

# The great aviation patent spike of 1910

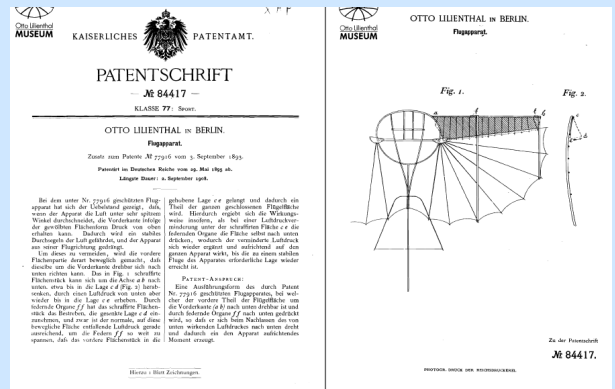
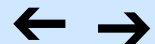
Peter B. Meyer

U.S. Bureau of Labor Statistics

Views and findings in this work represent only the author

WEAI Conference

June 29, 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 ; Integration of the field across countries  
Many designs were shared — “open source” practices
- 1903 Wright brothers’ powered-glider flight, 1906 major patent
- 1908-11 Big exhibitions.  
New aviation industry startups; sharp increase in aero patents
- 1914 World War I begins -- patents decline



# Economic context: change in “equilibrium”

- Early period: Scientists and tinkerers exchange information
  - Publications, scientific ambitions, sharing, problem-solvers equilibrium
- Later: In an industry, patents are 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
- Research question: What do patent flows look like over this period?

# A patent of Otto Lilienthal



KAISERLICHES



PATENTAMT.

## PATENTSCHRIFT

— № 84417 —

KLASSE 77: SPORT.

OTTO LILIENTHAL IN BERLIN.

Flugapparat.

Zusatz zum Patente № 77916 vom 3. September 1893.

Patentiert 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, daß, 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, daß dieselbe um die Vorderkante drehbar sich nach unten richten kann. Das in Fig. 1 schraffierte Flächenstück kann sich um die Achse *ab* nach unten, etwa bis in die Lage *cd* (Fig. 2) herabsenken, durch einen Luftdruck von unten aber wieder bis in die Lage *ce* erheben. Durch federnde Organe *ff* hat das schraffierte Flächenstück das Bestreben, die gesenkte Lage *cd* einzunehmen, und zwar ist der normale, auf diese bewegliche Fläche entfallende Luftdruck gerade ausreichend, um die Federn *ff* so weit zu spannen, daß das vordere Flächenstück in die

gehobene Lage *ce* gelangt und dadurch ein Theil der ganzen geschlossenen Flügelfläche wird. Hierdurch ergibt sich die Wirkungsweise insofern, als bei einer Luftdruckverminderung unter der schraffirten Fläche *ce* 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 (*ab*) nach unten drehbar ist und durch federnde Organe *ff* nach unten gedrückt wird, so daß er sich beim Nachlassen des von unten wirkenden Luftdruckes nach unten dreht und dadurch ein den Apparat aufrichtendes Moment erzeugt.



OTTO LILIENTHAL IN BERLIN.

Flugapparat.

Fig. 1.

