TECHNICAL — Eternaus Super-Rigid Aerostatic Architecture

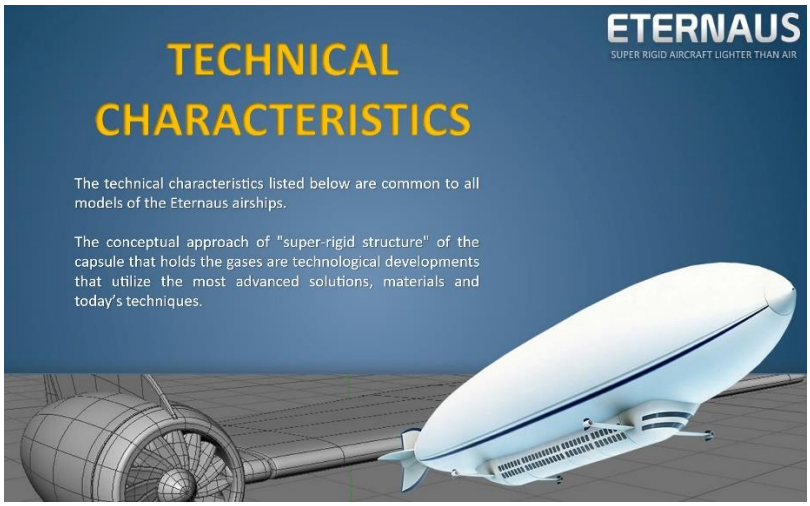
For aerospace entrepreneurs, operators, and premium clients

1. **Initial Considerations**

By applying a new structural concept and an innovative construction method, the Eternaus project introduces a new class of large-scale, safe, environmentally efficient, and highly versatile aerostatic aircraft. These platforms float smoothly in the atmosphere, transporting heavy cargo and passengers with exceptional stability and minimal energy consumption.

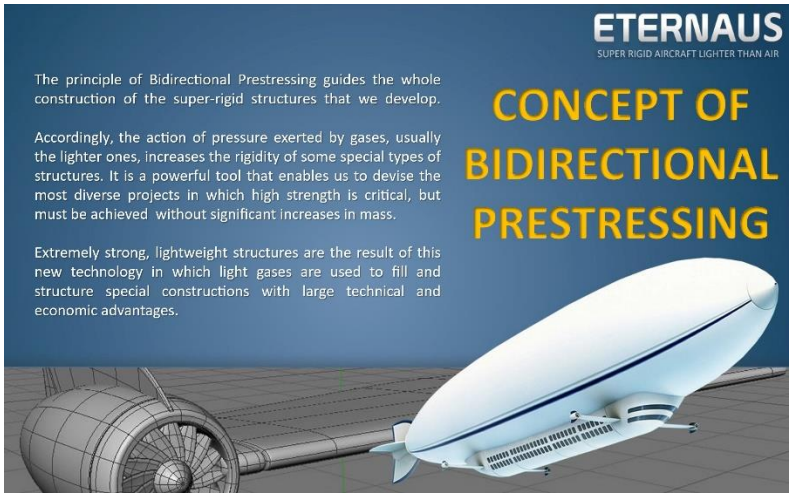
The objective is to deliver a new machine, a new technology, and a new tool capable of transforming logistics, engineering, extraction, tourism, and environmental operations worldwide.

2. Technical Characteristics



The following characteristics are common to all Eternaus models. They derive from the “super-rigid structure” concept, which combines rigid aerospace materials with active internal pressurization and bidirectional prestressing.

2.1 Concept of Bidirectional Prestressing



The principle of **Bidirectional Prestressing** guides the entire structural philosophy of the Eternaus system.

