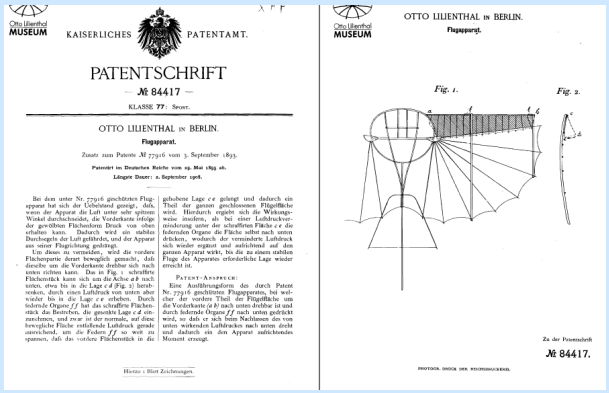
# The great aviation patent spike of 1910

Peter B. Meyer
U.S. Bureau of Labor Statistics
Views and findings in this work represent only the author

WEAI Virtual International Conference
March 17, 2021

←




→

# Historical overview

- 1880s: Ballooning clubs, journals, and exhibitions
  - Interest in "aerial navigation" and "flying machines" gathers there
  - Aeronautics is a hobby – maybe hopeless, useless, dangerous

- 1890s: Public glider flights ; Chanute's survey book
  - Many designs were shared — "open source" practices

- 1903 Wright brothers' powered-glider flight, 1906 major patent

- 1908-11 Big exhibitions.
  - A wave of new manufacturers start up or branch into aviation
  - Huge increase in aero patents, then a decline

- 1914 World War I begins

# Economic context: change in "equilibrium"

- Early period: Scientists and tinkerers exchange information
  - Publications, scientific ambitions, sharing, problem-solvers equilibrium

- In a competitive industry, patents act as intellectual property
  - Designs and technologies for productive use or sale, industry equilibrium

- In between: radical inventions, new companies, startup industry.
  - Many different perspectives in play
  - Not like an equilibrium

What does the patent stream look like through this period? A data question

# A patent of Otto Lilienthal

Otto Lilienthal MUSEUM

KAISERLICHES PATENTAMT.

# PATENTSCHRIFT

— № 84417 —

KLASSE 77: SPORT.

## OTTO LILIENTHAL IN BERLIN.

**Flugapparat.**

Zusatz zum Patente № 77916 vom 3. September 1893.

**Patentirt im Deutschen Reiche vom 29. Mai 1895 ab.**

**Längste Dauer: 2. September 1908.**

Bei dem unter Nr. 77916 geschützten Flugapparat hat sich der Uebelstand gezeigt, dafs, wenn der Apparat die Luft unter sehr spitzem Winkel durchschneidet, die Vorderkante infolge der gewölbten Flächenform Druck von oben erhalten kann. Dadurch wird ein stabiles Durchsegeln der Luft gefährdet, und der Apparat aus seiner Flugrichtung gedrängt.

Um dieses zu vermeiden, wird die vordere Flächenpartie derart beweglich gemacht, dafs dieselbe um die Vorderkante drehbar sich nach unten richten kann. Das in Fig. 1 schraffirte Flächenstück kann sich um die Achse *a b* nach unten, etwa bis in die Lage *c d* (Fig. 2) herabsenken, durch einen Luftdruck von unten aber wieder bis in die Lage *c e* erheben. Durch federnde Organe *f f* hat das schraffirte Flächenstück das Bestreben, die gesenkte Lage *c d* einzunehmen, und zwar ist der normale, auf diese bewegliche Fläche entfallende Luftdruck gerade ausreichend, um die Federn *f f* so weit zu spannen, dafs das vordere Flächenstück in die gehobene Lage *c e* gelangt und dadurch ein Theil der ganzen geschlossenen Flügelfläche wird. Hierdurch ergiebt sich die Wirkungsweise insofern, als bei einer Luftdruckverminderung unter der schraffirten Fläche *c e* die federnden Organe die Fläche selbst nach unten drücken, wodurch der verminderte Luftdruck sich wieder ergänzt und aufrichtend auf den ganzen Apparat wirkt, bis die zu einem stabilen Fluge des Apparates erforderliche Lage wieder erreicht ist.

PATENT-ANSPRUCH:

Eine Ausführungsform des durch Patent Nr. 77916 geschützten Flugapparates, bei welcher der vordere Theil der Flügelfläche um die Vorderkante *(a b)* nach unten drehbar ist und durch federnde Organe *f f* nach unten gedrückt wird, so dafs er sich beim Nachlassen des von unten wirkenden Luftdruckes nach unten dreht und dadurch ein den Apparat aufrichtendes Moment erzeugt.

Hierzu 1 Blatt Zeichnungen.

Otto Lilienthal MUSEUM

OTTO LILIENTHAL IN BERLIN.

