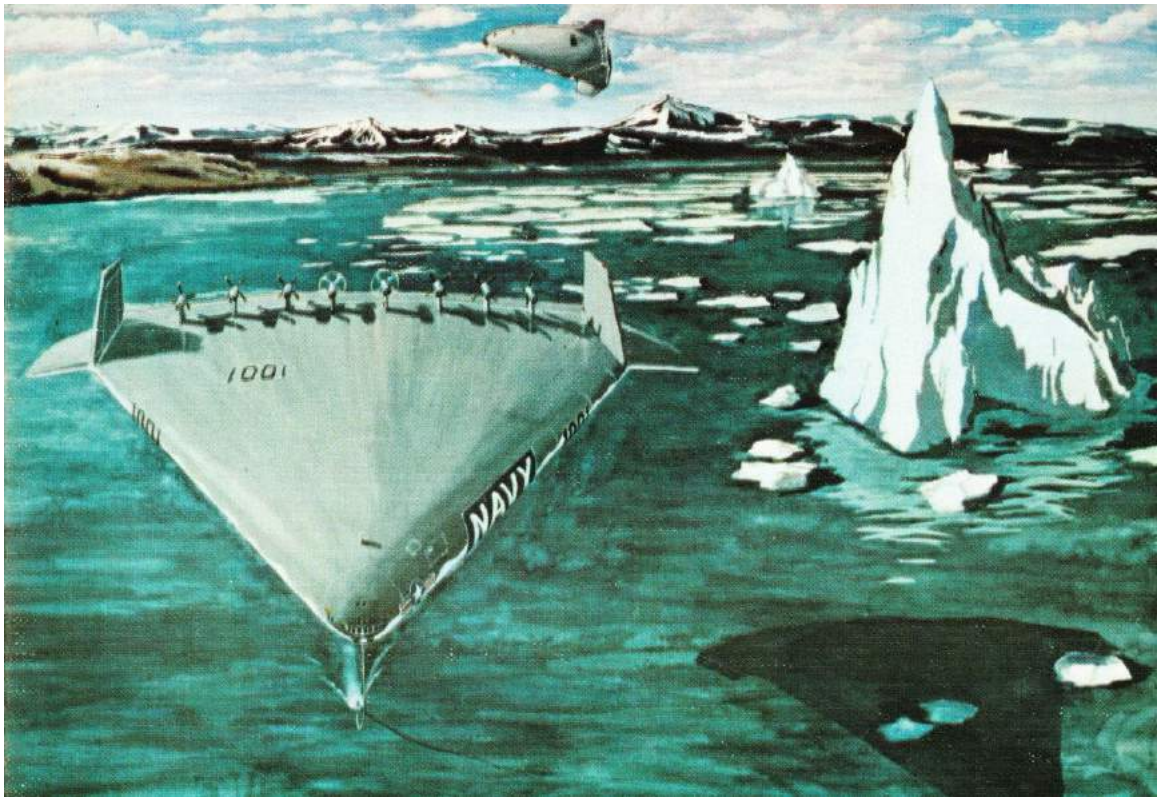
- A "logistic carrier" much larger than the Aereon 340
  - Length: 1,000 feet (300 m)
  - Gross weight: 4,200 tons (3,810 metric tons)
  - Cargo capacity: 3,300 tons (2,995 metric tons)
  - Cruise speed: 150 mph (241 kph)
- A "medium-size cargo aircraft" smaller than the Aereon 340
  - Length: 200 feet (61 m)
  - Gross weight: 270 tons (245 metric tons)
  - Cargo capacity: 90 tons (81.6 metric tons)
  - Cruise speed: 150 mph (241 kph)
  - Range: 1,000 miles (1,609 km)
- A "small patrol aircraft"
  - Length: 50 feet (15 m)
  - Gross weight: 4,000 pounds (1,800 kg)
  - Crew: three persons
  - Cruise speed: 50 mph (80 kph)
  - Endurance: eight hour missions

None of the above proposed Dynairship concepts were funded.

In January 1975, William McElwee Miller, Jr., President of Aereon Corporation, made a presentation at NASA's Interagency Workshop on Lighter than Air Vehicles, in which he described the design of the Dynairship and potential applications derived from a phased development program outlined in the following graphic.