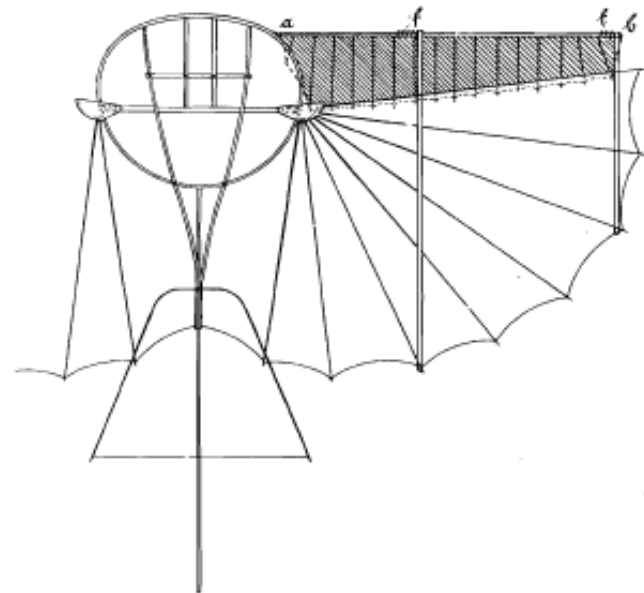


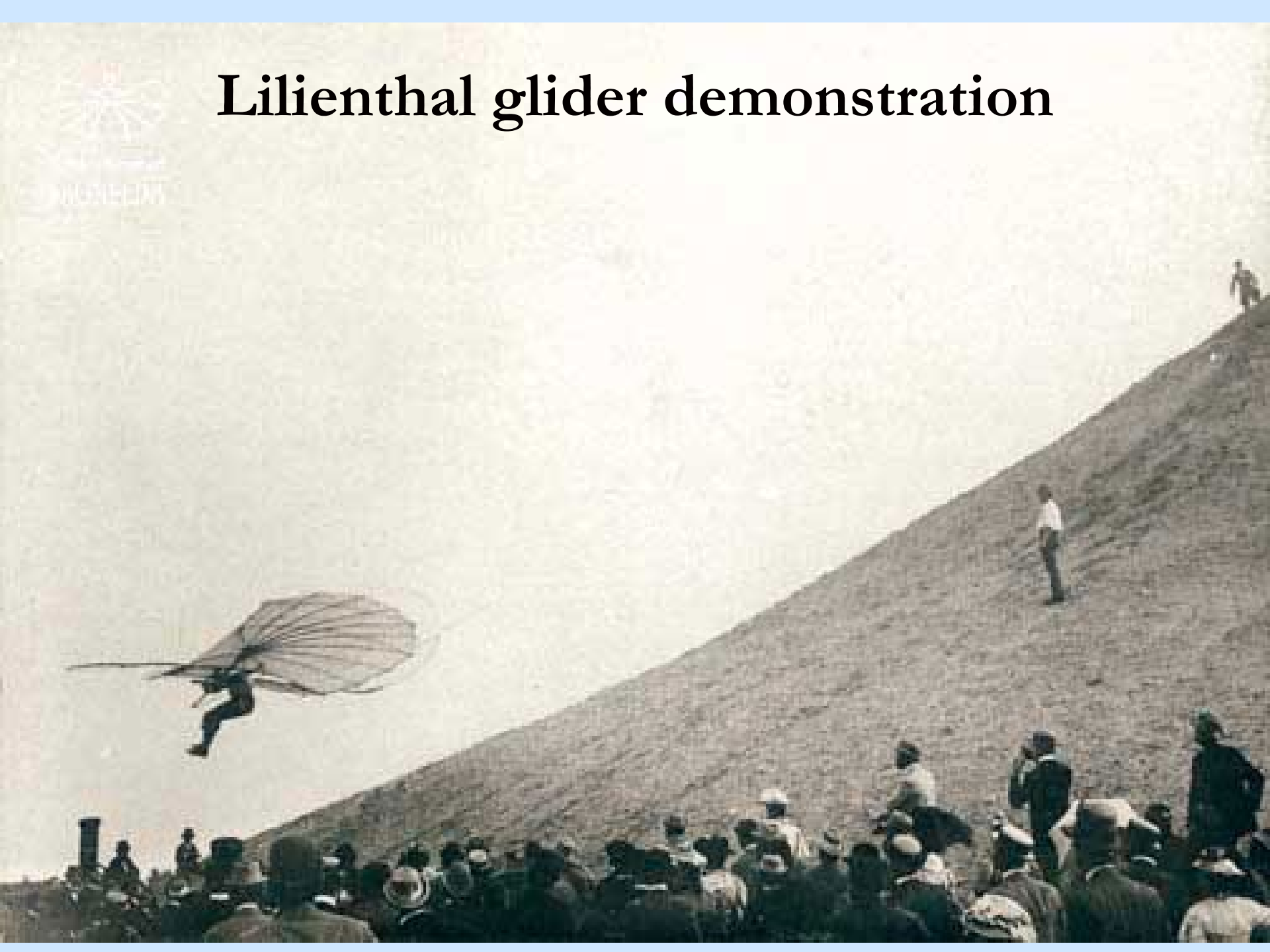
Fig. 2.



Zu der Patentschrift

№ 84417.

# 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](http://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](http://archive.org), [hathitrust](http://hathitrust)
- **Aeronautics journals** of the time
- Archives and libraries (US PTO, Belgium)
  
- Sources are vast. There's more to collect

# Aero patent data challenges

- Patent's **relevance** to aviation not always clear
  - In some countries patents plainly classified by technology, in others not
- Very **limited data** on some, e.g. in lists at right
- **Patent office practices** are hard to find
- Country definitions: Austria-Hungary, colonies

Patent documents similar across countries in content but:

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

Distinctive patent types

- Patent “**additions**” to an earlier one
- A “**foreign filing**” is basically a patent with the same content as an earlier one but in another country

APPAREILS DE SAUVETAGE, PISCICULTURE ET GRANDE PÊCHE, AÉROSTATS.