**Flugapparat.**

*Fig. 1.*

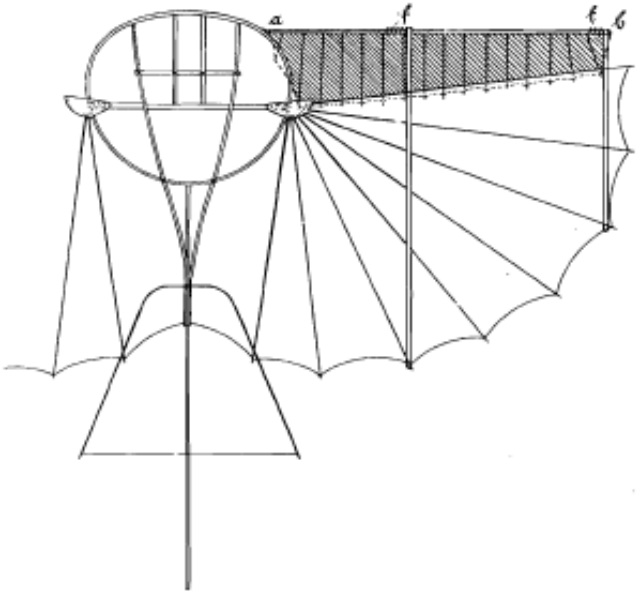


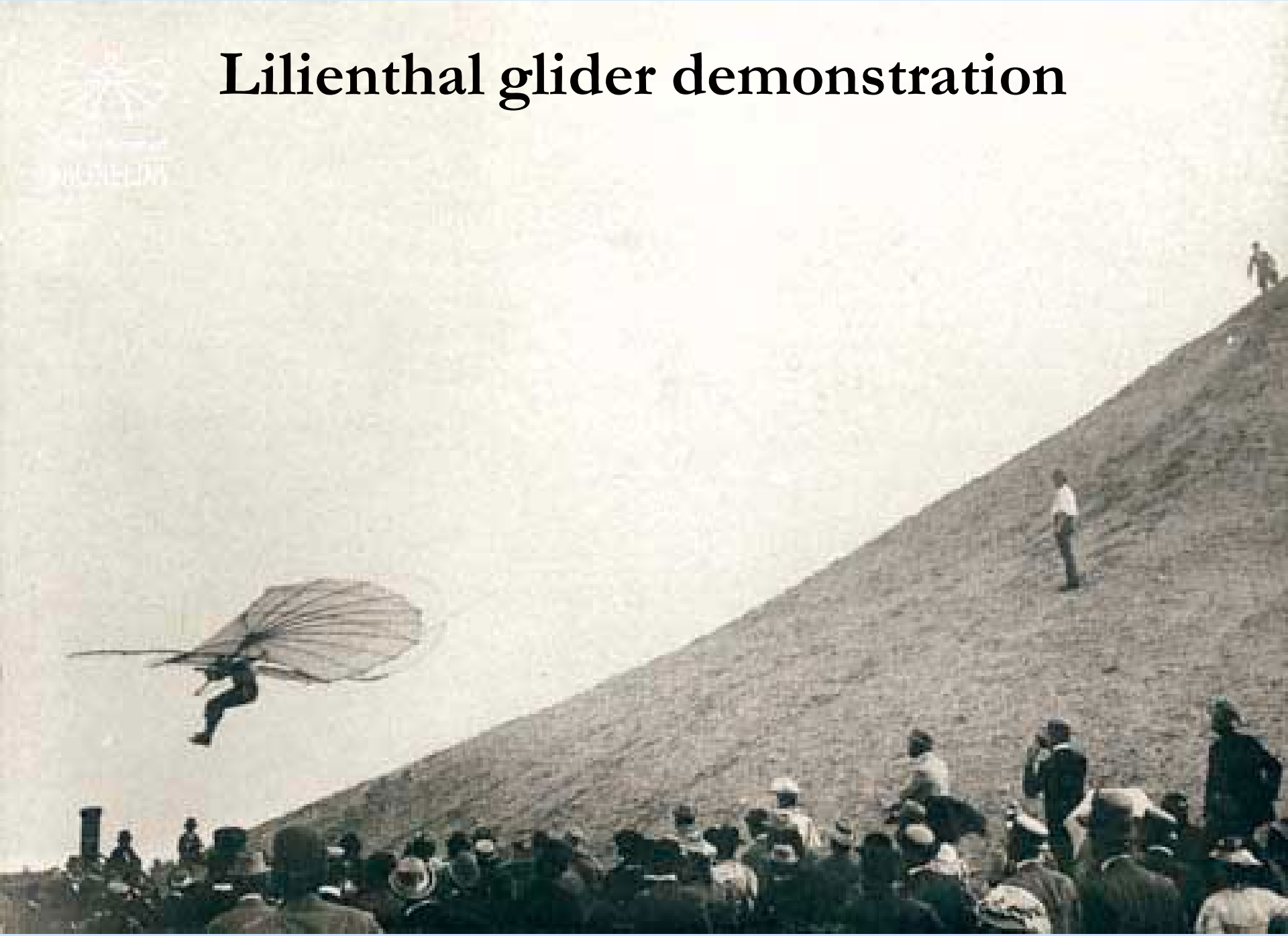

*Fig. 2.*


Zu der Patentschrift

№ 84417.

PHOTOGR. DRUCK DER REICHSDRUCKEREI.

# Lilienthal glider demonstration



# Aero patent data from many sources

Our data comes from many sources. Gathering it is the main task

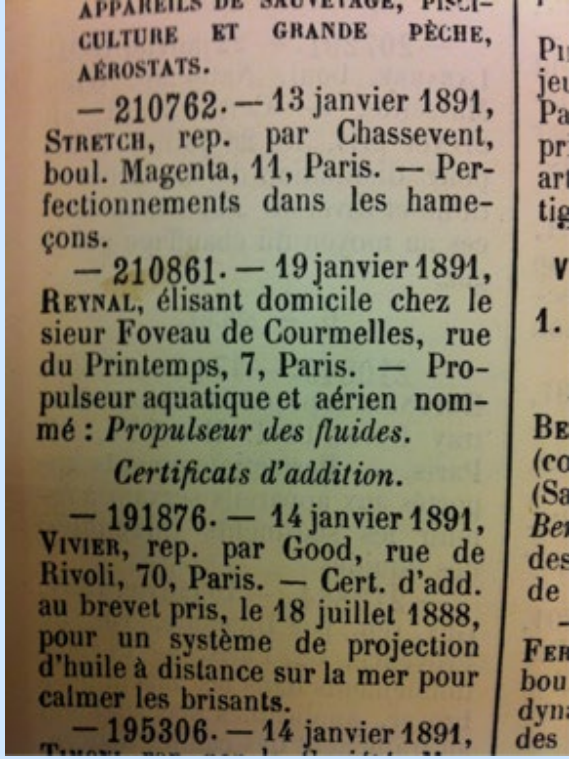
- EPO's Web site espacenet.com
- European Patent Office via World Intellectual Property Organization
- National patent offices – Web sites, with patents one by one, especially oldest ones
  - France, Germany, Hungary, Australia, NZ, Netherlands
- Official **government gazettes**, scanned on archive.org, hathitrust
- **Aeronautics journals** of the time
- Archives and libraries (US PTO, Belgium)

- Sources are vast and there's more to do

# Aero patent data challenges

- Patent's **relevance** to aviation not always clear
  - In some countries patents clearly classified by technology, in others that's not shown

- Very **limited data** on some, e.g. lists at right
- Some patent applications not complete when filed
- **Patent office practices** are hard to find
- Country definitions: Austria-Hungary, colonies



APPAREILS DE SAUVETAGE, PISCICULTURE ET GRANDE PÊCHE, AÉROSTATS.

