



Fundamentals of Intellectual Property Protection

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Aerospace Engineering

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Do You Need Formal Protection?

1. Do you and/or the company you will work for want a competitive advantage?
2. Do you and/or the company you will work for want to make money?
3. Do you and/or the agency you will work for want to preserve the taxpayer's rights to royalty free use of Government funded products?



If you answered “yes” or “probably someday” to #1 or #2 → Stick around...
Here’s what you need to know.





Maintenance and protection of IP Rights can give you the competitive advantage and/or funding that you want/need.



Failure to Protect has Consequences

- Funding issues
- Others may beat you to market





Types of Intellectual Property Protection

1. Trade Secrets – company secrets
2. Patents – new, useful inventions; designs
3. Copyrights – original expressions fixed in a tangible medium
4. Trademarks – distinguish source of goods
5. Service Marks – distinguish source of services





®

Has it All!





Trade Secrets



Any formula, pattern, device or compilation of information which is used in a person's business, and which gives the person an opportunity to obtain an advantage over competitors who do not know or use it.





Trade Secrets



- Relevant Factors
 - Publication → Go to patents
 - Extent secret is known inside the company
 - Measures taken to ensure secrecy
 - Value of information to company and its competitors
 - Time, effort put into developing information
 - Ease of discovery or reverse engineering





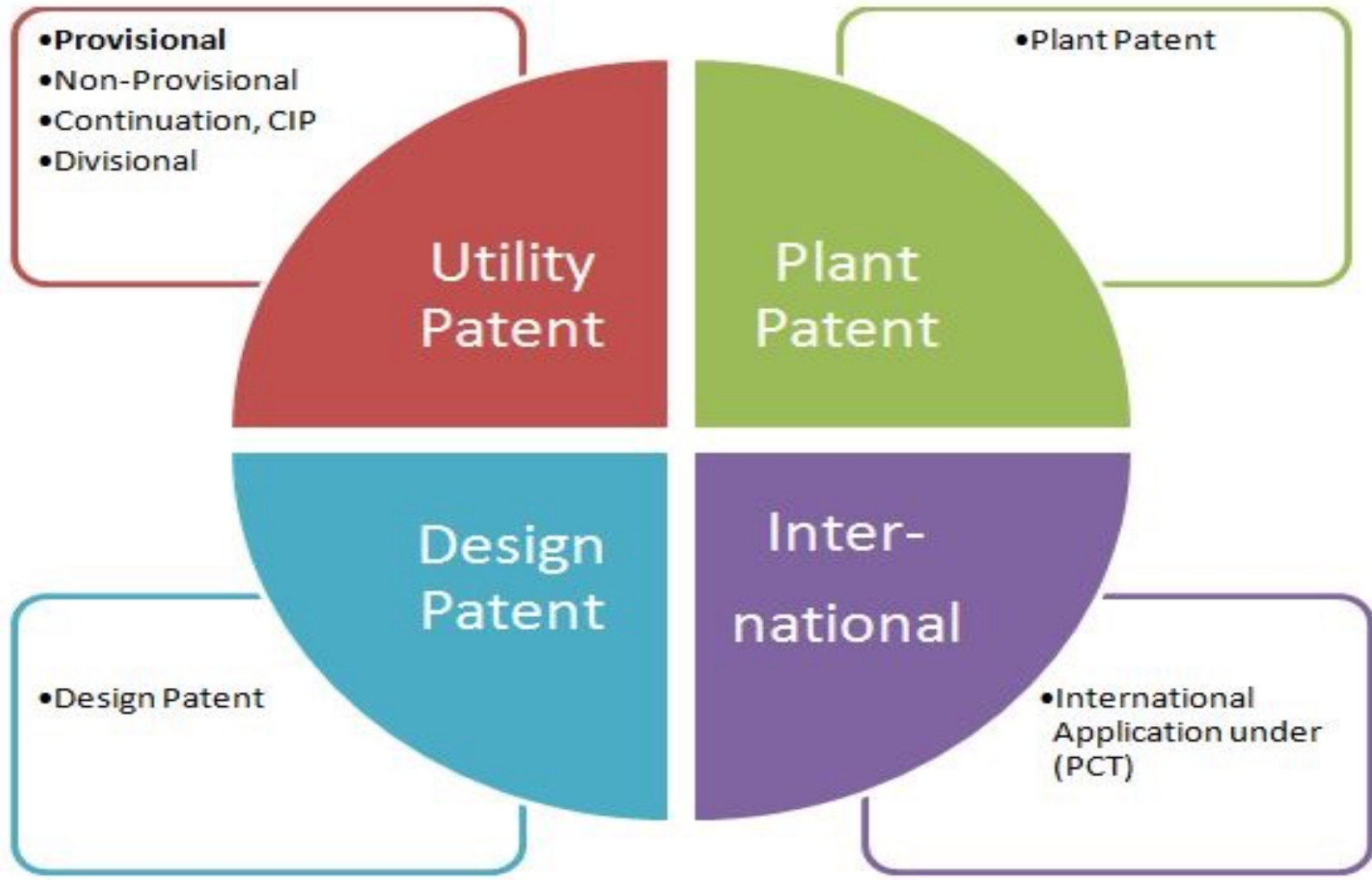
Patents



- A patent provides the exclusive right to exclude others from making, using, selling, offering to sell and importing the invention
- No right to practice invention → the “chair”
- Standard → New, useful, non-obvious
- It is a legal monopoly for a certain time in exchange for full disclosure
- As opposed to trade secrets → No disclosure; indefinite period of protection (e.g., Coca Cola[®] formula, Heinz[®] ketchup formula)



Patents *(cont'd)*



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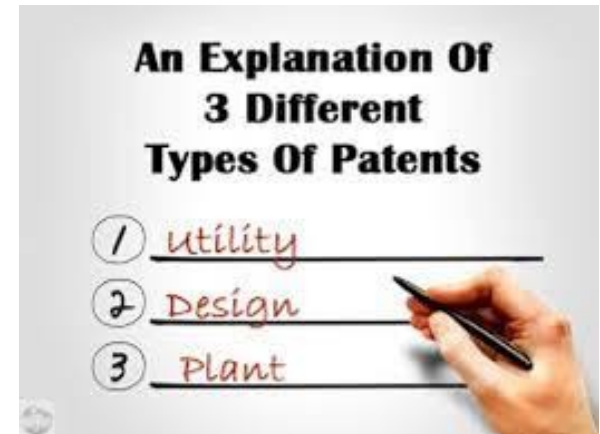




Patents *(cont'd)*

- Types of Patents
 - Utility

- Granted for inventions that perform some utility, including processes, machines, articles of manufacture, compositions of matter and improvements on any one of these
- The basic patent term is 20 years from the filing date of the application

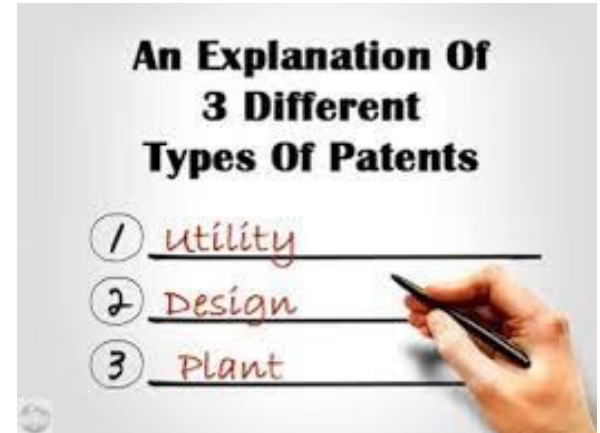




Patents *(cont'd)*

■ Types of Patents

- Design
 - Focuses on the aesthetics vs. functionality
 - 14-year term
- Provisional
 - patent “place-holder”
 - one-year protection
 - defend against disclosures
 - economical





Patents *(cont'd)*

What Can be Patented?

- Today, almost everything
- Life Forms
- Chemical formulations
- Manufacturing process
- Products
- Computer programs
- Methods of doing business
e.g., *Amazon v. Barnes and Noble*





4 LEGAL REQUIREMENTS TO GET A PATENT

Is your invention Useful?



Utility Requirement

1

Is your invention a


- 1. Machine
- 2. Process
- 3. manufacture
- 4. Composition of matter?



Eligibility Requirement

2


Is your invention New?



Novelty Requirement

3

Is your invention Obvious?



Nonobviousness Requirement

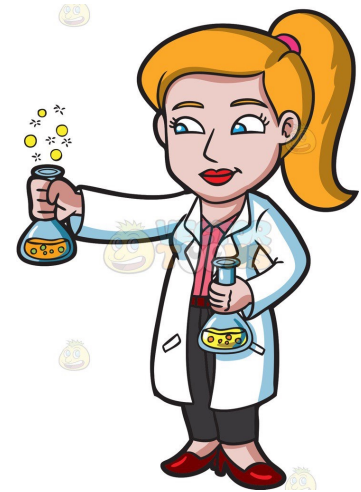
4

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Patents *(cont'd)*



- Who Is An Inventor?
 - A person who participates in the conception of an invention
- What Is An Invention?
 - Conception
 - Reduction to practice
- Consequences of failing to name all inventors



Patents *(cont'd)*



When to File:

- United States
 - One year from publication, sale or offer to sell
- Foreign
 - Before any public disclosure
- e.g., Inventor's own poster/abstract precluded patent protection





Patents (*cont'd*)



Prior Agreements/Policies

- May restrict your rights in your invention
e.g., *Fenn v. Yale* – Professor does not inform Yale of discovery in violation of policy; Yale owns patent



Copyrights

What is it?



- Copyright protection protects the expression of an idea, not the idea itself
- The types of works for which copyright protection is available are extremely varied
 - e.g., books, photographs, sound recordings, paintings, sculptures, drawings, software, websites





Copyrights *(cont'd)*



Scope of Rights:

- A copyright gives the owner of the work the exclusive right to copy, reproduce, distribute, publish, perform or display the work.
- The owner of the copyright also has the exclusive rights to so-called “derivative works” of the original work.





Copyrights *(cont'd)*



Term of Rights:

- Generally life of author + 70 years
- As to the ownership of rights, copyright vests initially in the author(s) of the work.
 - In the case of a “work made for hire,” the employer or other person for whom the work was prepared is the author and owner of all rights.



Copyrights *(cont'd)*



Be Aware:

- In employer/employee relationship, “work made for hire” status is presumed
- Outside employer/employee relationship, it is not presumed





Copyrights *(cont'd)*



Why Do I Care?

- The Materials/Works you use
- Owning Materials/Works created for you
- Protecting your Materials/Works





Trademarks



What is it?

- Identifies the source of one seller's products or services and distinguishes that source from other sources
- Trademark (TM) for goods/service mark (SM) for services
- Can be a word, symbol, logo, design, sound, scent, color, domain name, etc.
 - Just about anything that identifies a seller with its goods or services can be a trademark!



Trademarks *(cont'd)*



Who grants the rights?