Internal pressure acts simultaneously in the **radial** and **longitudinal** directions, tensioning the hull and the internal framework. This produces:

- high specific stiffness
- uniform stress distribution
- minimal deformation under aerodynamic loads
- exceptional resistance to turbulence and extreme winds

Pressurized Internal Framework (2 kg/cm^2)

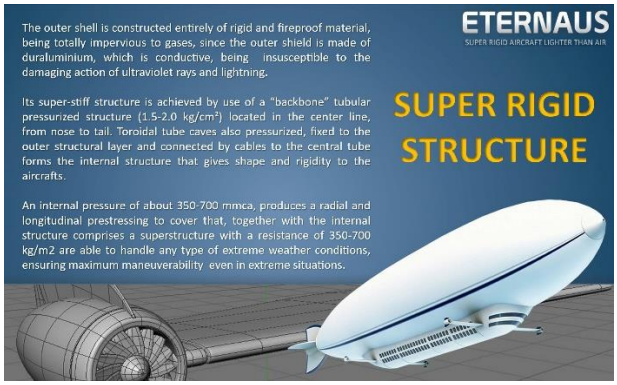
Both the **central backbone tube** and the **toroidal structural rings** operate under internal pressure of approximately **2 kg/cm^2 (≈2 bar)**. This ensures that:

- all internal members remain permanently tensioned
- propulsion forces are transmitted exclusively through tension
- compression, bending, and torsion cycles are eliminated
- structural fatigue is drastically reduced
- dimensional stability is preserved even if the main hull pressure (350–700 mmca) is partially lost

This dual-pressurized system elevates the aircraft from a rigid lighter-than-air vehicle to a **super-rigid aerostatic structure**.

Without this internal pressurization, the aircraft could still fly at reduced speeds (≈70–140 km/h), but would no longer benefit from the tensile-dominant regim

2.2 Super-Rigid Pressurized Structure



The external shell is built from rigid, fireproof duralumin and carbon-fiber composites, fully impermeable to gases and resistant to UV radiation and lightning.

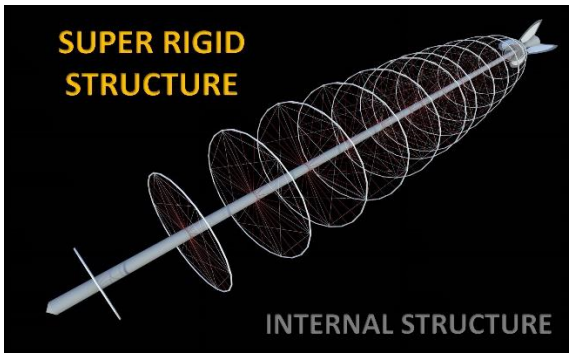
The super-rigid behavior results from the combination of:

- **backbone tube pressurized at 2 kg/cm^2**
- **toroidal rings pressurized at 2 kg/cm^2**
- **hull pressurization at 350–700 mmca**

Together, these elements create a structure capable of resisting **350–700 kg/m^2**, enabling safe operation in severe weather.

2.3 Internal Structural System

A) Central Backbone Tube



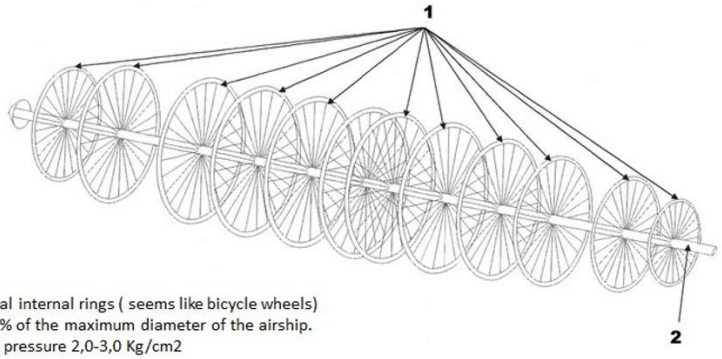
A longitudinal pressurized tube runs from nose to tail, functioning as:

- the primary longitudinal reinforcement
- the structural path for propulsion forces
- a load distributor for aerodynamic and pressurization forces

Its internal pressure (2 kg/cm^2) keeps it permanently prestressed, allowing it to transmit all thrust loads purely through tension.