— 210762. — 13 janvier 1891, STRETCH, rep. par Chassevent, boul. Magenta, 11, Paris. — Perfectionnements dans les hamecons.

— 210861. — 19 janvier 1891, REYNAL, élisant domicile chez le sieur Foveau de Courmelles, rue du Printemps, 7, Paris. — Propulseur aquatique et aérien nommé : *Propulseur des fluides.*

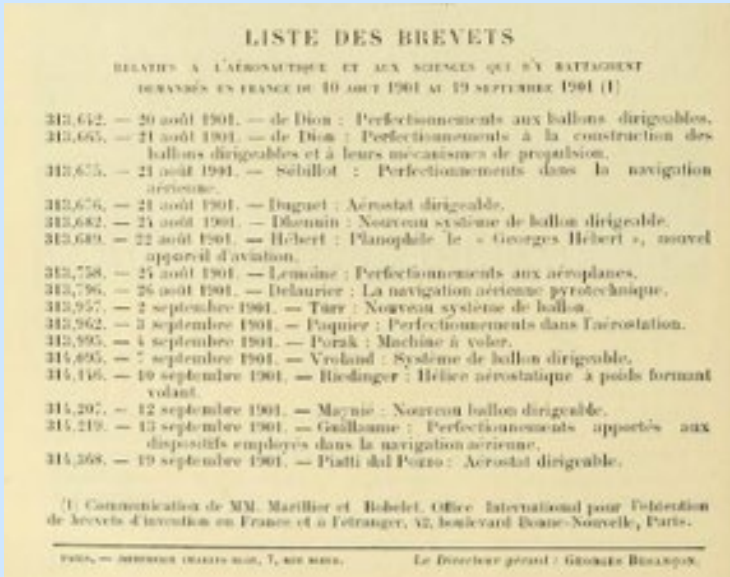
*Certificats d'addition.*

— 191876. — 14 janvier 1891, VIVIER, rep. par Good, rue de Rivoli, 70, Paris. — Cert. d'add. au brevet pris, le 18 juillet 1888, pour un système de projection d'huile à distance sur la mer pour calmer les brisants.

— 195306. — 14 janvier 1891,

Patent documents similar across countries in content but:

- France and Britain "register" patents, then courts decide
- Germany and U.S. had higher criteria ("examinations")
- So patent rates differ across countries; trends are similar.



LISTE DES BREVETS

RELATIFS À L'AÉRONAUTIQUE ET AUX SCIENCES QUI S'Y RATTACHENT DÉLIVRÉS EN FRANCE DU 10 AOUT 1901 AU 19 SEPTEMBRE 1901 (1)

312,642. — 20 août 1901. — de Dion : Perfectionnements aux ballons dirigeables.
312,665. — 21 août 1901. — de Dion : Perfectionnements à la construction des ballons dirigeables et à leurs mécanismes de propulsion.
312,675. — 21 août 1901. — Sebillot : Perfectionnements dans la navigation aérienne.
312,676. — 21 août 1901. — Dugnet : Aérostat dirigeable.
312,682. — 24 août 1901. — Dhennin : Nouveau système de ballon dirigeable.
312,689. — 22 août 1901. — Hébert : Planophile le « Georges Hébert », nouvel appareil d'aviation.
312,758. — 25 août 1901. — Lemoine : Perfectionnements aux aéroplanes.
312,796. — 26 août 1901. — Delaurier : La navigation aérienne pyrotechnique.
312,957. — 2 septembre 1901. — Tarr : Nouveau système de ballon.
312,962. — 3 septembre 1901. — Paquier : Perfectionnements dans l'aérostation.
312,995. — 4 septembre 1901. — Porak : Machine à voler.
314,695. — 7 septembre 1901. — Vroland : Système de ballon dirigeable.
314,146. — 10 septembre 1901. — Riedinger : Hélice aérostatique à poids formant volant.
314,207. — 12 septembre 1901. — Mayaie : Nouveau ballon dirigeable.
314,219. — 13 septembre 1901. — Guillaume : Perfectionnements apportés aux dispositifs employés dans la navigation aérienne.
314,368. — 19 septembre 1901. — Piatti dal Pozzo : Aérostat dirigeable.

(1) Communication de MM. Mazillier et Robelet, Office International pour l'obtention de brevets d'invention en France et à l'étranger, 32, boulevard Beaune-Nouvelle, Paris.

Distinctive patent types

- Patent "**additions**" to an earlier one
- A patent can be a "**foreign filing**" of another: same content in another country

# Patent data on a wiki

- Each patent has a page
- It can be edited from browser
- Paragraphs discuss patent
- Hyperlinks, footnotes, and categories as on Wikipedia
- Can use Wikipedia images or upload more
- The table at bottom is structured data
- That's a row in table of patents

## Patent US-1889-398984

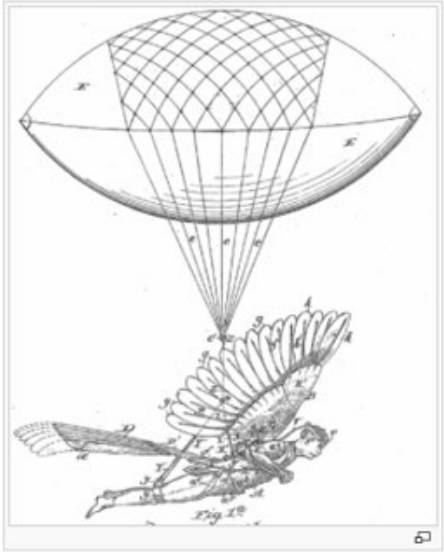
Human flapping attached wings underneath a gas balloon

Lilienthal museum's Seifert notes:

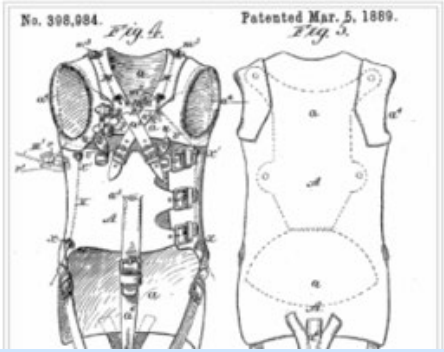
- Spalding built a model in the shape of a flying human. The flying apparatus consists of wings and a tail, which are connected to the plane with a jacket-like construction. Straps in the pelvic area pass between the legs on the back. The wings attached to the wrist are pivotable by Holm joints. They are attached to the 13 springs along the direction of flight. The wings are to be flapped by the movement of the arms. The tail was spreadable. The model is to be made airworthy by a balloon. It is located in the Washington DC National Air and Space Museum. Spalding patented this model. Bildquelle: Quelle 1, S. 63 gl 68 S. 77
- Seifert cites V. Moolman. *The way to Kitty Hawk*. Amsterdam 1981, p. 63, and translates the original title as "Flügelschlagmodell"
- Inventor location: Rosita, CO

**Sources** [edit]

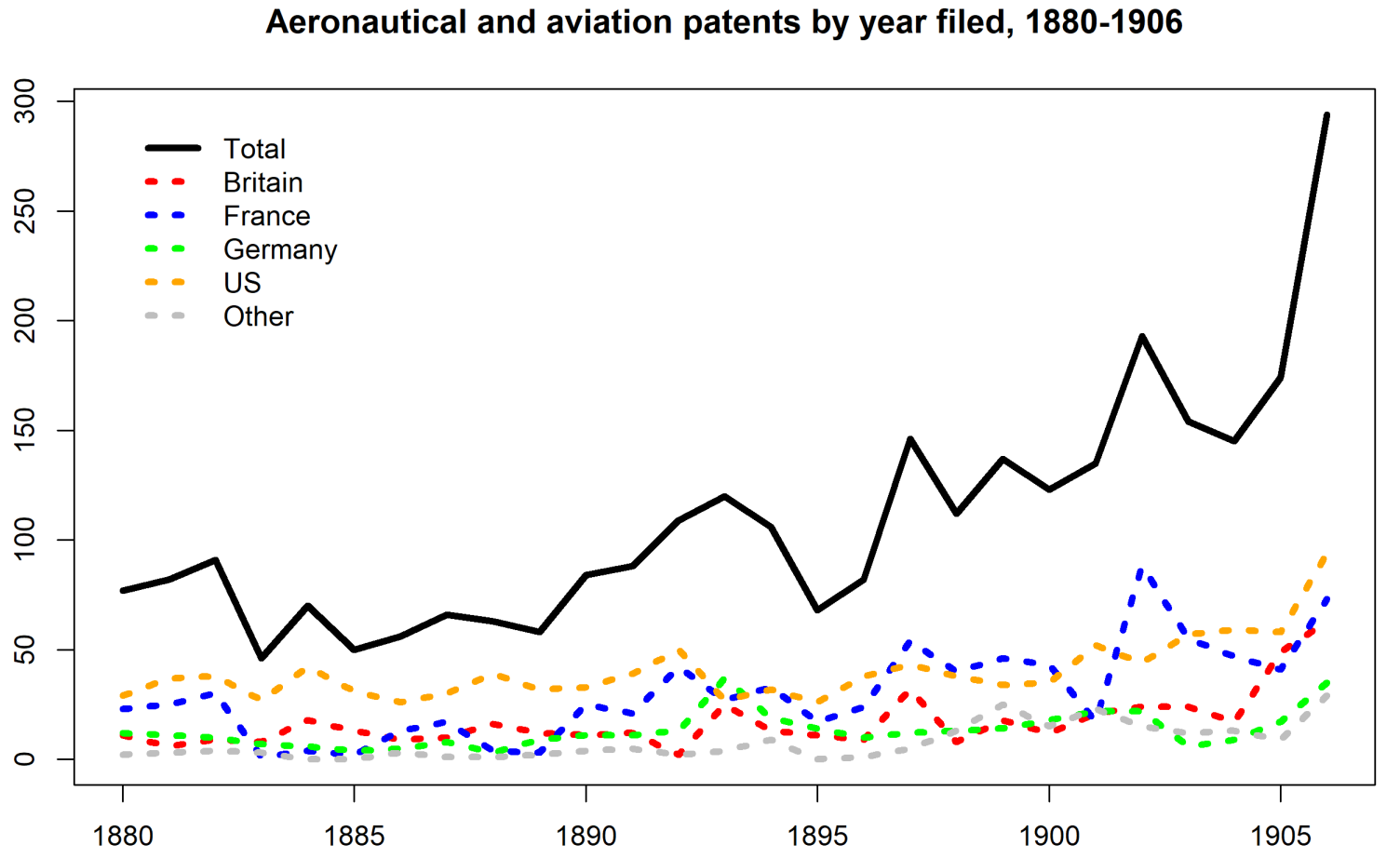
- Original patent document and USPTO classification metadata at US PTO site
- Patent 398984 document and bibliographic info on espacenet
- Patent 398984 at google patents
- Archive record of this patent at the Lilienthal museum patents web site
- Short's DB
- Other sources of information about this patent are on the Web



| | |
|---|---|
| **Year filed** | 1888 |
| **Year granted** | 1889 |
| **Office** | US |
| **Patent number** | 398984 |
| **Inventors** | Reuben Jasper Spalding |
| **Inventor country** | US |
| **Applicant person** | |
| **Applicant firm** | |
| **Applicant type** | |
| **Applicant is inventor?** | Yes |
| **Original title** | Flying-machine |