- Trademark rights are acquired through actual use in interstate commerce and are not governmentally created
- You can file an application based only upon a bona fide intent to use a mark, without actual use





Trademarks *(cont'd)*



Term of Rights:

- Ten years from the date of registration
- Trademark or service mark registration can be renewed indefinitely as long as the mark is used and not abandoned or does not become generic





Trademarks (cont'd)



Why Do I Care?

- Brand identity/equity = \$\$
 - Business name – McDonald's®
 - Product names – Coca Cola®, BMW®, Bayer®
 - Slogans – “Where’s the Beef?”®
“Greatest Show on Earth®”
 - Shapes – Coca-Cola® bottle

IP Policies on KU Campus



- If invented for class = student's property
- For KU sponsored research:
 - <\$10k/yr = inventors
 - >\$10k/yr = owned by KU
- If KU facilities are used, and unsponsored, rights to IP must be negotiated
- If KU admin. is not interested, then inventor may patent
- If invention is made off University time, property etc., then it is owned by inventor, if student. If KU employee... then... it's complicated...
- Royalty split: 1/3 Inventor(s), 1/3 Inventor's Unit, 1/3 Administration



United States Patent [19]

Zaleski

[11] 3,771,192

[45] Nov. 13, 1973

[54] **COMBINATION TOY DOG AND VACUUM CLEANER** 2,421,958 6/1947 Moretti..... 46/116 UX
 FOREIGN PATENTS OR APPLICATIONS
 [76] Inventor: Anne Margaret Zaleski, 314 57th St., Pittsburgh, Pa. 15201 387,061 2/1933 Great Britain..... 118/268
 355,905 9/1961 Switzerland..... 15/323

[122] Filed: Mar. 16, 1972
 [21] Appl. No.: 235,290

Related U.S. Application Data
 [63] Continuation-in-part of Ser. No. 8,963, Feb. 5, 1970, abandoned.

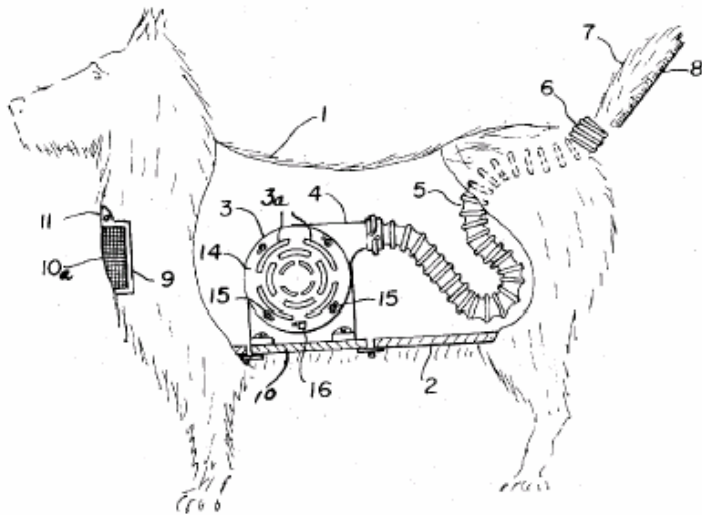
[52] U.S. Cl. 15/330, 46/116
 [51] Int. Cl. A47I 5/12
 [58] Field of Search 46/116; 15/257, 323, 15/327 D, 327 E, 328, 330, 335

[56] **References Cited**
UNITED STATES PATENTS
 2,367,437 1/1945 Salt..... 15/323
 3,002,215 10/1961 MacFarland..... 15/328 X

Primary Examiner—Billy J. Wilhite
Assistant Examiner—C. K. Moore
Attorney—William J. Ruano

[57] **ABSTRACT**
 A toy dog closely resembling a real dog and having a hollow interior in which is mounted a vacuum cleaner having a suction hose which is retractable from the tail end of the dog. This enables vacuuming a dog after a hair cut and grooming without causing fear to the dog, inasmuch as the vacuum cleaner noise is greatly muffled by such enclosure. The vacuum cleaner is convertible to a blower and air issuing from the tail end can be heated so as to serve as a dryer.

5 Claims, 5 Drawing Figures



(12) United States Patent Olson

(10) Patent No.: US 6,368,227 B1
 (45) Date of Patent: Apr. 9, 2002

(54) **METHOD OF SWINGING ON A SWING** 5,413,298 A * 5/1995 Perreault 248/228
 (76) Inventor: Steven Olson, 337 Otis Ave., St. Paul, MN (US) 55104 * cited by examiner

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

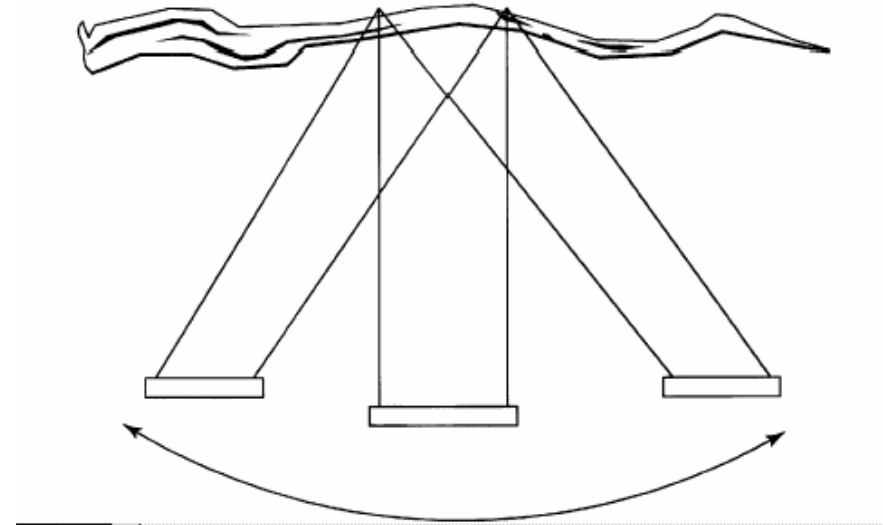
Primary Examiner—Kien T. Nguyen
 (74) *Attorney, Agent, or Firm*—Peter Lowell Olson

(21) Appl. No.: 09/715,198
 (22) Filed: Nov. 17, 2000
 (51) Int. Cl.⁷ A63G 9/00
 (52) U.S. Cl. 472/118
 (58) Field of Search 472/118, 119, 472/120, 121, 122, 123, 125

(57) **ABSTRACT**
 A method of swing on a swing is disclosed, in which a user positioned on a standard swing suspended by two chains from a substantially horizontal tree branch induces side to side motion by pulling alternately on one chain and then the other.

(56) **References Cited**
U.S. PATENT DOCUMENTS
 242,601 A * 6/1881 Clement 472/118

4 Claims, 3 Drawing Sheets



Examples...

United States Patent [19]

Barrett



US005440193A

[11] Patent Number: **5,440,193**

[45] Date of Patent: **Aug. 8, 1995**

[54] METHOD AND APPARATUS FOR STRUCTURAL, ACTUATION AND SENSING IN A DESIRED DIRECTION

4,868,447 9/1989 Lee et al. 310/328
5,331,241 7/1994 Itoh 310/328
5,359,494 10/1994 Morimoto 310/348

[75] Inventor: **Ronald M. Barrett**, Auburn, Ala.

FOREIGN PATENT DOCUMENTS

[73] Assignee: **University of Maryland**, College Park, Md.

1149636 4/1969 United Kingdom 73/767
12953 9/1991 WIPO 156/291

[21] Appl. No.: **43,988**

OTHER PUBLICATIONS

[22] Filed: **Apr. 7, 1993**

IBM Technical Disclosure Bulletin, vol. 14, No. 5, Oct. 1971, 310-328.

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 790,074, Nov. 12, 1991, abandoned, which is a continuation of Ser. No. 485,599, Feb. 27, 1990, abandoned.

Primary Examiner—Steven D. Maki
Attorney, Agent, or Firm—Oblon, Spivak, McClelland, Maier & Neustadt

[51] Int. Cl.⁶ **B29C 65/52; H01L 41/053**

ABSTRACT

[52] U.S. Cl. **340/328; 73/775; 156/291; 310/348**

An apparatus, system and method for actuating or sensing strains in a substrate which includes at least one actuator/sensor element which has transverse and longitudinal axes. The actuator/sensor element is attached to the substrate in such a manner that the stiffness of the actuator/sensor element differs in the transverse and longitudinal axes. In this manner, it is possible to sense or actuate strains in the substrate in a desired direction, regardless of the passive stiffness properties of the substrate, actuator element or sensor element. An isotropic actuator/sensor element attached to a substrate in this manner can then operate in an anisotropic way. In a preferred embodiment, the actuator/sensor element is bonded to the substrate at an area of attachment occupying only the central third of the actuator/sensor element in its longitudinal axis. The actuator/sensor element may be a piezoelectric, magnetostrictive, thermally actuated lamina (including bi-metallic) or shape memory alloy element.

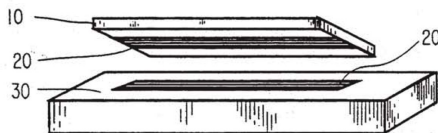
[58] Field of Search **156/291, 293; 310/321, 310/328, 333, 352, 368, 348; 73/767, 768, 775, 777, 779, 802, DIG. 2, DIG. 4; 244/75 R**

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2,558,563 6/1951 Janssen 73/775
2,735,025 2/1956 Wiggins 310/328
2,782,397 2/1957 Young 310/358
2,920,480 1/1960 Haas 73/787
3,136,154 6/1964 Christensen 73/775
3,184,962 5/1965 Gay 73/775
3,401,377 9/1968 Bartlett et al. 310/328
3,462,746 8/1969 Bartlett 310/328
3,786,679 1/1974 Crites 73/775
3,863,250 2/1975 McCluskey 310/328
4,725,020 2/1988 Whitener 244/76 R
4,793,189 12/1988 Dell'Orto et al. 73/775
4,857,791 8/1989 Uchino et al. 310/328

20 Claims, 15 Drawing Sheets



US006502787B1

(12) United States Patent Barrett

(10) Patent No.: **US 6,502,787 B1**
(45) Date of Patent: **Jan. 7, 2003**

(54) CONVERTIBLE VERTICAL TAKE-OFF AND LANDING MINIATURE AERIAL VEHICLE

3,138,349 A * 6/1964 Piasecki 224/230
5,295,643 A * 3/1994 Ebbert et al. 244/12.2
5,516,060 A * 5/1996 McDonnell 244/207
6,082,675 A * 7/2000 Woodall et al. 244/120

(75) Inventor: **Ronald Martin Barrett**, Auburn, AL (US)

* cited by examiner

(73) Assignees: **Micro Autonomous Systems LLC**, Del Mar, CA (US); **Singapore Technologies Dynamics PTE LTD**, Singapore (SG)

Primary Examiner—Robert P. Swiatek
(74) *Attorney, Agent, or Firm*—John L. Rogitz

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(57) ABSTRACT

A vertical take-off and landing miniature aerial vehicle includes an upper fuselage segment and a lower fuselage segment that extend in opposite directions from a rotor guard assembly. A rotor rotates within the rotor guard assembly between the fuselage segments. Plural turning vanes extend from the rotor guard assembly beneath the rotor. Moreover, plural grid fins extend radially from the lower fuselage segment below the turning vanes. The aerial vehicle is capable of taking off and landing vertically. During flight, the aerial vehicle can hover and transition between a horizontal flight mode and a vertical flight mode using the grid fins.