B) Toroidal Structural Rings

FIGURA 1



Structural internal rings (seems like bicycle wheels)
Ø = 1-2 % of the maximum diameter of the airship.
Internal pressure 2,0-3,0 Kg/cm2
2-Central tube
Ø =2-4% of the maximum diameter of the airship

INTERNAL STRUCTURE

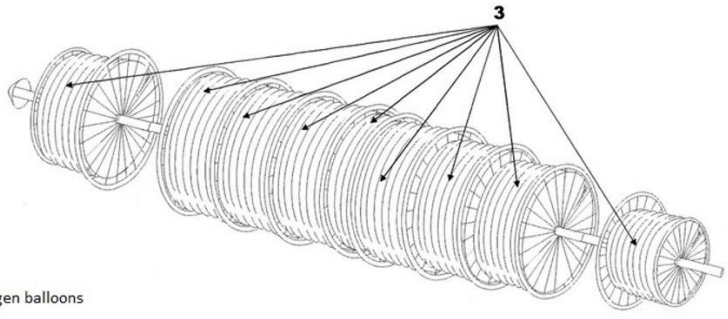
Pressurized toroidal rings (2 kg/cm^2), with diameters equal to 1–2% of the aircraft's maximum diameter, are connected to the central tube by structural cables.

They:

- define the hull geometry
- ensure radial stiffness
- maintain shape even under partial depressurization

C) Hydrogen Lift Cells

FIGURA 2



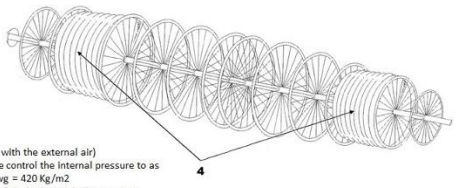
3.- Hydrogen balloons

INTERNAL STRUCTURE

Hydrogen cells provide primary buoyancy

D) Air Ballonets

FIGURA 3



4-Ballonets (filled with the external air)
One special device control the internal pressure to as example 420 mmwg = 420 Kg/m2
With the heating of the hydrogen balloons, air is expelled out of the ballonets and the airship climbs
With the cooling of the hydrogen balloons, air is admitted inside of the ballonets and the airship descends

INTERNAL STRUCTURE

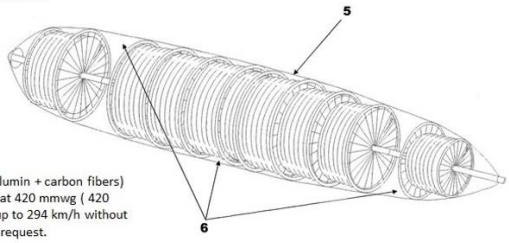
Ballonets filled with external air regulate:

- internal pressure
- fine altitude control
- buoyancy adjustments

Heating hydrogen expels air from ballonets (climb). Cooling hydrogen admits air (descent).

E) Safety Layer

FIGURA 4



5- external structural hull (duralumin + carbon fibers) With the internal pressure kept at 420 mmwg (420 kg/mm2) it can Support winds up to 294 km/h without any damage or any mechanical request.

6- a mixture of Helium and Halon in the space between the hydrogen balloons, ballonets and the structural outside hull (5% of the volume of the airship) give us a total security and incombustibility of the hydrogen balloons and the external duralumin structure gives a guarantee against lightning's and electrical discharges and protects the structure against UV rays

INTERNAL STRUCTURE

A peripheral buffer containing a **helium + halon mixture** (≈5% of total volume) provides:

- fire-barrier protection
- hydrogen ignition isolation
- thermal stability
- UV and lightning shielding

2.4 Vertical Construction Technique

The Eternaus construction method uses buoyancy to lift each concentric segment as it is sealed and pre-pressurized. The two halves are joined in the air, eliminating the need for giant hangars and enabling aircraft of virtually unlimited size.