- Wiki platform is good for handling data ambiguity and uncertainty

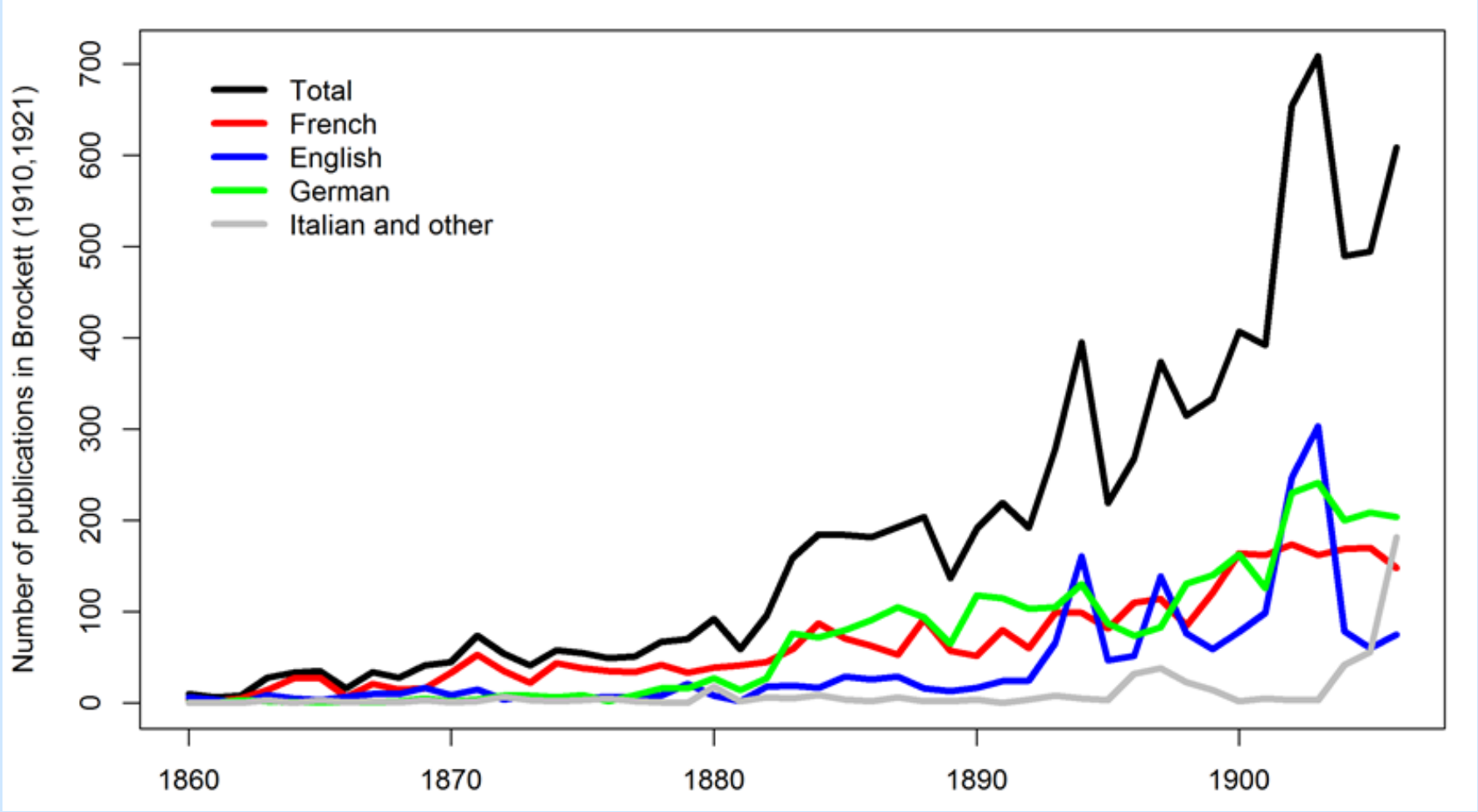



Aero patents grew steadily then spike

Year = year patent was filed, if available; otherwise year granted minus 1

Grows 5% to 7% per year, exponentially, roughly like patents overall

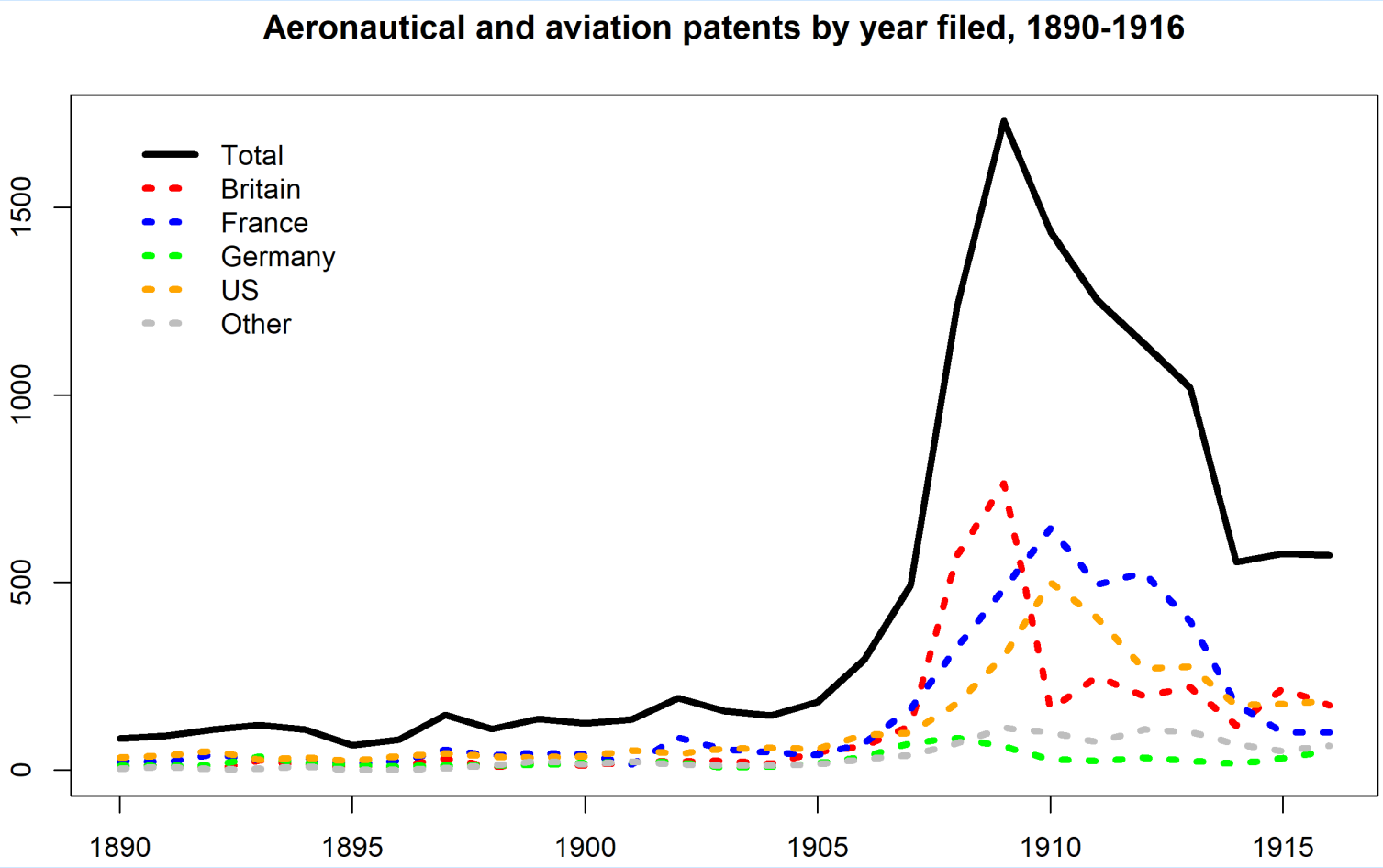
In 1906: Wrights get patent; Public flight by Santos-Dumont