(21) Appl. No.: **10/082,814**
(22) Filed: **Feb. 22, 2002**

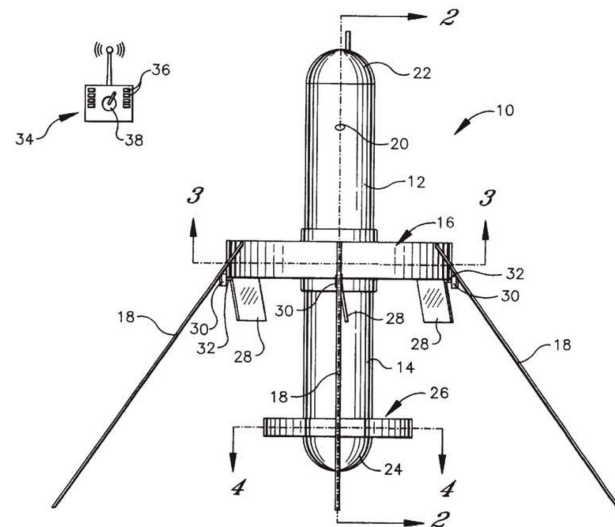
(51) Int. Cl.⁷ **B64C 27/20**
(52) U.S. Cl. **244/23 A; 244/7 B; 244/73 R**
(58) Field of Search **244/7 B, 23 A, 244/23 D, 34 A, 73 R**

(56) References Cited

U.S. PATENT DOCUMENTS

3,065,932 A * 11/1962 Herrmann 244/15

30 Claims, 5 Drawing Sheets





XQ-138 CUAV
\$83k/aircraft

Examples...

(12) **United States Patent**
Barrett et al.

(10) Patent No.: **US 6,796,533 B2**
(45) Date of Patent: **Sep. 28, 2004**

(54) **METHOD AND APPARATUS FOR BOUNDARY LAYER REATTACHMENT USING PIEZOELECTRIC SYNTHETIC JET ACTUATORS**

(75) Inventors: **Ronald M. Barrett, Auburn, AL (US); Christopher Reasonover, Fredericksburg, VA (US); Jeremy Corpening, West Lafayette, IN (US)**

(73) Assignee: **Auburn University, Auburn, AL (US)**

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **10/104,914**

(22) Filed: **Mar. 22, 2002**

(65) **Prior Publication Data**

US 2002/0195526 A1 Dec. 26, 2002

Related U.S. Application Data

(60) Provisional application No. 60/278,790, filed on Mar. 26, 2001.

(51) Int. Cl.⁷ **B64C 21/06**

(52) U.S. Cl. **244/208; 244/207**

(58) Field of Search **244/207, 208, 244/209, 204, 130, 109, 201**

(56) **References Cited**

U.S. PATENT DOCUMENTS

- 1,913,644 A * 6/1933 Stalker
- 2,219,234 A * 10/1940 Messerschmitt
- 3,055,614 A * 9/1962 Thompson
- 4,363,991 A 12/1982 Edelman
- 4,664,345 A * 5/1987 Lurz
- 4,863,118 A * 9/1989 Stallings et al.

- 5,758,823 A 6/1998 Glezer et al.
- 5,957,413 A 9/1999 Glezer et al.
- 5,988,522 A 11/1999 Glezer et al.
- 6,412,732 B1 * 7/2002 Amitay et al.
- 6,425,553 B1 * 7/2002 Smith et al.

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- DE 586496 * 7/1929 244/208
- EP 558904 * 9/1993 244/204
- IT 302531 * 10/1932 244/204

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Barrett, R., Gross, R.S., and Brozowski, E.T., "Design and Testing of a Subsonic All-Moving Smart Flight Control Surface", AIAA Journal, vol. 35, No. 7, pp. 1217-1219 (Jul. 1997).

Barrett, R. Stutts, J., "Modeling, Design and Testing of a Barrel-Launched Adaptive Munition," paper presented at SPIE's 1997 Symposium on Smart Structures and Materials, San Diego, CA, Mar. 3-6, 1997.

Cooper, P., "U.S. Eyes Stealthy, Flexible Airframes," Defense News, May 29, 1995, pp. 1,36 vol. 10, No. 21.

Proctor, P., "New Munition Could Replace Some Missiles," Aviation Week and Space Technology, McGraw-Hill, New York, NY, vol. 146, No. 27, Jun. 30, 1997, p. 49.

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Primary Examiner—Tien Dinh

(74) Attorney, Agent, or Firm—Gardner Groff, P.C.

(57)

ABSTRACT

A method and apparatus for active boundary layer control on an aerodynamic surface. One or more piezoelectric synthetic jet actuators operate as a boundary layer pump to ingest fluid along the surface of an aerodynamic object and discharge fluid tangentially to the fluid flow along the surface and/or at the trailing edge of the object to reduce drag and delay stall.

17 Claims, 4 Drawing Sheets

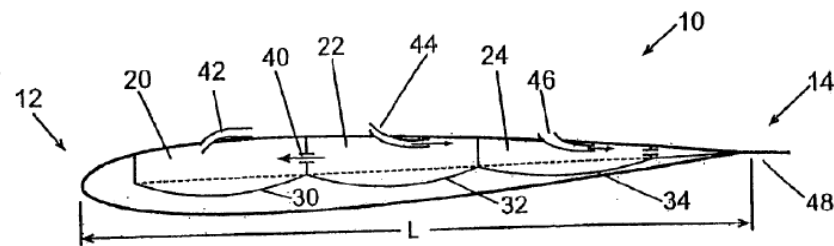


Fig. 1

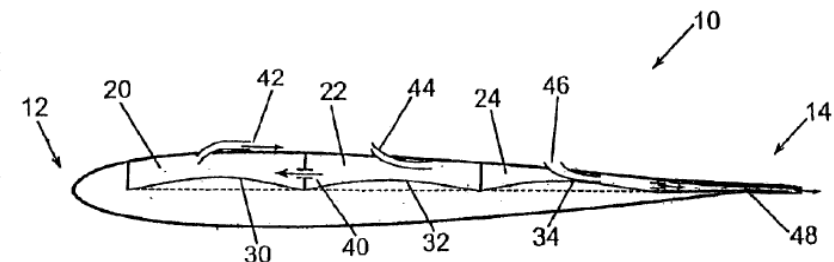
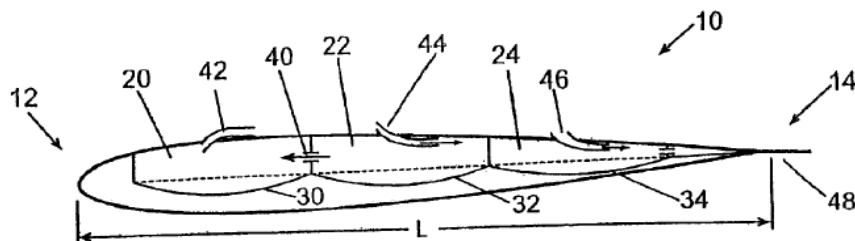


Fig. 2



Examples...

(12) **United States Patent**
Barrett et al.

(10) **Patent No.:** **US 7,898,153 B2**
 (45) **Date of Patent:** **Mar. 1, 2011**

(54) **ACTUATOR**

(56) **References Cited**

(76) Inventors: **Ronald Martin Barrett**, Lawrence, KS (US); **Paolo Tiso**, Varese (IT)

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5,973,441 A * 10/1999 Lo et al. 310/330
 6,236,143 B1 * 5/2001 Lesieutre et al. 310/331
 6,665,917 B2 * 12/2003 Knowles et al. 29/25.35

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 264 days.

* cited by examiner

Primary Examiner — Walter Benson

Assistant Examiner — Karen Addison

(74) *Attorney, Agent, or Firm* — Haverstock & Owens LLP

(21) Appl. No.: **11/795,830**

(57) **ABSTRACT**

(22) PCT Filed: **Jan. 25, 2005**

Actuator comprising:
 a) a support beam
 b) a first means for placing said support beam in compression.

(86) PCT No.: **PCT/NL2005/000054**
 § 371 (c)(1).

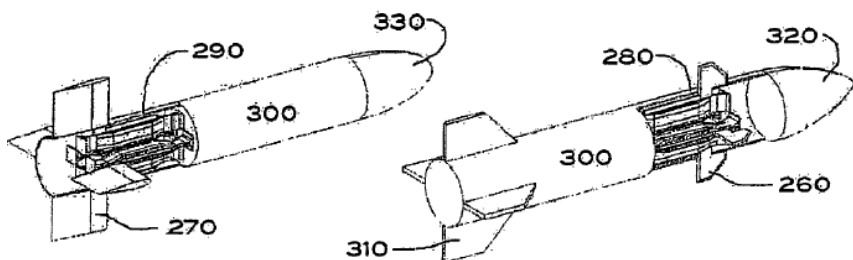
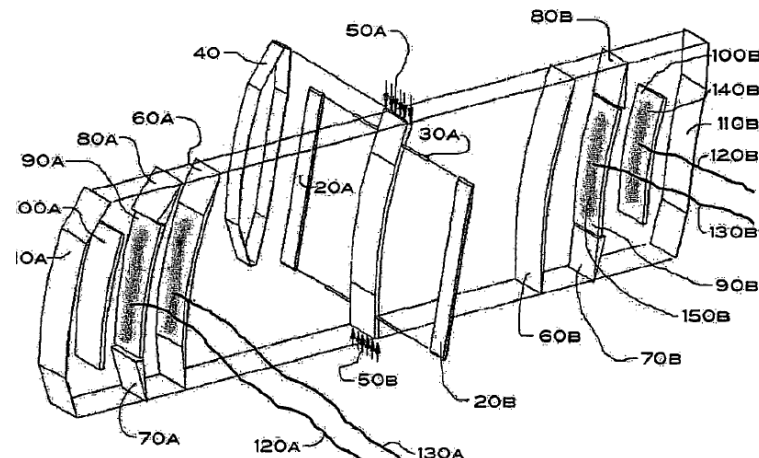


Fig. 11



Examples...

(12) **United States Patent**
Vos et al.

(10) **Patent No.:** US 8,366,057 B2
 (45) **Date of Patent:** Feb. 5, 2013

(54) **METHOD AND APPARATUS FOR PRESSURE ADAPTIVE MORPHING STRUCTURE**

6,015,115 A * 1/2000 Dorsett et al. 244/219
 6,199,796 B1 * 3/2001 Reinhard et al. 244/35 R
 6,347,769 B1 * 2/2002 To et al. 244/219
 6,487,959 B2 * 12/2002 Perez et al. 92/92
 7,055,782 B2 * 6/2006 Dittrich 244/219
 (Continued)

(75) Inventors: **Roelof Vos**, Breda (NL); **Ronald M. Barrett**, Lawrence, KS (US)

(73) Assignee: **University of Kansas**, Lawrence, KS (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 233 days.