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

— 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,

## LISTE DES BREVETS

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

312,642. — 20 août 1901. — de Dion : Perfectionnements aux ballons dirigeables.  
312,645. — 21 août 1901. — de Dion : Perfectionnements à la construction des ballons dirigeables et à leurs mécanismes de propulsion.  
312,675. — 21 août 1901. — Sébillot : Perfectionnements dans la navigation aérienne.  
312,676. — 21 août 1901. — Bugnet : Aérostat dirigeable.  
312,682. — 21 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. — Turr : Nouveau système de ballon.  
312,962. — 3 septembre 1901. — Paquier : Perfectionnements dans l'aérostation.  
312,995. — 4 septembre 1901. — Porak : Machine à voler.  
313,495. — 7 septembre 1901. — Vroland : Système de ballon dirigeable.  
313,416. — 10 septembre 1901. — Riedinger : Hélice aérostatique à poids formant volant.  
313,207. — 12 septembre 1901. — Maynie : Nouveau ballon dirigeable.  
313,219. — 13 septembre 1901. — Guillaume : Perfectionnements apportés aux dispositifs employés dans la navigation aérienne.  
313,268. — 19 septembre 1901. — Patti dal Pozzo : Aérostat dirigeable.

(1) Communication de MM. Martillet et Babelet, Office International pour l'Édition de Brevets d'Invention en France et à l'étranger, 42, boulevard Beaune-Nouvelle, Paris.



# Patent data on a wiki

- We collect the data in this format
- Each patent has a page
- It can be edited from browser

Paragraphs discuss patent in our terms

Hyperlinks, footnotes, and categories as on Wikipedia

Can use Wikipedia images or upload one

The table at bottom is structured data

- That's a row in table of patents
- Dates, tech categories, page counts
- Statistics come from those

Wiki platform is good for handling data ambiguity and uncertainty during analysis

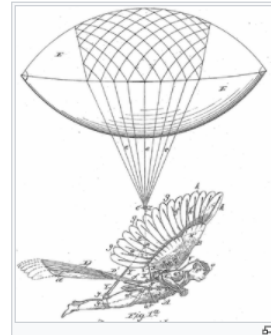
Human flapping attached wings underneath a gas balloon

Lilienthal museum's Seifert notes:

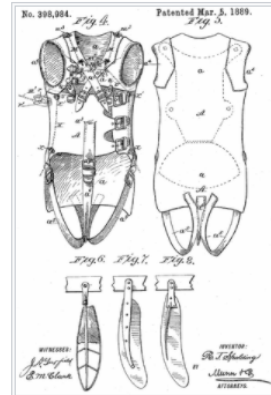
- Spalding built a model in the shape of a flying human. The flying apparatus consists of wings and a tail, which are connected to the plane with a jacket-like construction. Straps in the pelvic area pass between the legs on the back. The wings attached to the wrist are pivotable by Holm joints. They 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 airyworthy 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 "Flügeschlagmodell"
- Inventor location: Rosita, CO

Sources [edit]

- [Original patent documents](#) 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	<a href="#">Reuben Jasper Spalding</a>
Inventor country	US
Applicant person	
Applicant firm	
Applicant type	
Applicant is inventor?	Yes
Original title	Flying-machine
English title	Human-powered flapping wings with balloon
Tech fields	<a href="#">LTA</a> , <a href="#">flapping</a> , <a href="#">piloting</a> , <a href="#">human-powered</a> , <a href="#">hybrid</a> , <a href="#">ornithopter</a> , <a href="#">texture</a> , <a href="#">leather</a>
Filing date	September 1, 1888
Full specification filed date	
Application number	
Grant date	March 5, 1889
Granted?	Yes
Publication date	
Supplementary to patent	
Related to aircraft?	Yes
Serial number	284340
Patent agent	<a href="#">Munn &amp; Co.</a>
Assigned to	
National tech categories	<a href="#">USPC 244/28</a> , <a href="#">USPC 244/64</a> , <a href="#">USPC 244/151R</a>
IPCs	
CPCs	<a href="#">CPC B64B1/00</a> , <a href="#">CPC B64B1/00</a>
Family year	1888
First filing?	Yes
Cites these patents	
Citations from after 1930	
Application ID	
INPADOC family ID	
Number of text pages	7
Number of diagram pages	5
Number of figures	14
Number of claims	20