# Aeronautics publications, 1860-1906

- These are mostly short articles in journals. Source: Brockett bibliography (1910)
- Same exponential growth, across languages. More numerous than patents

# Spike in aero-related patents 1906-1911




From coded sample of all the patents, using filing-year or (grant year minus 1)
No apparent distinct effect of Wright lawsuits in U.S. 1910-1911
In World War I, aviation technology is dangerous to share; less is published

# Comparing patents as text

When possible we count pages of text and numbers of diagrams and claims

For a sample we compare page counts across France, Germany, Britain, US

- Germany's were shortest, with fewer text pages and diagrams
- British patents were longer with more text
- U.S.'s make the most legal claims
- These patterns may be the same for non-aero patents – plan to test

Aero patents have slightly more text in 1909-11 and afterward

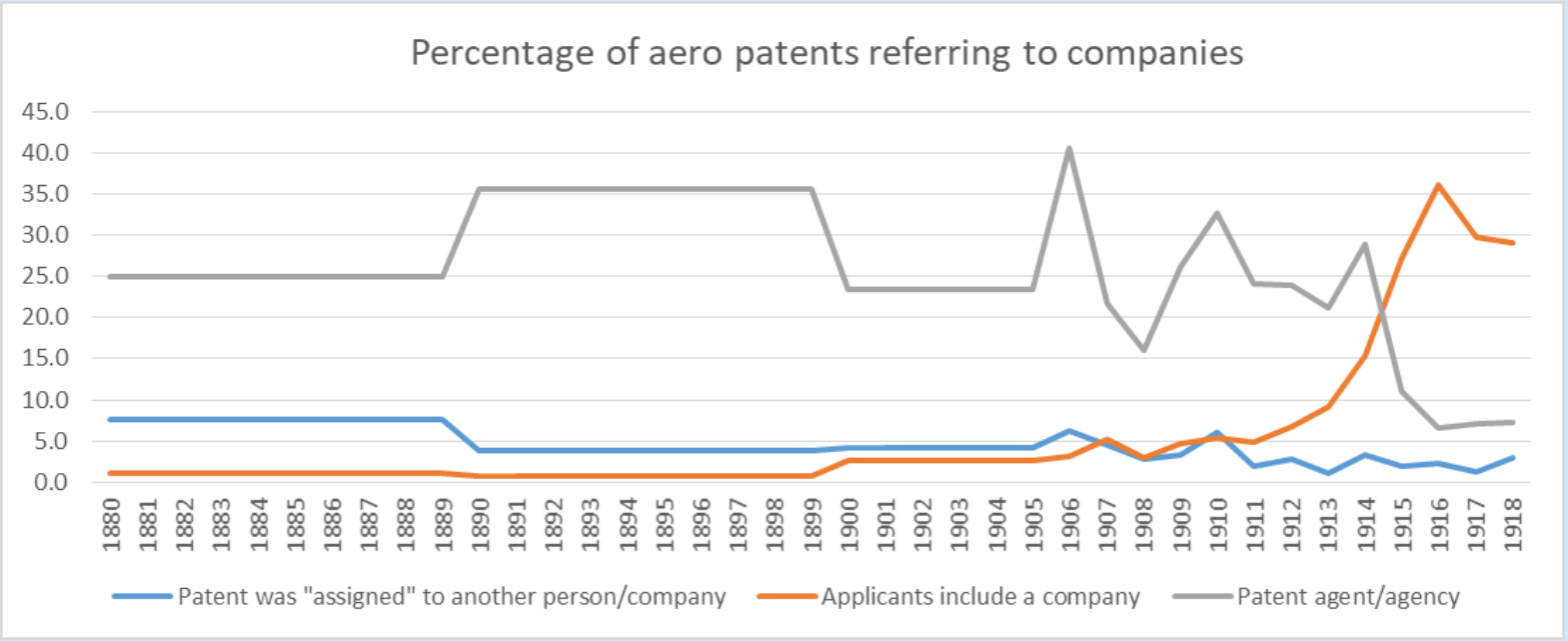
We see a modest increase in foreign filings in the spike period

# Relations of patentees to firms

1) A **patent agent** may have filed the patent. Procedures and documentation vary by country.

2) An **applicant** for a patent may be a firm or org, perhaps along with the inventor.

3) A firm or person might be "**assigned**" (buy) the patent rights at the time of the grant.




Thin data for 1880s, 1890s, and 1900-1905 are smoothed by averaging.

To address later: procedures and documentation vary by country

Findings: **These practices didn't change much around 1910**. Assignment was still rare.