(21) Appl. No.: **12/843,255**

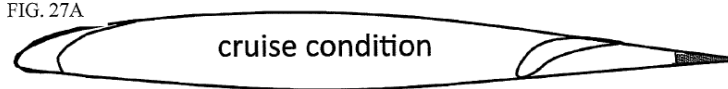
(22) Filed: **Jul. 26, 2010**

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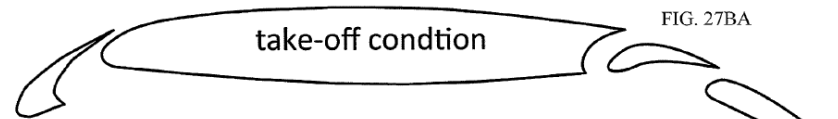
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FIG. 27A

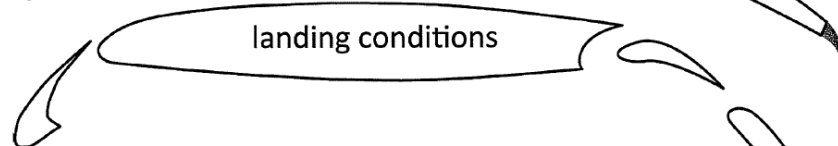


cruise condition

FIG. 27BA



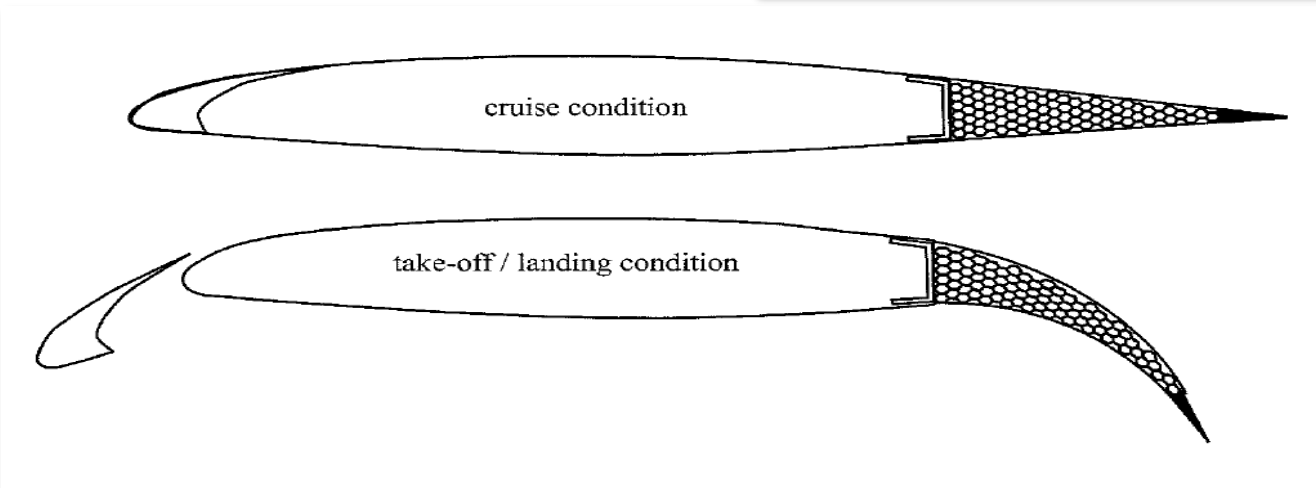
take-off condtion



landing conditions

Pressure adaptive Gurney flap

FIG. 27C



cruise condition

take-off / landing condition



(12) **United States Design Patent** (10) **Patent No.:** **US D776,571 S**
Barrett et al. (45) **Date of Patent:** **** Jan. 17, 2017**

(54) **AERIAL VEHICLE** 3,063,375 A * 11/1962 Hawley F42B 10/14
 244/3.27
 (71) Applicant: **University of Kansas**, Lawrence, KS 3,578,263 A 5/1971 Gunter et al.
 (US) 3,884,431 A 5/1975 Burrell
 D250,966 S * 1/1979 Spore D21/442
 5,060,886 A 10/1991 Davis et al.
 (72) Inventors: **Ronald M. Barrett**, Lawrence, KS
 (US); **Robert B. Honea**, Lenoir City,
 TN (US); **Richard B. Bramlette**, Little
 Rock, AR (US)
 (Continued)

FOREIGN PATENT DOCUMENTS

(73) Assignee: **University of Kansas**, Lawrence, KS
 (US)
 CN 10205022 5/2011
 WO 2013/048339 4/2013
 WO 2014/055899 4/2014

(**) Term: **15 Years**

OTHER PUBLICATIONS

(21) Appl. No.: **29/529,811** U.S. Appl. No. 14/120,446, filed Jun. 10, 2014, Barrett et al.
 (Continued)
 (22) Filed: **Jun. 10, 2015**

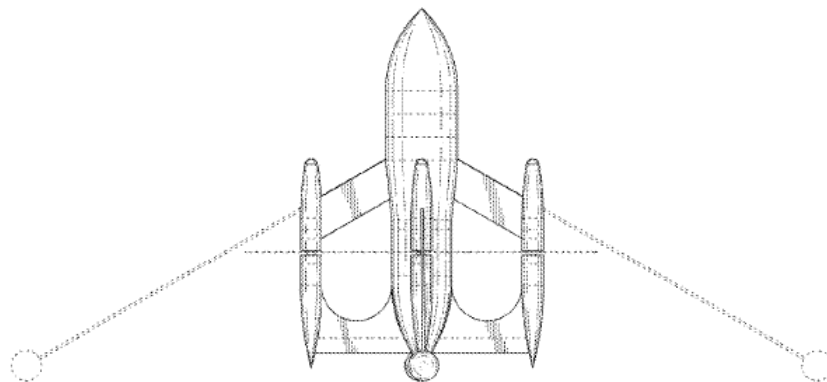
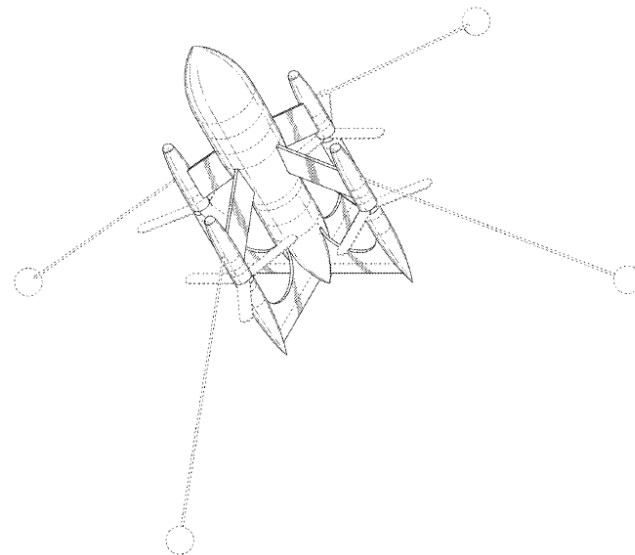


FIG. 8



(12) **United States Design Patent** (10) **Patent No.:** **US D853,939 S**
Barrett et al. (45) **Date of Patent:** ** *Jul. 16, 2019

(54) **AERIAL VEHICLE** FOREIGN PATENT DOCUMENTS
 (71) Applicant: **University of Kansas**, Lawrence, KS (US)
 (72) Inventors: **Ronald M. Barrett**, Lawrence, KS (US); **Richard B. Bramlette**, Little Rock, AR (US); **Robert B. Honea**, Lenoir City, TN (US)
 (73) Assignee: **University of Kansas**, Lawrence, KS (US)
 (*) Notice: This patent is subject to a terminal disclaimer.
 (**) Term: **15 Years**
 (21) Appl. No.: **29/574,073**
 (22) Filed: **Aug. 11, 2016**

Related U.S. Application Data
 (63) Continuation-in-part of application No. 14/810,090, filed on Jul. 27, 2015, which is a continuation-in-part of application No. 14/120,449, filed on Jul. 25, 2014.
 (51) **LOC (11) Cl.** **12-07**
 (52) **U.S. Cl.**
 (58) **Field of Classification Search**
 USPC D12/16.1, 319-345; D21/436, 441, 442, D21/443, 444, 447-454, 437
 CPC B64C 2201/141; B64C 39/024; B64C 2201/127
 See application file for complete search history.

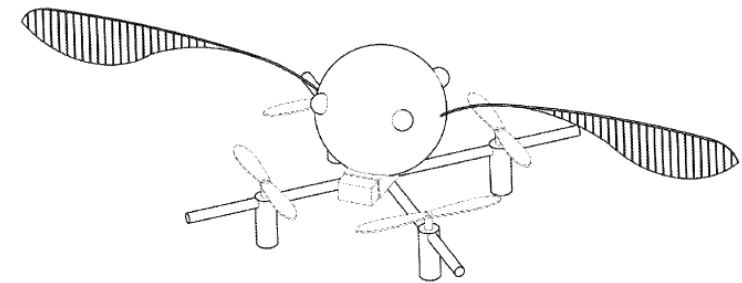
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Primary Examiner — Brandon Michael Rosati
Assistant Examiner — Marissa J Cash
 (74) *Attorney, Agent, or Firm* — Ray Quinney & Nebeker, P.C.; Paul N. Taylor

(57) **CLAIM**
 The ornamental design for an aerial vehicle, as shown and described.

DESCRIPTION
 This invention was made with government support under grant no. DTOS59-06-G-00047 awarded by the Department of Transportation. The government has certain rights in the invention.
 FIG. 1 is a perspective view of an aerial vehicle showing my new design;
 FIG. 2 is a front elevational view thereof;
 FIG. 3 is a side elevational view thereof;
 FIG. 4 is a top plan view thereof;
 FIG. 5 is a bottom plan view thereof;
 FIG. 6 is a perspective view of an aerial vehicle showing a yet further new design;
 FIG. 7 is a front elevational view thereof;
 FIG. 8 is a side elevational view thereof;
 FIG. 9 is a top plan view thereof; and
 FIG. 10 is a bottom plan view thereof.
 In the drawings, the broken lines depict environmental subject matter only and form no part of the claimed design.

1 Claim, 8 Drawing Sheets



(12) **United States Patent** (10) **Patent No.:** **US 10,561,956 B2**
Barrett et al. (45) **Date of Patent:** **Feb. 18, 2020**

(54) **MOVEABLE MEMBER BEARING AERIAL VEHICLES AND METHODS OF USE** (56) **References Cited**
 (71) Applicant: **University of Kansas**, Lawrence, KS (US)
 (72) Inventors: **Ronald M. Barrett**, Lawrence, KS (US); **Richard B. Bramlette**, Little Rock, AR (US); **Robert B. Honea**, Lenoir City, TN (US)
 (73) Assignee: **University of Kansas**, Lawrence, KS (US)
 (*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 1209 days.