Source: Aereon, 1975



Artist's concept of large Navy Dynairships patrolling in the Arctic. Note that the lead ship is flying on two of eight engines and appears to be trailing a dipping sonar from its nose.
Source: Aereon Corporation via Airships of the Future (1976)

7. Jetflap Dynairships - the Aer/lighter

In the mid-1970's Aereon introduced the concept of "jetflaps" to augment the amount of aerodynamic lift generated by a Dynairship for a given amount of power. Aereon patent US 4,149,688A, "Lifting body aircraft for V/STOL service," filed 1 October 1976 and granted 17 Apr 1979, describes the application of jetflap aerodynamic devices that augment lift by directing a propeller's slipstream over a deflected flap along the trailing edge of the deltoid aerobody. Small canard wings mounted forward on the fuselage tilt to direct propulsor thrust in coordination with the jetflap. You can read this patent here: https://patents.google.com/patent/US4149688A/en

The jetflap concept was applicable to semi-buoyant and heavier-than-air Dynairships. Jetflaps could enable VTOL operations with semi-buoyant Dynairships and improve the STOL performance of heavier-than-air Dynairships. The general arrangement of jetflaps on a large Dynairship is shown in patent Figure 3.

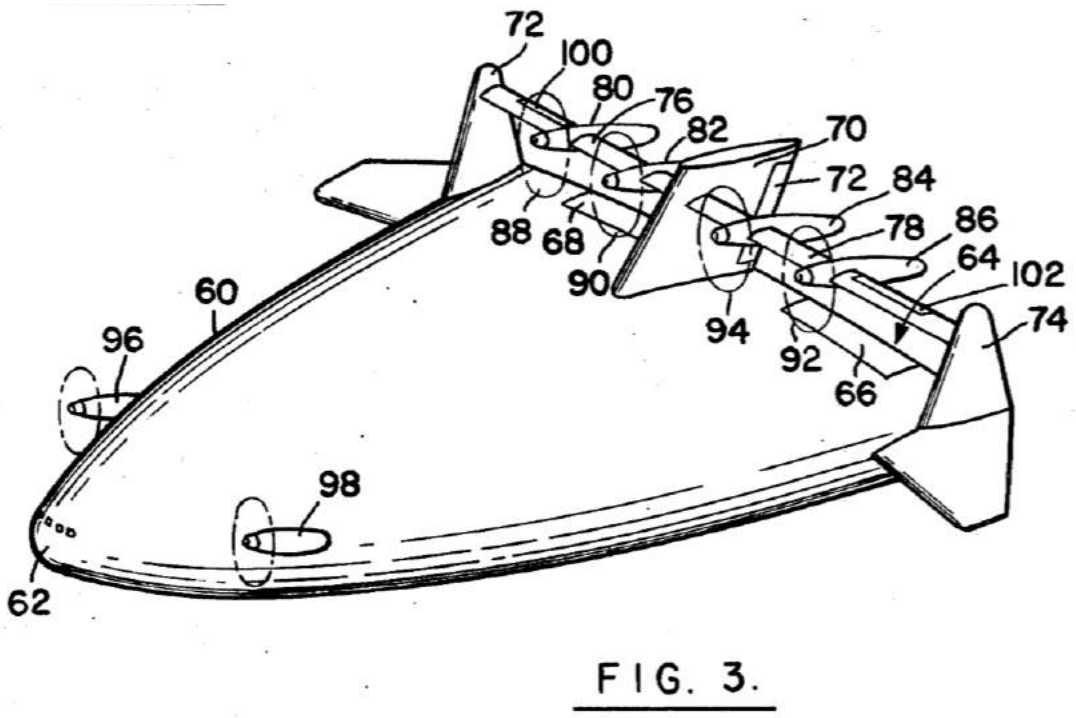


FIG. 3.

This large Dynairship is shown in cruise flight. The trailing edge flaps on the deltoid lifting body fuselage (66 & 68) are located below the airfoil-shaped main engine supports (76 & 78). For jetflap operation, the engine supports rotate all the main engines up so the slipstream from the propellers is directed down toward the leading edges of flaps (66 & 68), which are deflected down to generate high lift. The forward engines (96 & 98) also are tilted upward to generate high lift.