2.5 Accessories

A) Wings

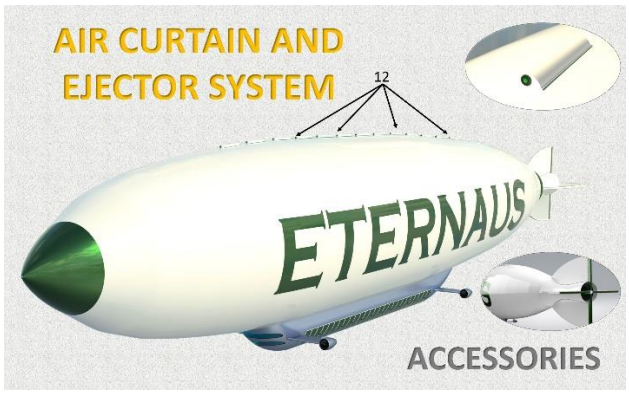
Rigid wings with multidirectional turboprops provide:

- precise hover control
- directional stability
- intuitive handling for airplane/helicopter pilots

B) Air Curtains

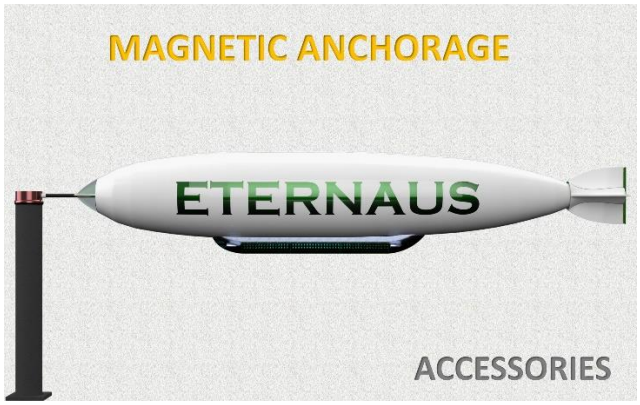
High-velocity air jets (28–42 m/s) sweep the upper surface, removing rainwater and generating supplemental lift.

C) Rear Ejector (Ducted Fan)



A high-flow ducted fan induces airflow, reducing parasitic drag and improving propulsion efficiency.

D) Magnetic Anchorage

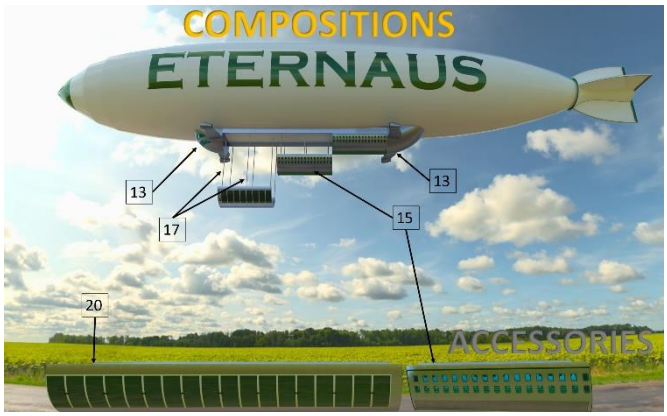


A frontal magnetic docking system enables rapid mooring without ground crews.

E) Heat Exchangers

Thermal control of hydrogen cells allows buoyancy adjustments without ballast.

3. Compositions (Modular Payload System)



Eternaus aircraft use modular compositions similar to rail systems:

- passenger modules
- cargo modules
- mission modules
- fixed front and rear command cabins

Modules move vertically like an elevator, allowing loading/unloading without landing.