(21) Appl. No.: **14/810,090**
 (22) Filed: **Jul. 27, 2015**
Prior Publication Data
 US 2016/0023759 A1 Jan. 28, 2016
 (51) **Int. Cl.**
B64C 27/00 (2006.01)
A63H 27/00 (2006.01)
B64C 27/08 (2006.01)
B64C 27/20 (2006.01)
 (52) **U.S. Cl.**
 CPC **A63H 27/12** (2013.01); **B64C 27/00** (2013.01); **B64C 27/006** (2013.01); **B64C 27/08** (2013.01); **B64C 27/20** (2013.01)
 (58) **Field of Classification Search**
 CPC A63H 27/00; A63H 27/12; B64B 1/24; B64B 1/30; B64B 1/32; B64B 1/34; B64C 27/00; B64C 27/006; B64C 27/08; B64C 27/20; B64C 39/00; B64C 39/02; B64C 39/024; B64C 39/028; B64C 2201/024; B64C 2201/108; B64C 33/00; B64C 33/02

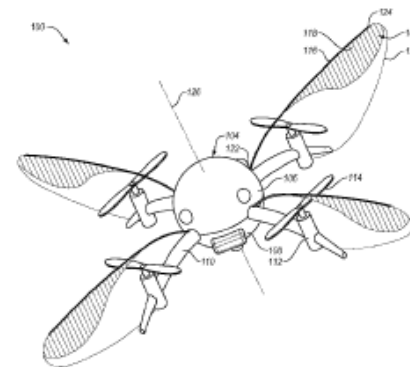
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Primary Examiner — Richard R. Green
Assistant Examiner — Michael A. Fabula
 (74) *Attorney, Agent, or Firm* — Ray Quinney & Nebeker P.C.; Paul N. Taylor

(57) **ABSTRACT**
 An aerial vehicle includes a body having a longitudinal axis, a plurality of moveable members emanating connected to the body, at least one motor, and at least three aerodynamic propulsors driven by the at least one motor. The moveable members are connected to the body and extend away from the body.