Application of jetflaps for small Dynairships are shown in patent Figures 1 and 2 and the following graphic

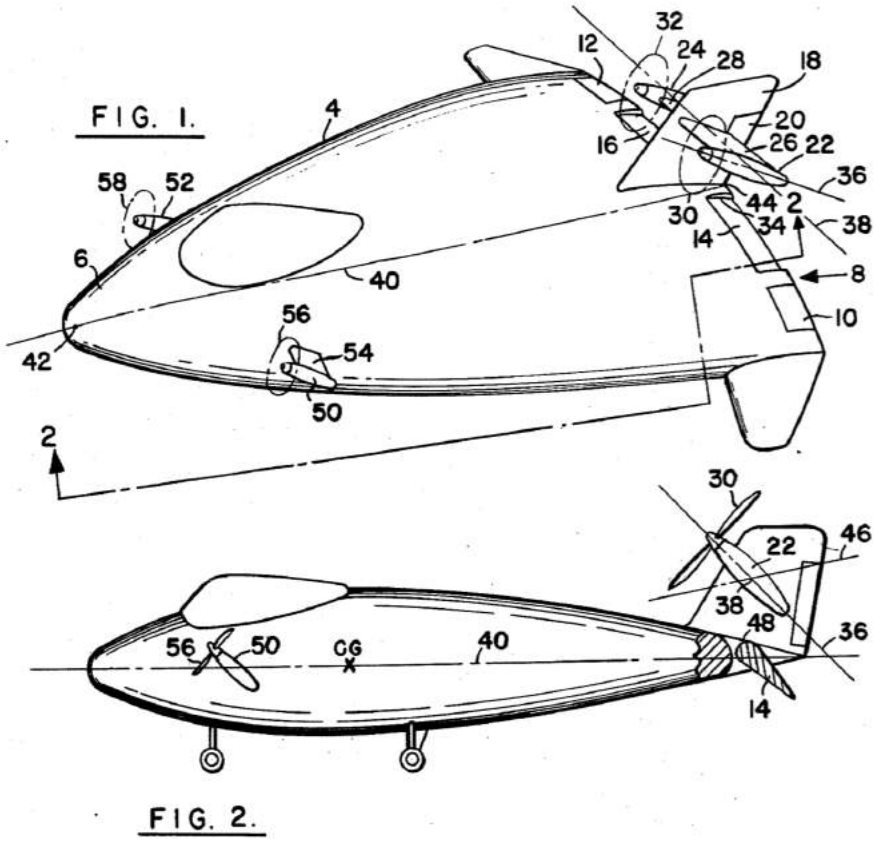


FIG. 2.

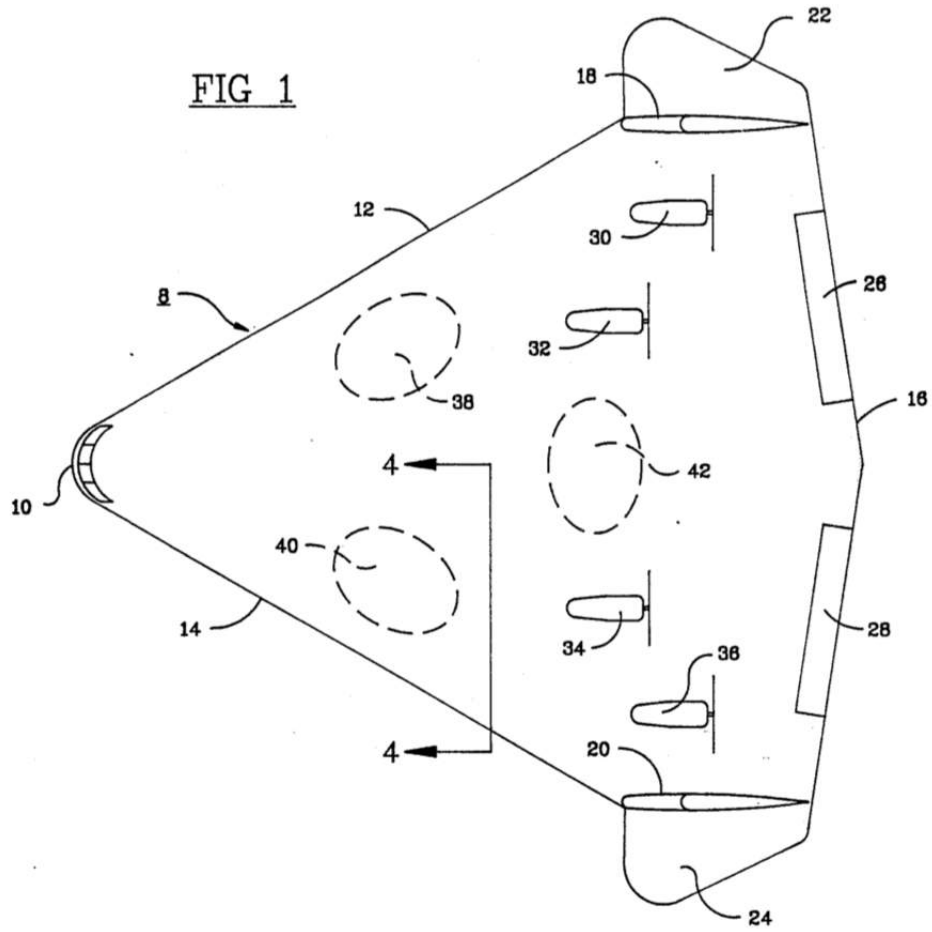
The V/STOL jetflap Dynairship concept known as the Aer/lighter, showing all engines rotated up and the jetflaps at the aerobody trailing edge deflected down for high lift. Circa 1975. Source: Aereon