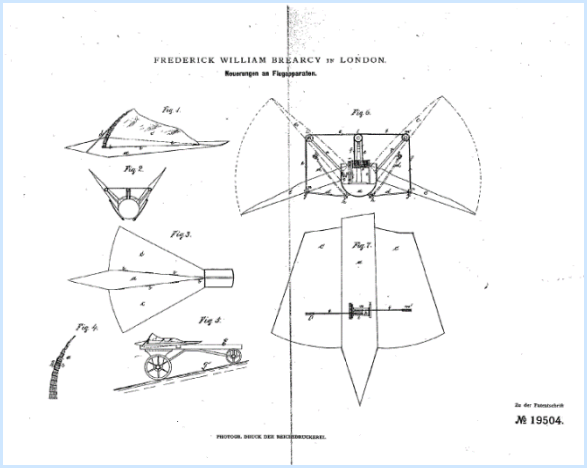
Later, after 1912: Increase in company applicants. Sharply up in World War I.

Decline in use of patent agents here mirrors growth in company applicants, maybe mechanically

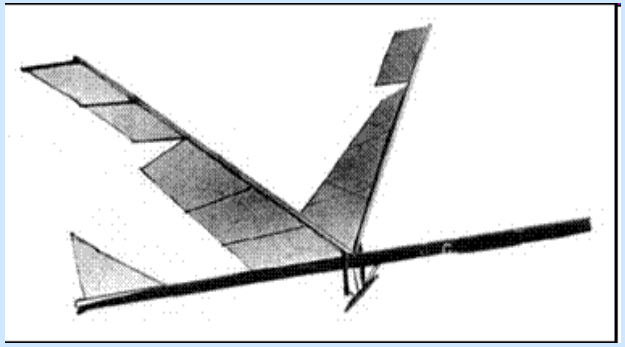
# Tech theme 1: Flapping wings

They want to make a bird.

**Ornithopters:** machines with flapping wings



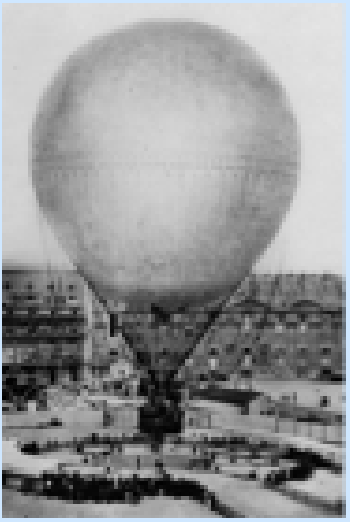

Brearey's 1882 patent



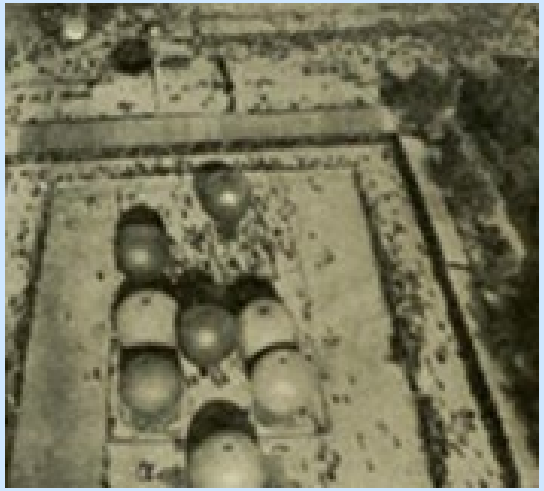
Hargrave 1891 model ornithopter

Frost 1902 ornithopter

# Tech theme 2: balloons to dirigibles (steerable)



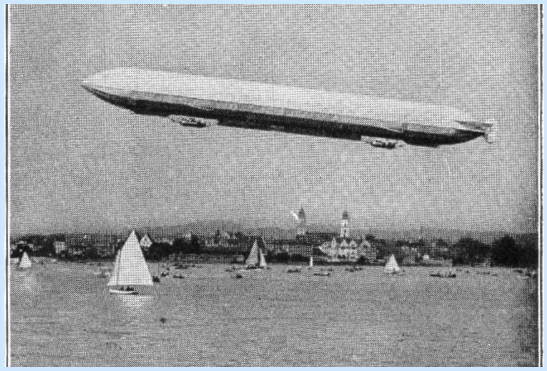
Giffard 1878



Balloon contest 1895

Santos-Dumont 1901 dirigible flew around Eiffel Tower and returned to starting place

Zeppelin, ~1910



# Tech theme (3): Soaring
# Fixed wings, kites, gliders, airplanes

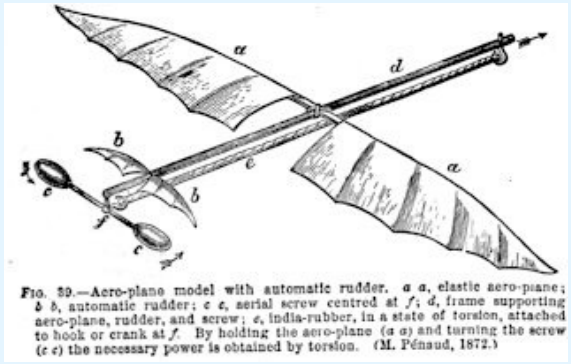



Fig. 39.—Aero-plane model with automatic rudder. *a a*, elastic aero-plane; *b b*, automatic rudder; *c c*, aerial screw centred at *f*; *d*, frame supporting aero-plane, rudder, and screw; *e*, india-rubber, in a state of torsion, attached to hook or crank at *f*. By holding the aero-plane (*a a*) and turning the screw (*c c*) the necessary power is obtained by torsion. (M. Pénaud, 1872.)

Penaud, ~1872
Wind-up model with tail

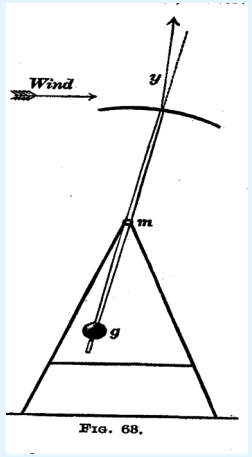
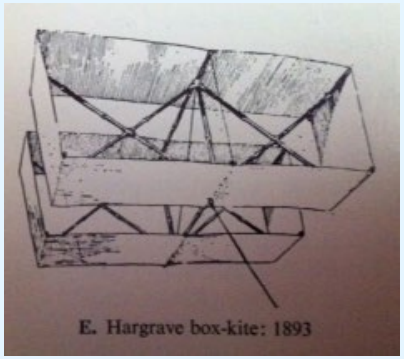



Fig. 68.