22 Claims, 36 Drawing Sheets



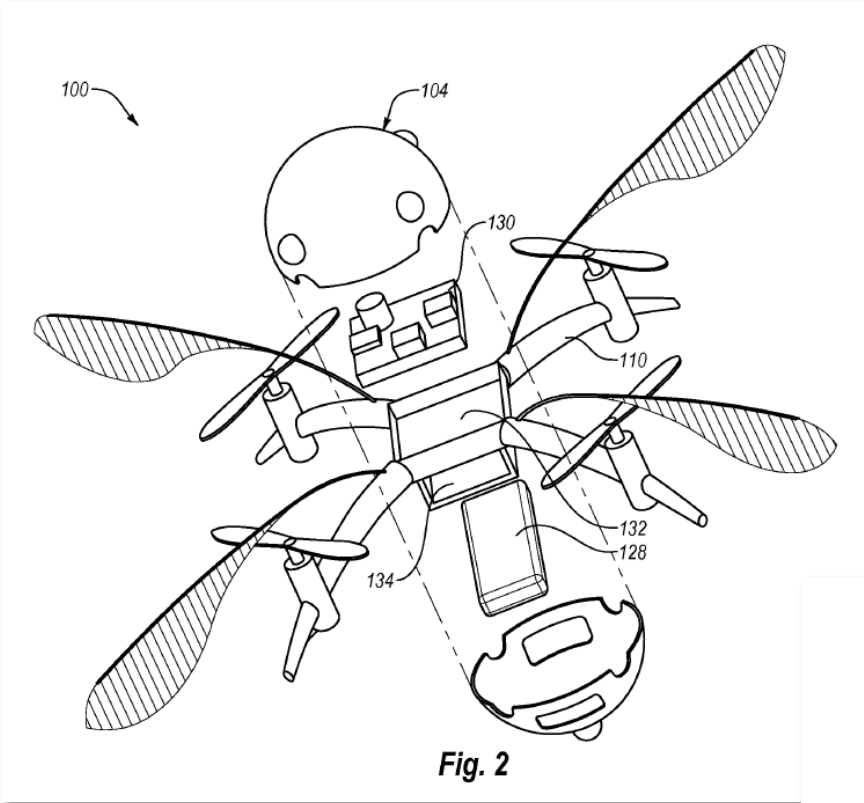


Fig. 2

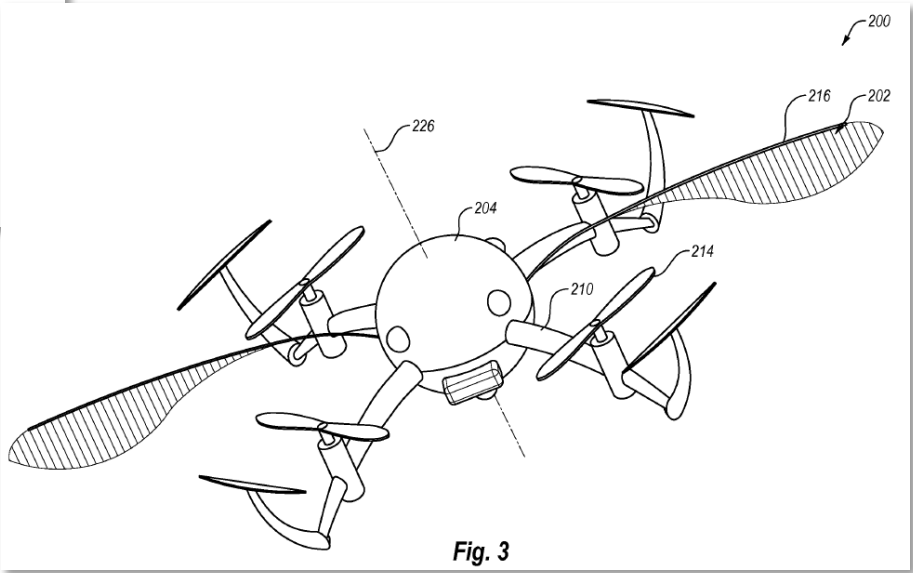


Fig. 3



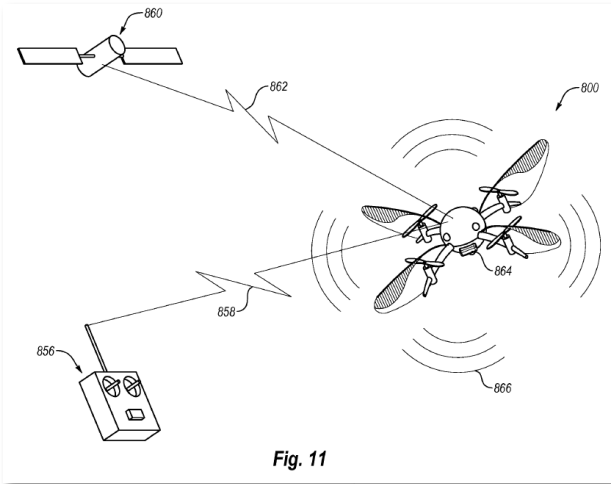


Fig. 11

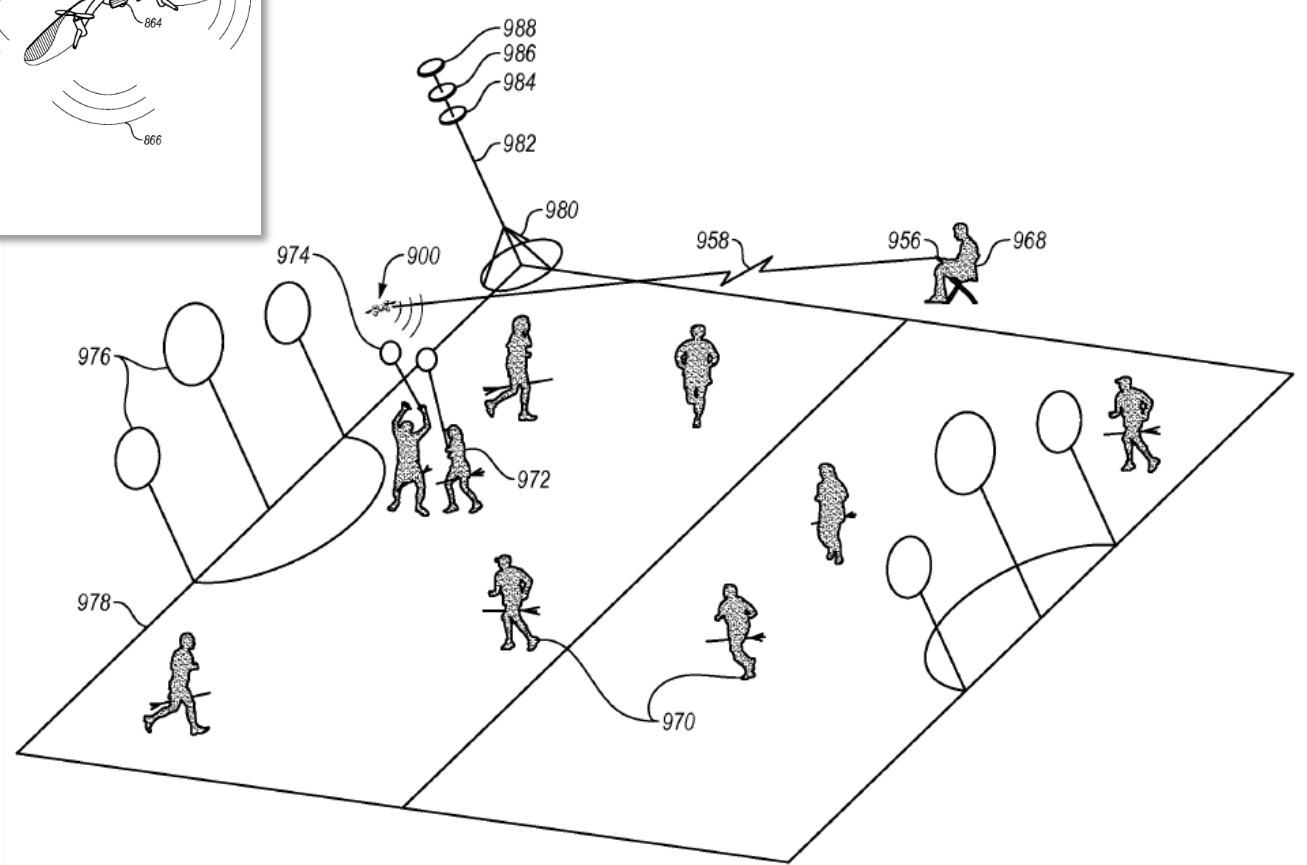


Fig. 12



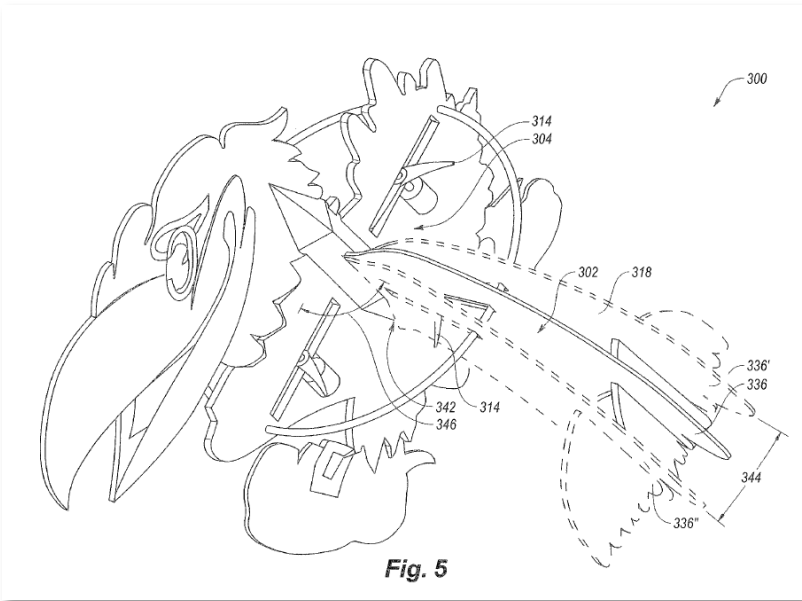


Fig. 5

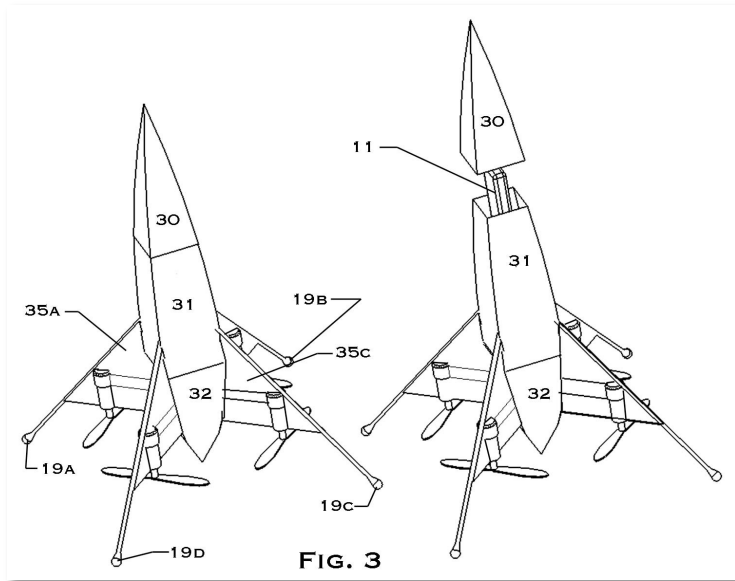


FIG. 3

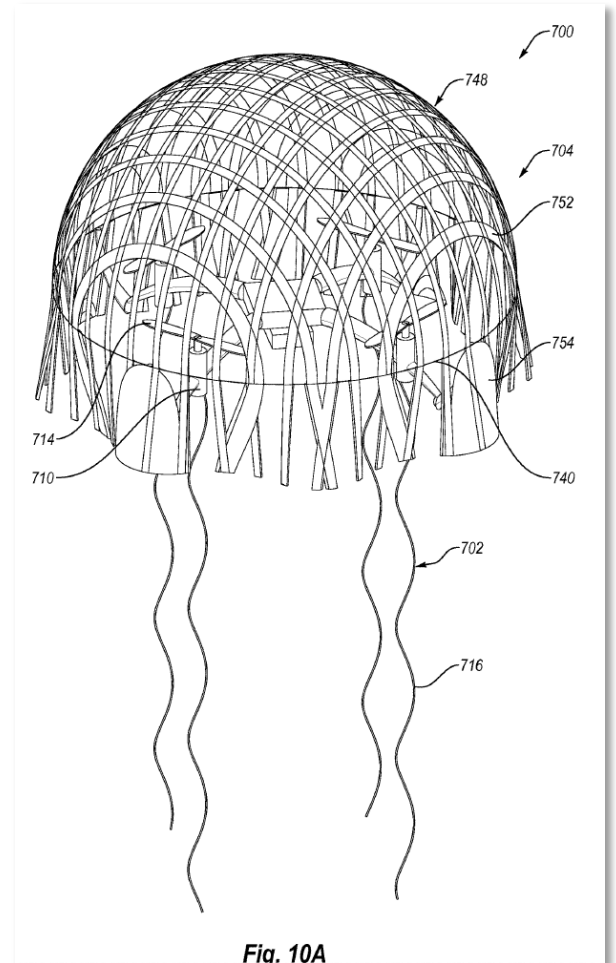


Fig. 10A







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(12) **United States Patent**
Barrett-Gonzales

(10) **Patent No.:** US 9,004,393 B2
(45) **Date of Patent:** Apr. 14, 2015

(54) **SUPERSONIC HOVERING AIR VEHICLE**

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Lawrence, KS (US)

(73) Assignee: **University of Kansas**, Lawrence, KS
(US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 93 days.

(21) Appl. No.: **13/279,827**

(22) Filed: **Oct. 24, 2011**

(65) **Prior Publication Data**
US 2012/0097801 A1 Apr. 26, 2012

(60) **Related U.S. Application Data**
Provisional application No. 61/406,140, filed on Oct. 24, 2010.

(51) **Int. Cl.**
B64C 27/24 (2006.01)
B64C 29/02 (2006.01)
B64C 39/02 (2006.01)

(52) **U.S. Cl.**
CPC *B64C 29/02* (2013.01); *B64C 27/24* (2013.01); *B64C 39/024* (2013.01); *B64C 2201/027* (2013.01); *B64C 2201/084* (2013.01); *B64C 2201/102* (2013.01)

(58) **Field of Classification Search**
USPC 244/7 A, 3.27, 3.28, 14, 17.23, 17.11
See application file for complete search history.

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Primary Examiner — Tien Dinh
Assistant Examiner — Vicente Rodriguez
(74) Attorney, Agent, or Firm — Douglas G. Gallagher, John V. Daniluck; Bingham Greenebaum Doll LLP

(57) **ABSTRACT**
Embodiments of the present invention include an aircraft capable of sustained out-of-ground-effect hover flight and sustained supersonic flight. At least some embodiments include two wings powered by an engine to counterrotate while hovering, and to not rotate and sweep while flying at transonic and supersonic speeds. Other embodiments include two rotating wings that generate a force per unit area of under 100 lb/ft² within the rotating wing disk during hover. Still other embodiment include a vehicle with rotating wings that can increase pitch to accelerate the aircraft, align the chord line of the wings with the airstream, and sweep the wings. Still further embodiments include a power plant that powers unducted rotating wings during hover and disengages from the wings to propel the aircraft at supersonic speeds.

14 Claims, 9 Drawing Sheets

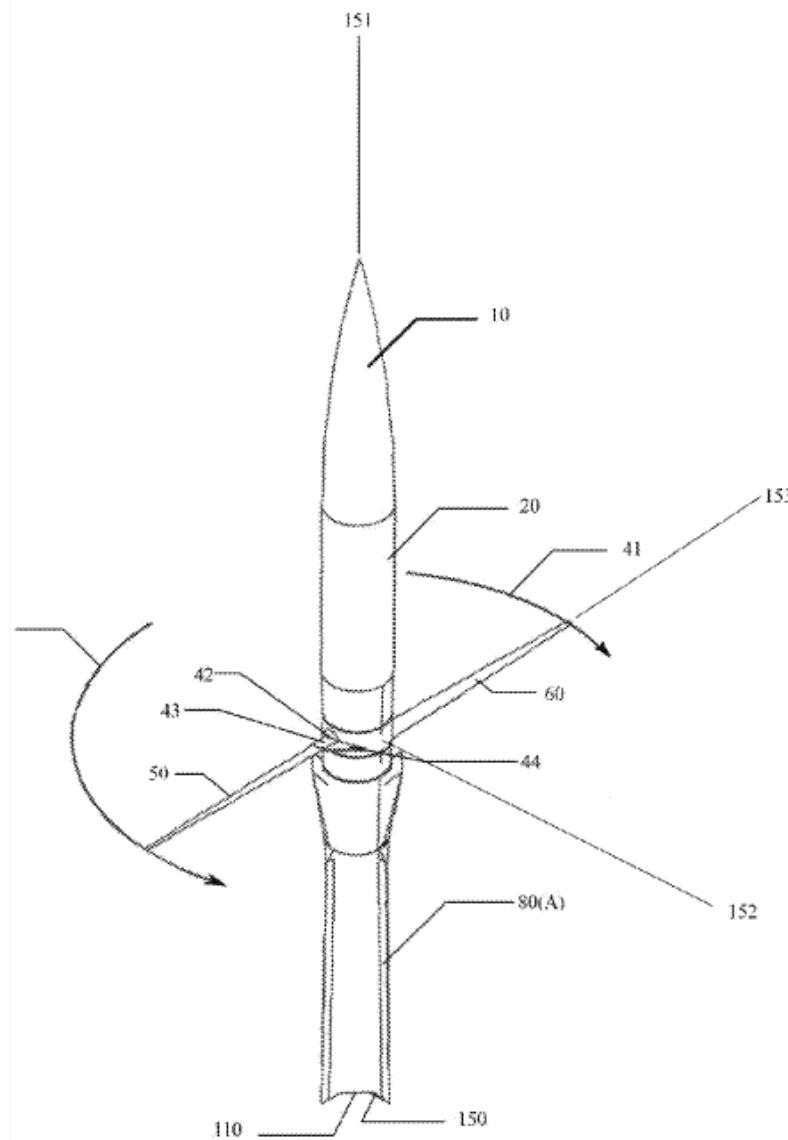
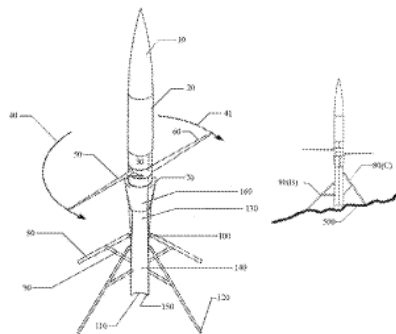