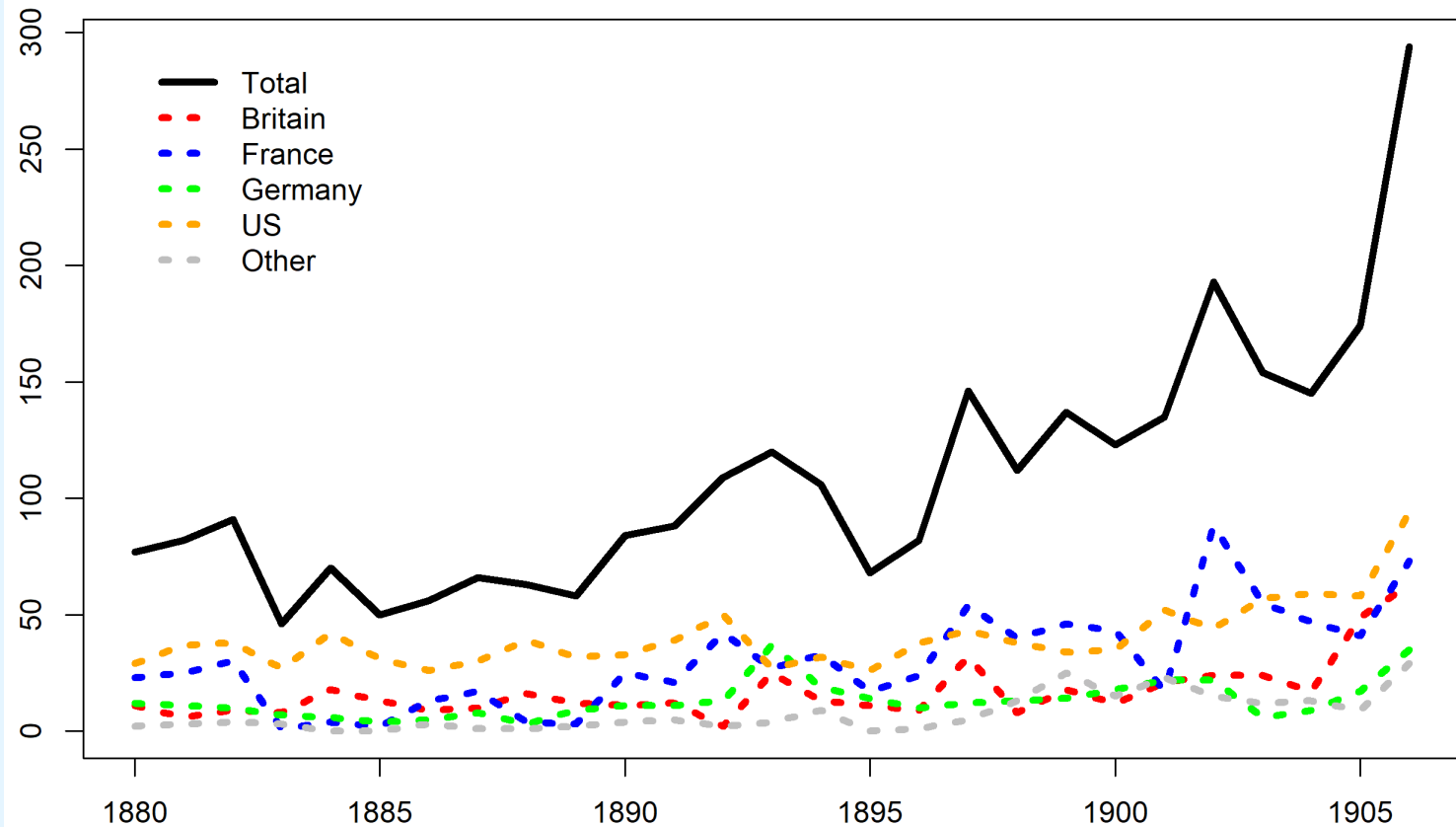


The aeronaut's jacket A (shown most clearly in Figs. 4 and 5 of the drawings) is preferably made mainly of leather; but it may be made mainly of cloth or any other suitable material or fabric. It has an elongated main or back portion, a, and a front consisting mainly of a breast-belt, a', two shoulder-belts, a'' a'', and a broad body-belt, a''', all having suitable buckle-and-strap connections with the main part of the jacket, which is provided with holes a'' a'', through which the aeronaut will slip his arms prior to buckling the jacket around his body. A couple of straps, a'' a'', fastened at one end to the bottom of the jacket-back a, are brought up between the aeronaut's legs, and thence diagonally across his thighs, and are buckled to tabs at the sides of the jacket, and another belt, a''', also connected to the middle lower part of the back, a, is brought around between the aeronaut's legs, and is buckled to a tab at the central lower portion of the broad body-belt a''', and whereby when all these belts are buckled the jacket will be held very tightly to the aeronaut's body [...]