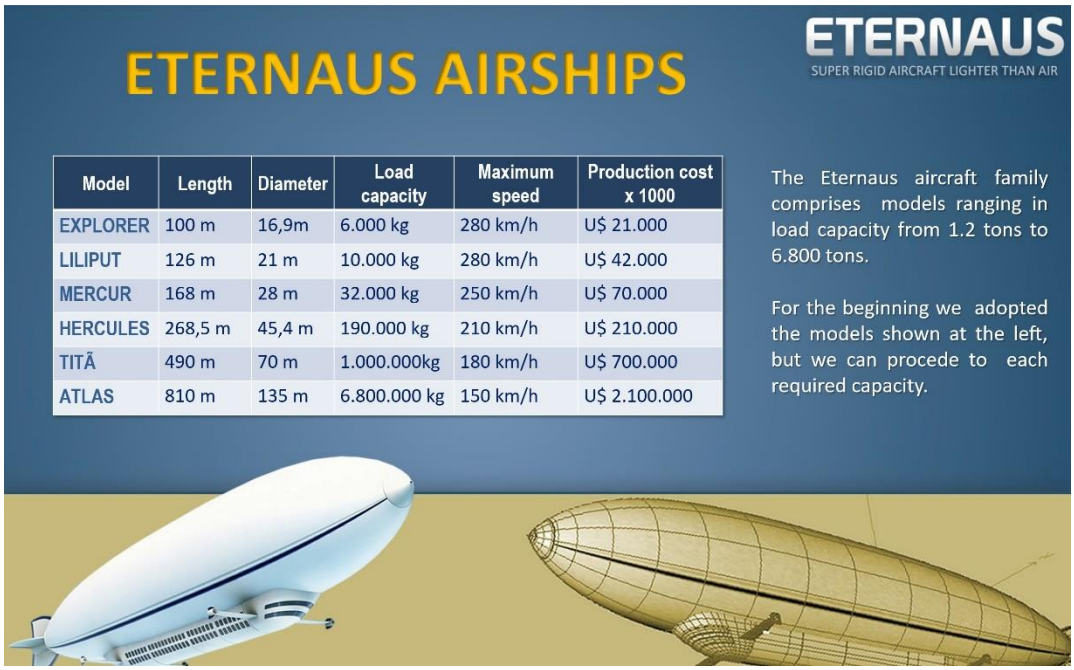
4. Autopilot and Navigation

A redundant system combining:

- differential GPS
- gyroscopes
- laser leveling
- dual command-cabin sensors

ensures stable flight even in adverse conditions.

5. Aircraft Models



Model	Length	Diameter	Load capacity	Maximum speed	Production cost x 1000
EXPLORER	100 m	16,9m	6.000 kg	280 km/h	U$ 21.000
LILIPUT	126 m	21 m	10.000 kg	280 km/h	U$ 42.000
MERCUR	168 m	28 m	32.000 kg	250 km/h	U$ 70.000
HERCULES	268,5 m	45,4 m	190.000 kg	210 km/h	U$ 210.000
TITÃ	490 m	70 m	1.000.000kg	180 km/h	U$ 700.000
ATLAS	810 m	135 m	6.800.000 kg	150 km/h	U$ 2.100.000

The Eternaus family ranges from 1.2 to 6,800 tons of payload capacity.

PATENTS — Eternaus Super-Rigid Aerostatic Architecture

International Intellectual Property Portfolio

The Eternaus system is protected by a comprehensive international patent portfolio covering its structural concept, construction method, and operational innovations. These patents secure the exclusivity of the **super-rigid, continuously self-sustained aerostatic aircraft**, ensuring global protection for the core technologies that differentiate the Eternaus platform from all conventional lighter-than-air vehicles.

The portfolio includes granted international patents nationalized in the **United States**, **Russia**, **China, GB, Germany** and **Brazil**, with priority rights dating from **June 7, 2010**.

- United States Patent
- Russian Patent
- Chinese Patent
- Brazilian Patent

The United States of America

The Director of the United States Patent and Trademark Office

Has received an application for a patent for a new and useful invention. The title and description of the invention are enclosed. The requirements of law have been complied with, and it has been determined that a patent on the invention shall be granted under the law.