FIG. 5

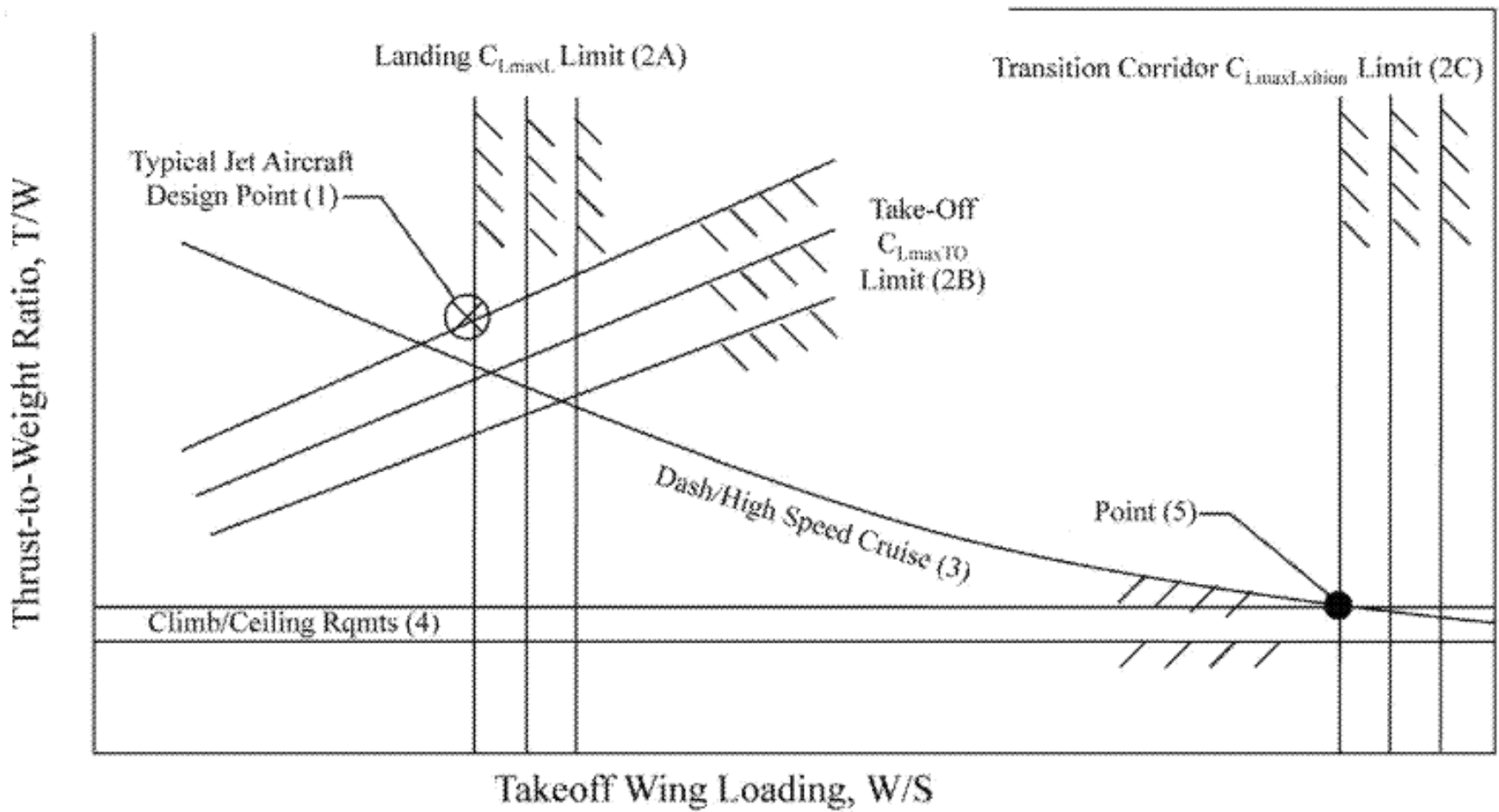


FIG. 1

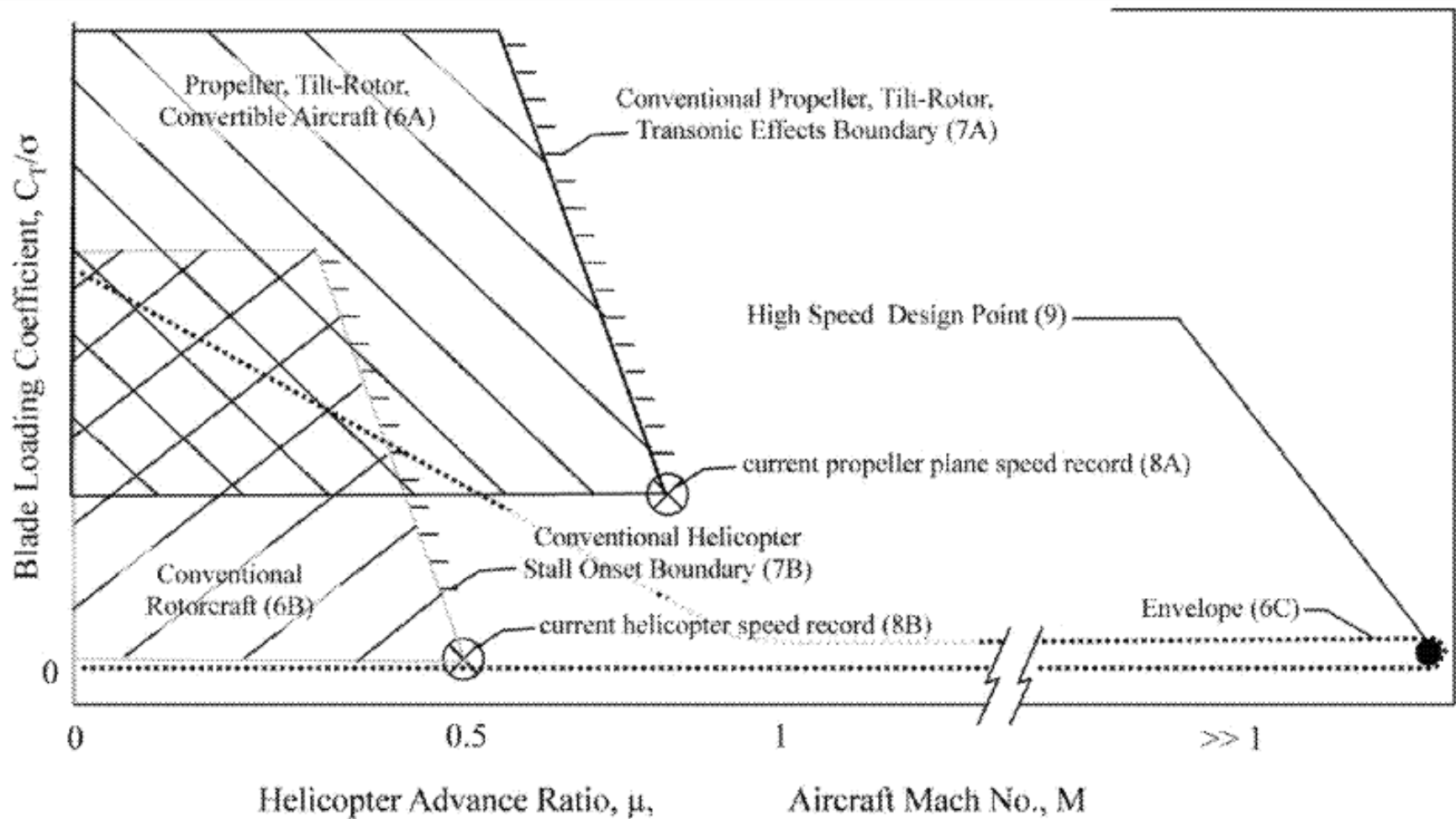
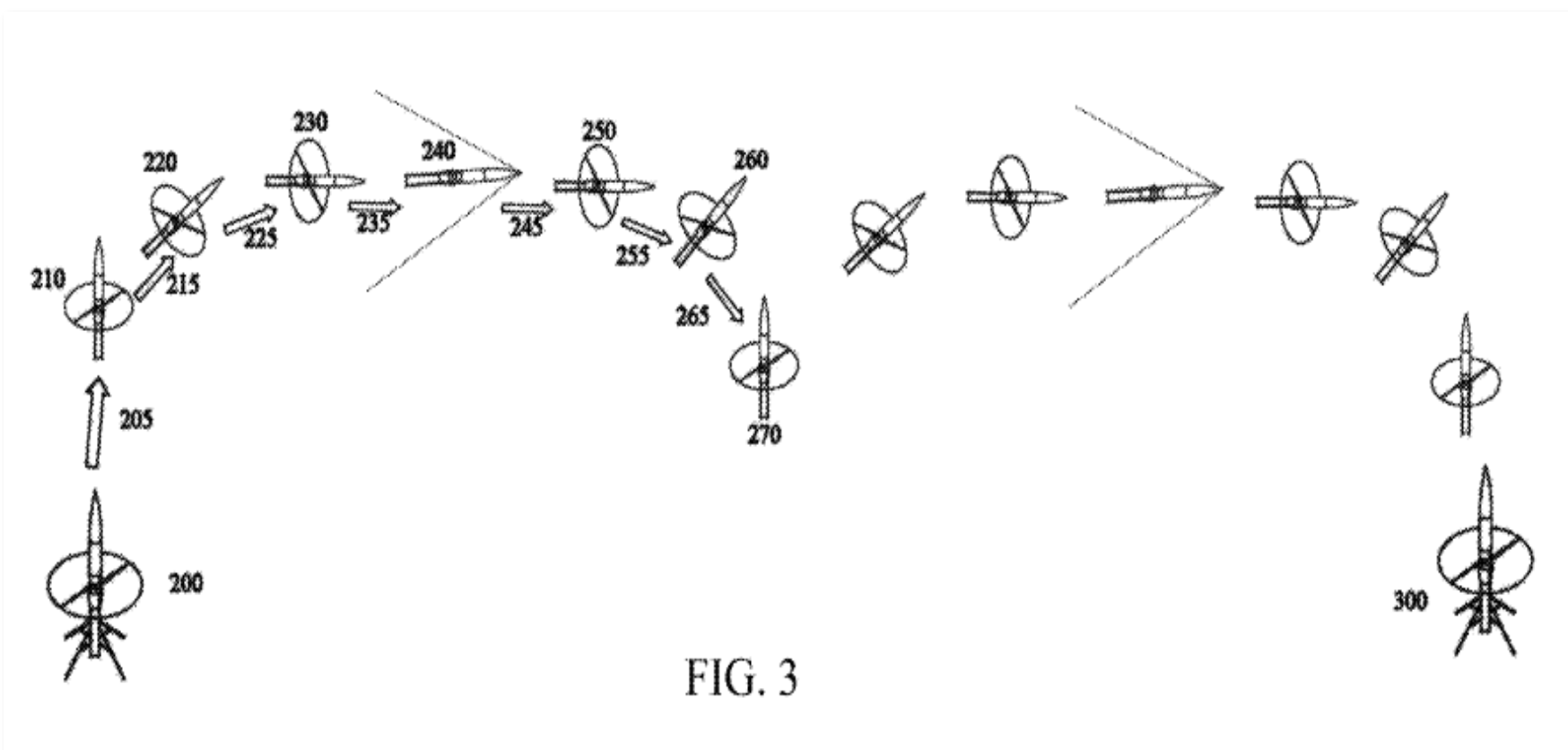