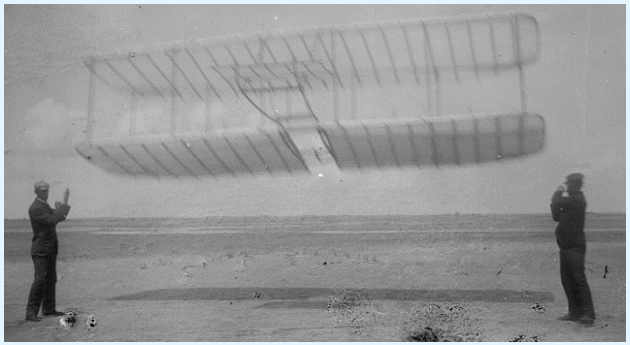
Lilienthal airfoil tests
1870s-1880s



E. Hargrave box-kite: 1893

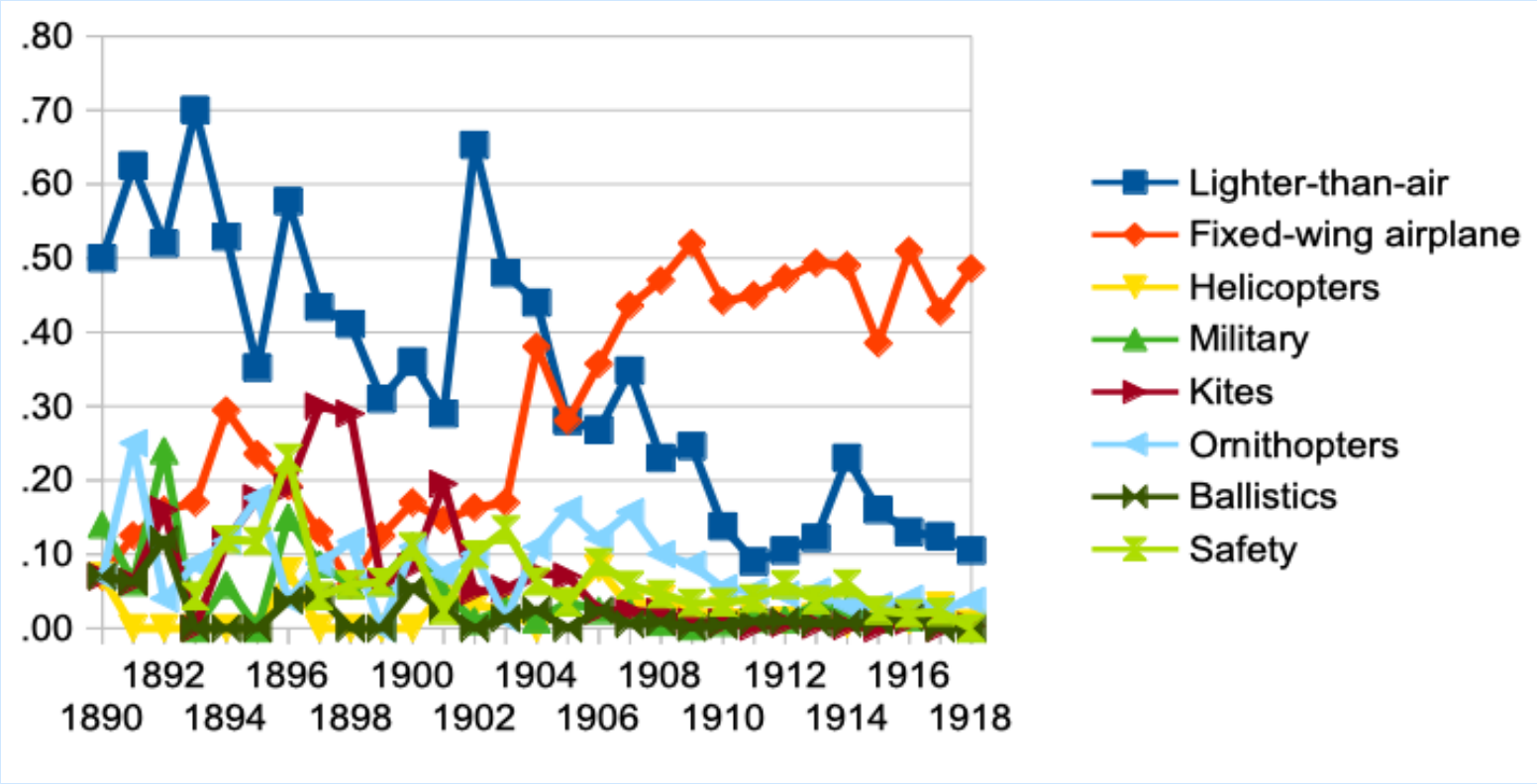
Hargrave box kites 1893

Chanute-Herring glider, 1896



Wrights, 1901-2

# Proportions of patents by topic




- **Fixed-wing airplane designs rise to half about 1909 then stabilize**
- Relative decline after 1903 in alternatives: balloons, dirigibles, and ornithopters
- The 1906-1910 jump raises numbers in all these categories – aviation is hot

Patents were categorized by official sources or our interpretation, in multiple classes

# Possible narratives for 1909-11 patent boom

- Experienced patentees (tinkerers) could have founded startups. (not much)
- Companies accumulated patent rights in the new industry (not much)

- New patentees responding to opportunity appear in this field (**yes**)
- Previous & new aero patentees put more effort into inventing or filing

- There are more supplementary patents (foreign filings, additions) (**yes**)
- There are more duplicative or trivial patents (probably)

- More conflict over patent rights (yes re Wrights in this time, and others later)

# Conclusions: how patents changed

Aero-related patents boom from 1906 to 1909 then decline after 1911

Tech: The spike/wave is associated with the success of airplane design

Airplane designs outgrow balloon and ornithopter designs

Industry: Airplane manufacture has begun.

We can measure some increases in aero patenting in the spike:

- Patentees make more foreign filings (investment, not invention)
- Many new filers for aero patents (to be estimated)

- Companies did not seem to acquire many patents.
- Wrights' lawsuits do not seem to affect the U.S. numbers particularly
- Later in WWI, industry consolidates, invests; more company patents