## Aeronautical and aviation patents by year filed, 1880-1906

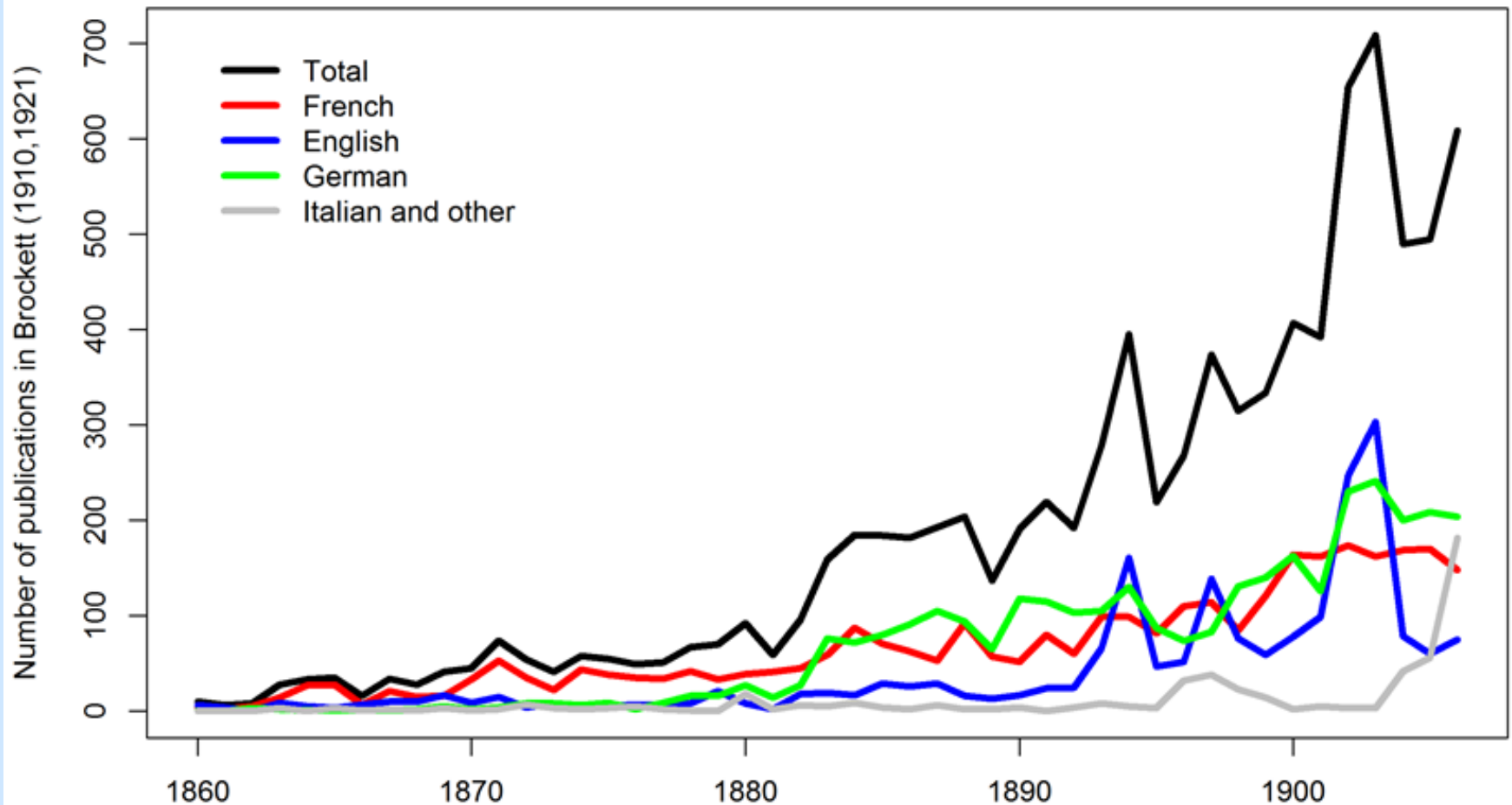


Aero patents grew steadily then spike in 1906

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