8. Heavier-than-air Dynairships

Aereon Corporation proposed versions of the Dynairship that, like the Aereon 26, lacked lifting gas and operated as heavier-than-air aircraft at all times. Following are two Aereon patents for heavier-than-air large Dynairships configured as radar surveillance platforms. None were built.

Patent US 4,896,160A, "Airborne surveillance platform,"

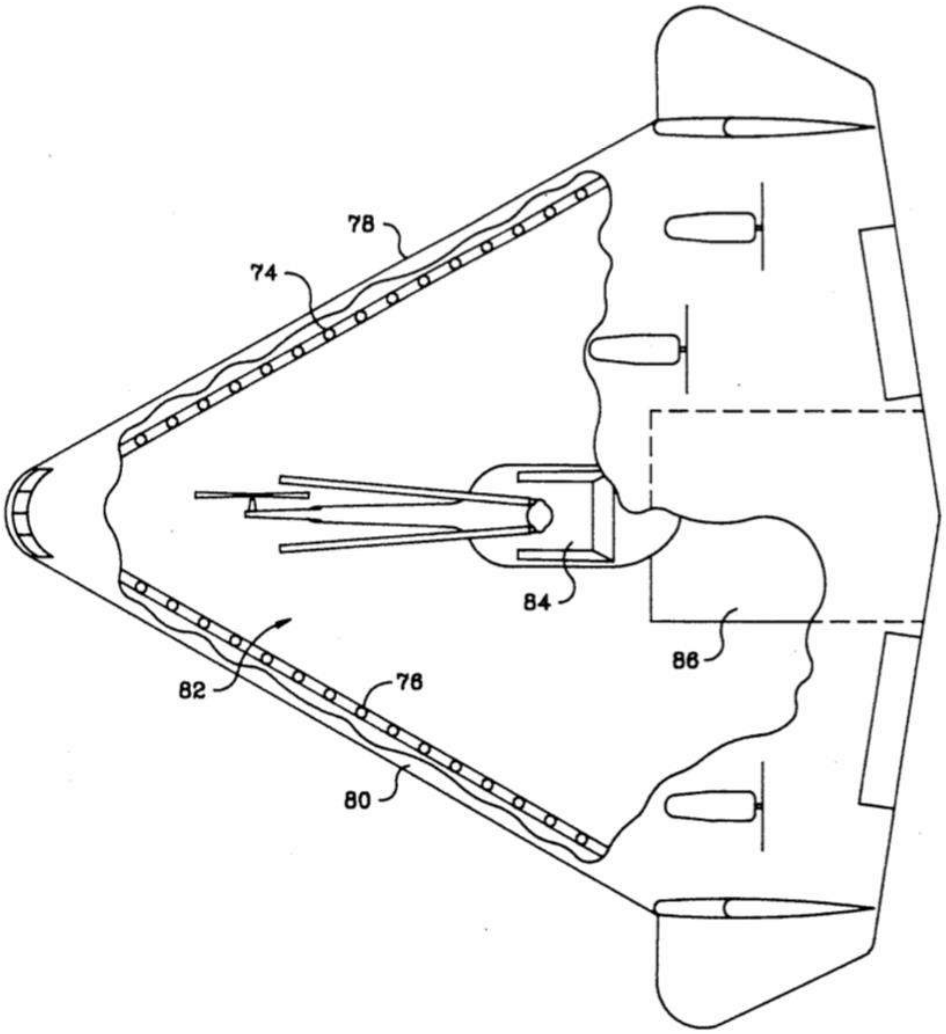
This patent, granted 23 Jan 1990, describes a heavier-than-air airborne surveillance platform with long endurance and a high altitude flight capability. Patent Figures 1 shows how planar phased array antennas (38, 40, 42) can be arranged to scan in a continuous pattern in all azimuthal directions from within the deltoid hull. You can read this patent here:
https://patents.google.com/patent/US4896160A/en