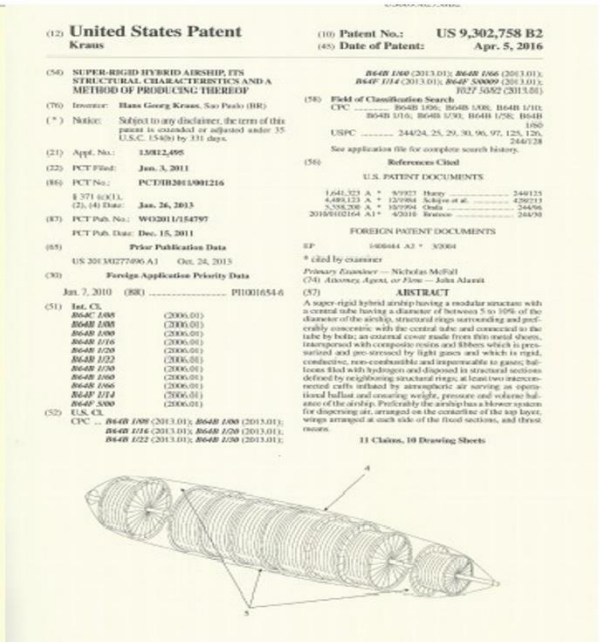
Therefore, this

United States Patent

Grants to the person(s) having title to this patent the right to exclude others from making, using, offering for sale, or selling the invention throughout the United States of America or importing the invention into the United States of America, and if the invention is a process, of the right to exclude others from using, offering for sale or selling throughout the United States of America, or importing into the United States of America, products made by that process, for the term set forth in 35 U.S.C. 154(a)(2) or (c)(1), subject to the payment of maintenance fees as provided by 35 U.S.C. 41(b). See the Maintenance Fee Notice on the inside of the cover.

Michelle K. Lee

Director of the United States Patent and Trademark Office



(12) **United States Patent**
Kraus

(10) **Patent No.: US 9,302,758 B2**
(45) **Date of Patent: Apr. 5, 2016**

(54) SUPER-RIGID HYBRID AIRSHIP, ITS STRUCTURAL CHARACTERISTICS AND A METHOD OF PRODUCING THEREOF

(76) Inventor: Hans Georg Kraus, Sao Paulo (BR)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 331 days.

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(22) PCT Filed: Jun. 3, 2011

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(58) **Field of Classification Search**
CPC B64B 1/06; B64B 1/00; B64B 1/10; B64B 1/16; B64B 1/30; B64B 1/58; B64B 1/60
USPC 244/24, 25, 29, 30, 96, 97, 125, 126, 244/128
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

1,641,323 A * 9/1927 Thery 244/125
4,489,123 A * 12/1984 Schjive et al. 428/213
5,358,208 A * 10/1994 Ondo 244/96
2010/0102164 A1 * 4/2010 Brenner 244/30

FOREIGN PATENT DOCUMENTS

EP 1408044 A2 * 3/2004

* cited by examiner

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(74) *Attorney, Agent, or Firm* — John Alarcon

(57) **ABSTRACT**

A super-rigid hybrid airship having a modular structure with a central tube having a diameter of between 5 to 10% of the diameter of the airship, structural rings surrounding and preferably concentric with the central tube and connected to the tube by bolts; an external cover made from thin metal sheets, interspersed with composite resins and fibbers which is pressurized and pre-stressed by light gases and which is rigid, conductive, non-combustible and impermeable to gases; ballonets filled with hydrogen and disposed in structural sections defined by neighboring structural rings, at least two interconnected cells inflated by atmospheric air serving as operational ballast and ensuring weight, pressure and volume balance of the airship. Preferably the airship has a blower system for dispersing air, arranged on the centerline of the top layer, wings arranged at each side of the fixed sections, and thrust means.

11 Claims, 10 Drawing Sheets

ПАТЕНТ

НА ИЗОБРЕТЕНИЕ

№ 2541587

СВЕРХЖЕСТКИЙ КОМБИНИРОВАННЫЙ АЭРОСТАТИЧЕСКИЙ ЛЕТАТЕЛЬНЫЙ АППАРАТ И СПОСОБ ЕГО ИЗГОТОВЛЕНИЯ

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Срок действия патента истекает **03 июня 2031 г.**

Врио руководителя Федеральной службы по интеллектуальной собственности *Л.Л. Кирий*