Grows 5% to 7% per year – exponentially – rate similar to patents overall

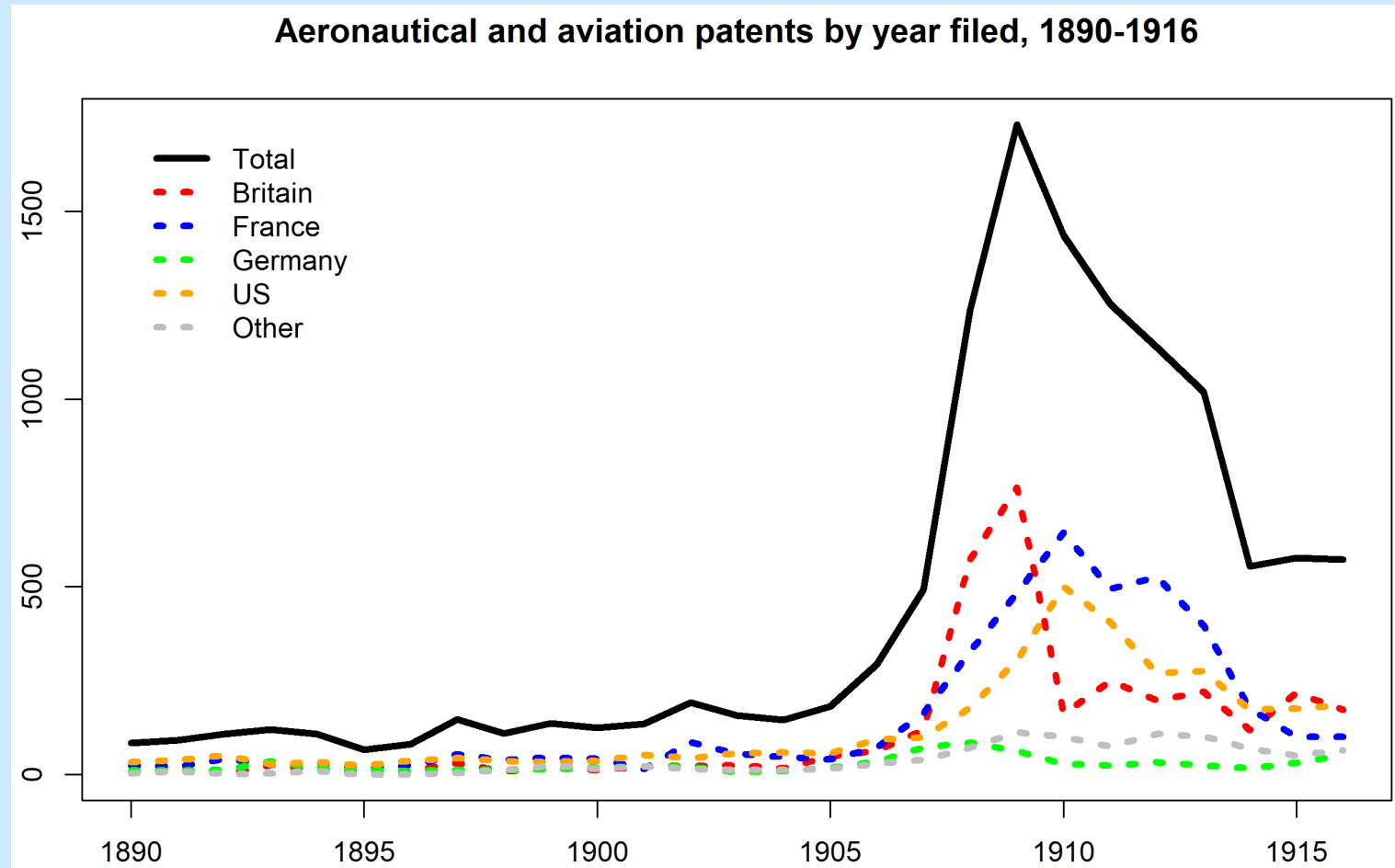
In 1906: Wrights get patent; Public flight by Santos-Dumont