Patent US 5,034,751, "Airborne surveillance platform,"

This patent, granted 23 Jul 1991, presents further refinements to the airborne surveillance platforms described in patent US 4,896,160A, including a dual-role surveillance platform / cargo airplane. The surveillance platform uses linear phased arrays (74, 76) in the wing leading edges, leaving the interior volume free for handling cargo. Patent Figure 12 shows an internal cargo space with a helicopter (84) stowed between the arrays, and a cargo access door (86) built into the trailing edge of the deltoid hull. You can read this patent here: https://patents.google.com/patent/US5034751

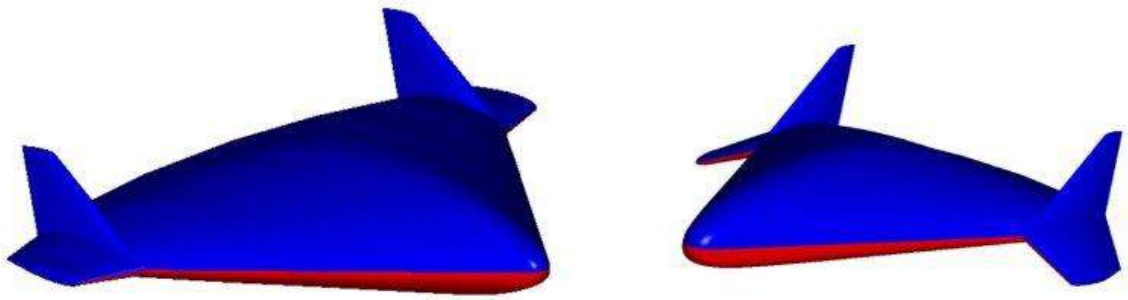
FIG 12



9. Dynairship II – the final designs by Aereon

On their archived website, Aereon presented their final concepts for an ultra-large airlifter, known as the Dynairship II.

> "The current U.S. military reawakening of interest in very large hybrid aircraft concept shows the validity of AEREON's DYNAIRSHIP II. Utilizing both buoyant and aerodynamic lift, DYNAIRSHIP II is the newest variant of AEREON's "lifting-body airship" concepts. Based upon a configuration AEREON's researched in the 1980's, DYNAIRSHIP II is a manned (or unmanned) aircraft concept that will allow the transportation of very large cargo weight and volume over great distances for military and commercial logistics."



Dynairship II lifting body airship design concepts.
Source: Aereon

The firm ceased operation in the mid 2000s, primarily due to the lack of external funding.

10. For more information

- William McElwee Miller, Jr., "*The Dynairship*," Proceedings of the Interagency Workshop on Lighter than Air Vehicles, NASA-CR-137800, pp. 441 – 455, Doc ID 19760007965, 1 January 1975: https://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/19760007965.pdf

- John McPhee, "*The Deltoid Pumpkinseed*," Farrar, Straus and Giroux, New York, ISBN-13: 978-0374137816, 9 July 1973 (also available in Kindle)
- Bill Allen, "Big Boom in Gas Bags," Popular Mechanics, July 1977, page 65: https://books.google.com/books?id=tOIDAAAAMBAJ&printsec=frontcover&source=gbs_ge_summary_r&cad=0#v=onepage&q&f=false
- "Aereon Dynairship Aircraft Projects (USA)," TopWar, 2 October 2019: https://en.topwar.ru/163086-proekty-letatelnyh-apparatov-aereon-dynairship-ssha.html

Other Aereon patents

- Patent US5931411A, "Hovering aircraft," filed 16 December 1997, granted 3 August 1999: https://patents.google.com/patent/US5931411A/en?oq=5931411
- Patent US6179248B1, "Aircraft," filed 4 November 1999, granted 30 January 2001: https://patents.google.com/patent/US6179248B1/en?oq=6179248
- Patent US2010/0252674A1, "Reducing runway requirement for aircraft," filed 16 January 2007, granted 16 August 2011: https://patents.google.com/patent/US20100252674A1/en?oq=20100252674
- Patent US7997528B2, "Reducing runway requirement for aircraft," filed 16 January 2007, granted 16 August 2011: https://patents.google.com/patent/US7997528B2/en?oq=US7997528B2

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/