РОССИЙСКАЯ ФЕДЕРАЦИЯ

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(51) МПК *B64B 1/06* (2006.01)

ФЕДЕРАЛЬНАЯ СЛУЖБА ПО ИНТЕЛЛЕКТУАЛЬНОЙ СОБСТВЕННОСТИ

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RU 2541587 C2

(54) **СВЕРХЖЕСТКИЙ КОМБИНИРОВАННЫЙ АЭРОСТАТИЧЕСКИЙ ЛЕТАТЕЛЬНЫЙ АППАРАТ И СПОСОБ ЕГО ИЗГОТОВЛЕНИЯ**

(57) Реферат:

Аэростатический летательный аппарат модульной конструкции включает центральную трубу (1) диаметром от 5 до 10% диаметра летательного аппарата, аппендиксы (2), окружающие центральную трубу и концентричные ей и прикрепленные к ней штагами (3), наружную обшивку (4) из тонких листов металла с прослойками из композиционных смол и волокон, которые находятся под давлением и предварительно напряжены легким газом и которые являются жесткими, электропроводящими, непроницаемыми для газов, баллоны (6), заполненные водородом и расположенные в сквозных конструкциях, определяемых соседними аппендиксами (2), соединенные друг с другом манжеты (7), надутые атмосферным воздухом, выполняющим функцию рабочего балласта, обеспечивающего баланс дирижабля по массе, давлению и объему. Изобретение направлено на упрощение поддержания положения летательного аппарата при остановке и приземлении. 2 н. и 12 з.п. ф-лы, 11 ил.

发明专利证书

Certificate of Invention Patent

中华人民共和国国家知识产权局

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07/06/2010

PI1001654-6

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DEPÓSITO DE PEDIDO DE PATENTE OU DE CERTIFICADO DE ADIÇÃO

Ao Instituto Nacional da Propriedade Industrial:
O requerente solicita a concessão de um privilégio na natureza e nas condições abaixo indicadas:

1. Depositante (71):

1.1 Nome: HANS GEORG KRAUS
1.2 Qualificação:
1.3 CNPJ/CPF: 694.006.958-53
1.4 Endereço completo: AV. WASHINGTON LUIS, 1576 - APTO. 72 - EDIFICIO JEQUITIBÁ SANTO
1.5 CEP: 04662-002 1.6 Telefone: 1.7 Fax:
1.8 E-mail: JCARLOS@MARTHOM.ADV.BR
☐ continua em folha anexa

2. Natureza: ◉ Invenção ○ Modelo de Utilidade ○ Certificado de Adição

Escreva, obrigatoriamente, e por extenso, a Natureza desejada: PATENTE DE INVENÇÃO.

3. Título da Invenção ou Modelo de Utilidade ou Certificado de Adição (54):

"AERONAVE SUPER-RÍGIDA CONTINUAMENTE AUTO-SUSTENTÁVEL, SUAS CARACTERÍSTICAS ESTRUTURAIS E SEU PROCESSO CONSTRUTIVO".

☐ continua em folha anexa

4. Pedido de Divisão: do pedido Nº: Data do Depósito:

5. Prioridade: ○ interna ○ unionista

O depositante reivindica a(s) seguinte(s):

País ou organização de origem	Número do depósito	Data do depósito

6. Inventor (72):

☐ Assinale aqui se o(s) mesmo(s) requer(em) a não divulgação de seu(s) nome(s)

6.1 Nome: HANS GEORG KRAUS
6.2 Qualificação: ENGENHEIRO 6.3 CPF: 694.006.958-53
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6.8 E-mail: JCarlos@marthom.adv.br
☐ continua em folha anexa

INPI Formulário 1.01 - Depósito de Pedido de Patente ou de Certificado de Adição (folha 1/2)

The Eternaus super-rigid aerostatic architecture is protected by an international patent portfolio.

The following section presents the complete technical data sheets and strategic applications of the five Eternaus models.

Each datasheet follows international aerospace standards and provides the structural, operational, and mission-specific parameters required for engineering and commercial evaluation.