## 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

We count pages of text and numbers of diagrams and claims, when possible

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

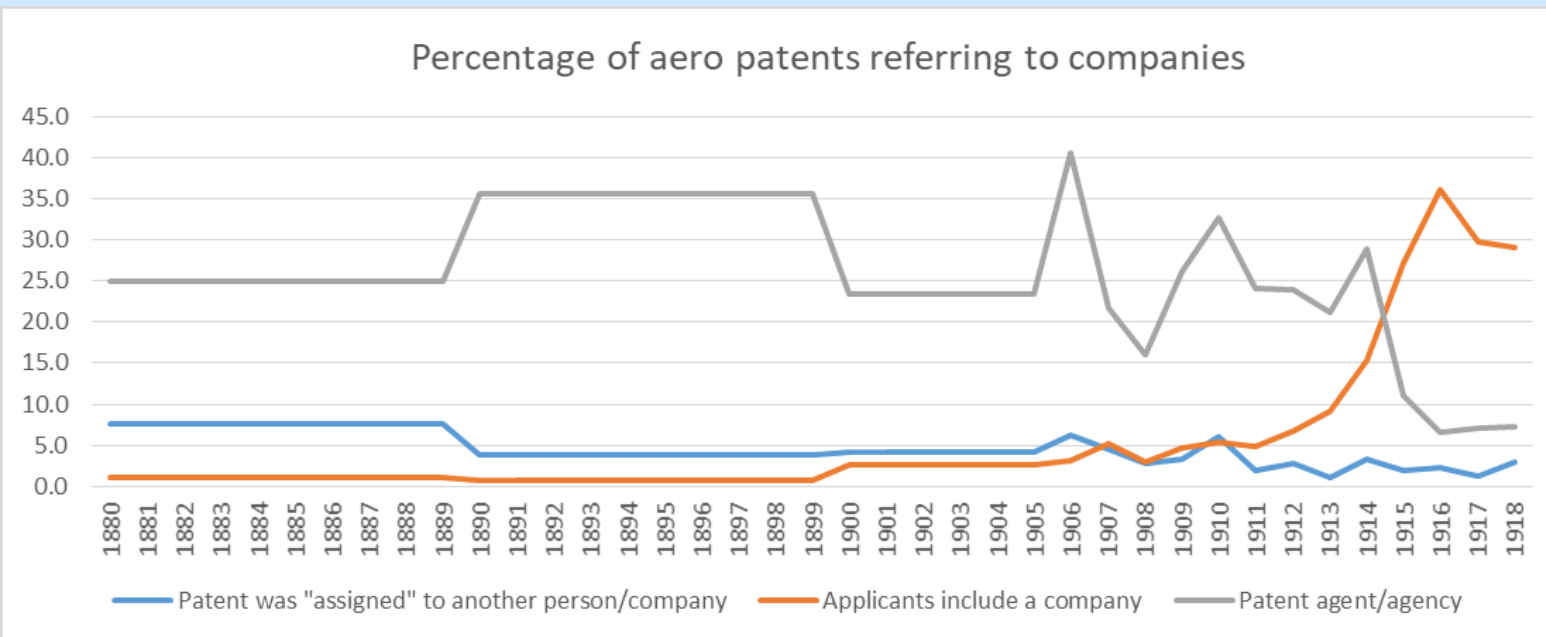
- Germany's were shortest, with fewer text pages and diagrams
- British patents were longer with more text
- U.S.'s make the most legal claims
- These patterns may be the same for non-aero patents – plan to test

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

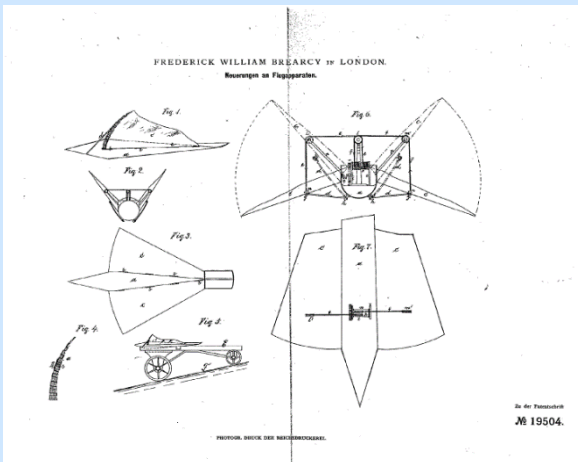
# Can compare design technology

## Tech theme 1: Flapping wings

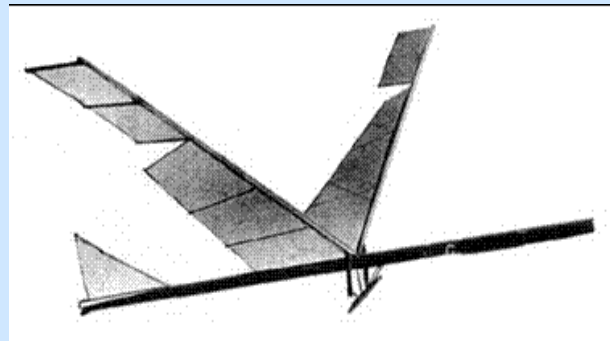


They want to make a bird.