FIG. 2



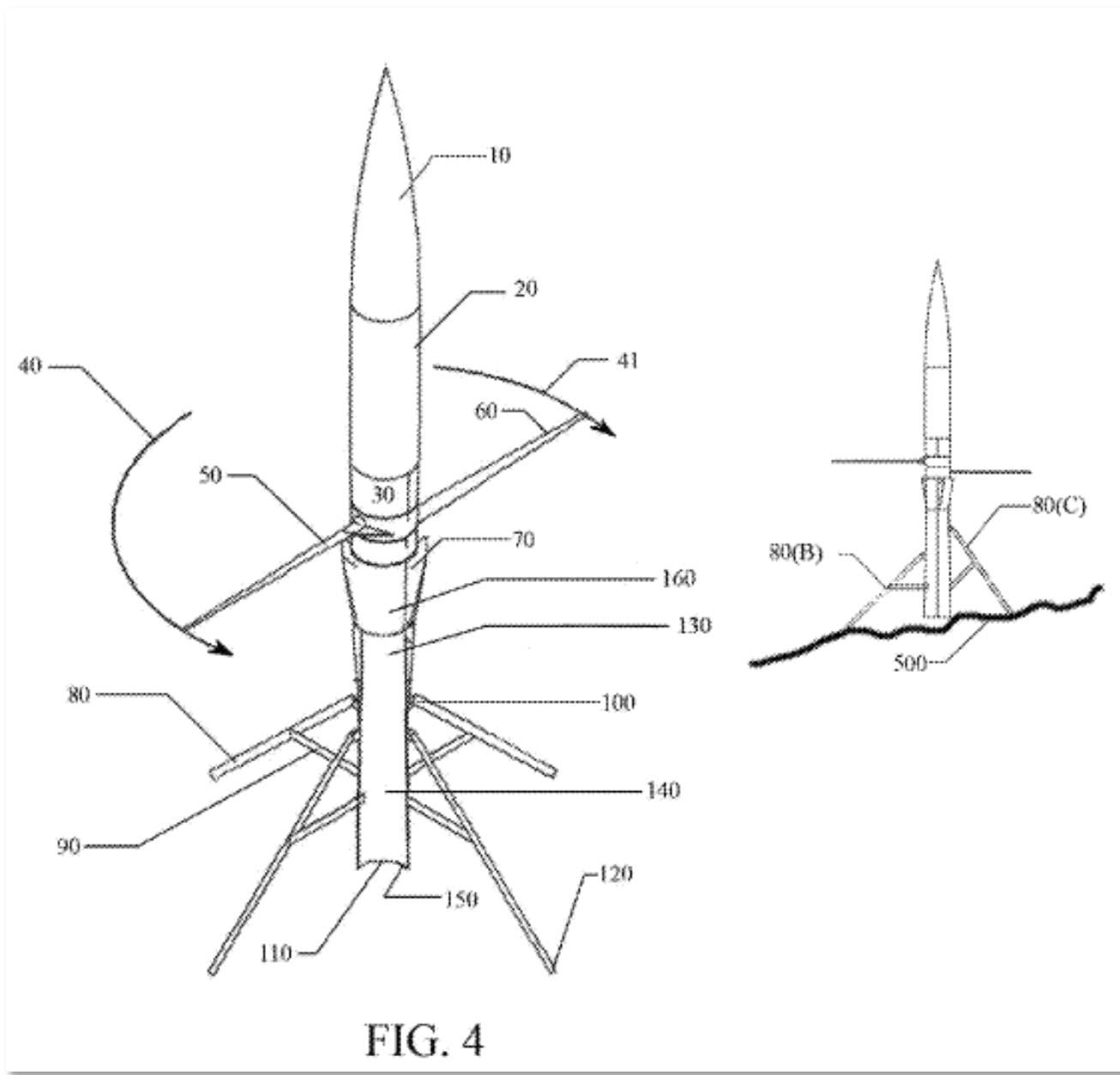


FIG. 4



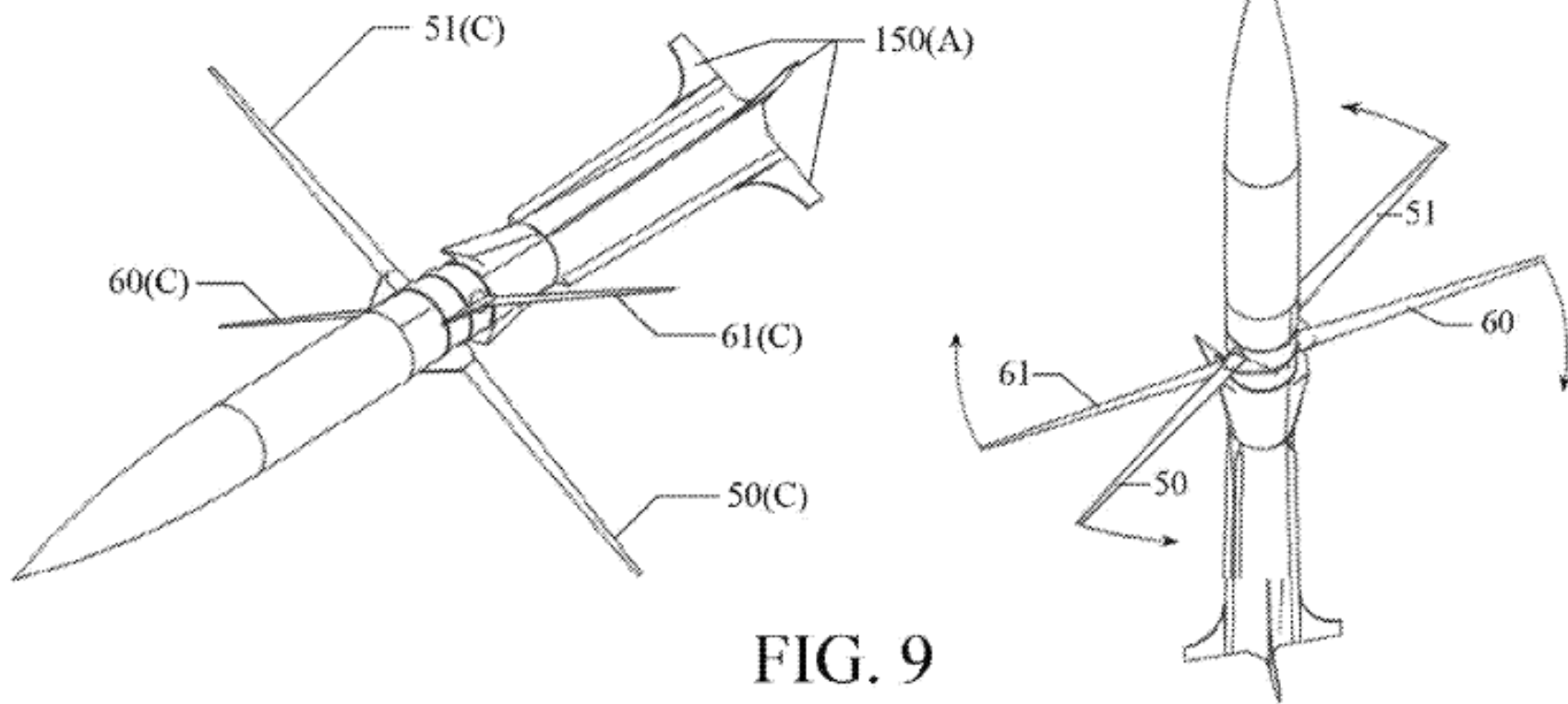


FIG. 9



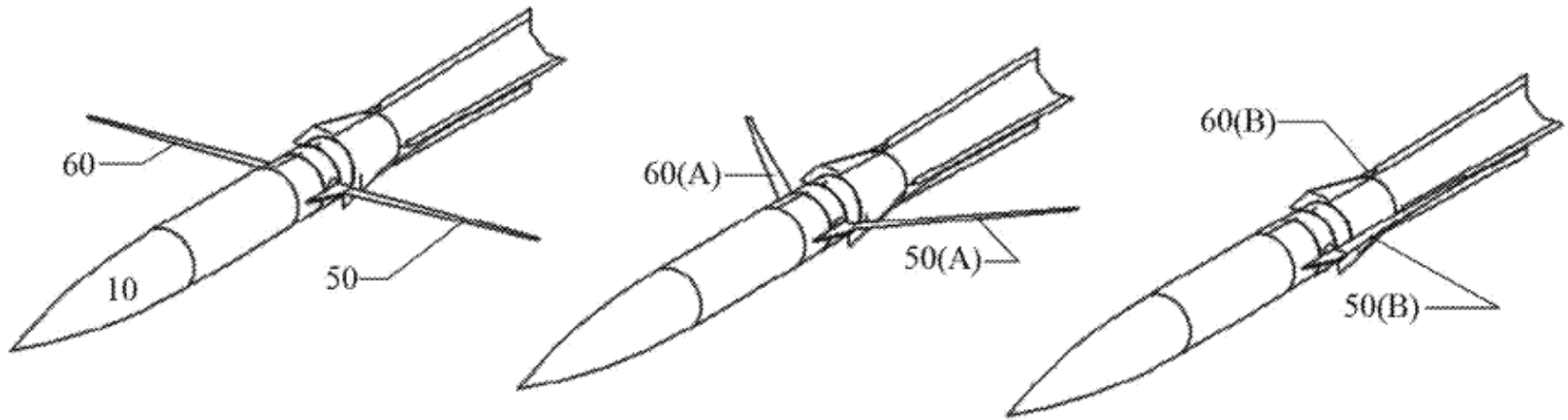


FIG. 6

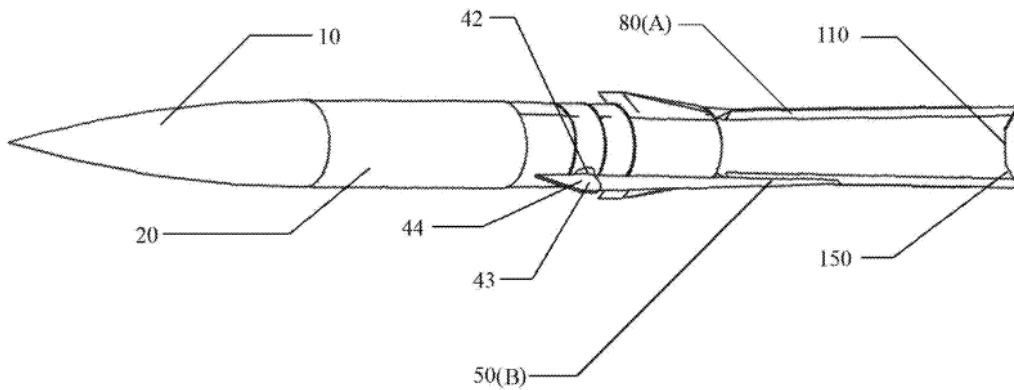


FIG. 7

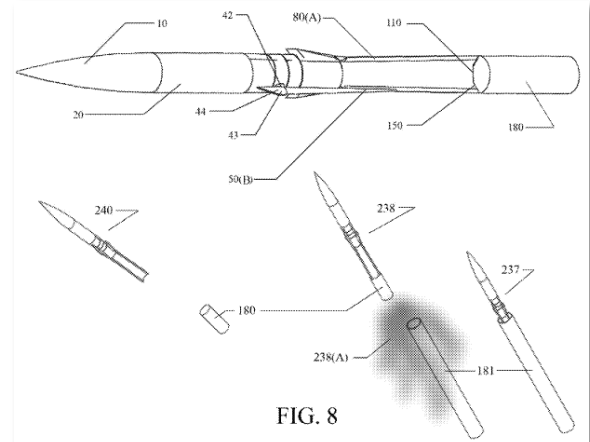


FIG. 8