**Ornithopters:** machines with flapping wings



Brearey's 1882 patent



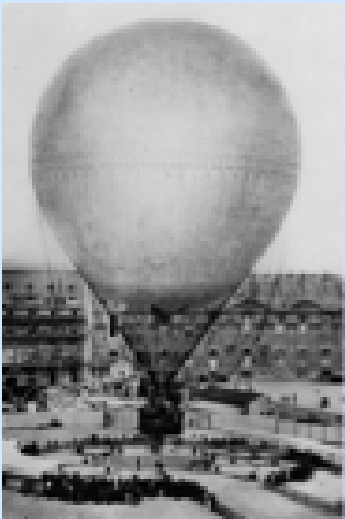
Hargrave 1891 model  
ornithopter



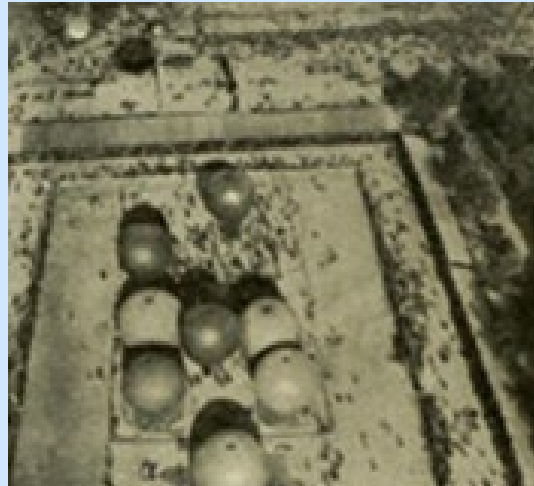
Frost 1902 ornithopter



# Tech theme 2: balloons to dirigibles (steerable)



Giffard 1878

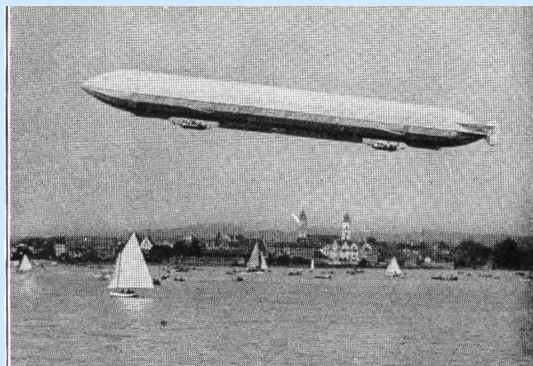


Balloon contest 1895



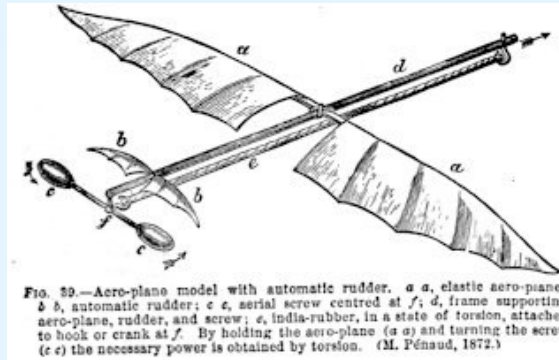
Santos-Dumont 1901 dirigible  
flew around Eiffel Tower and  
returned to starting place

Zeppelin,  
~1910



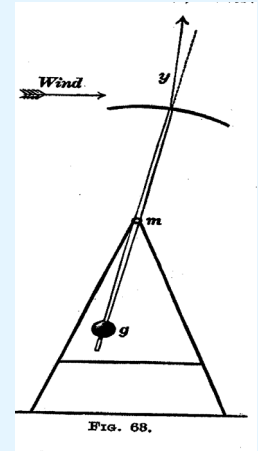
# Tech theme (3): Soaring

## Fixed wings, kites, gliders, airplanes

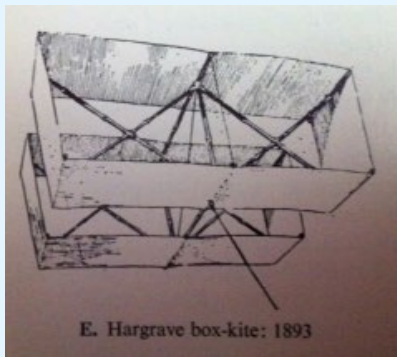


Penaud, ~1872

Wind-up model with tail



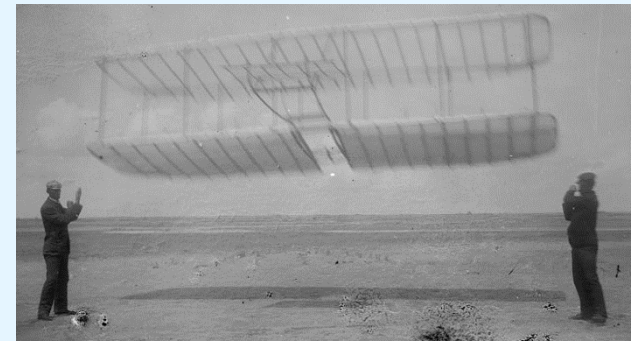
Lilienthal airfoil tests  
1870s-1880s



Hargrave box kites 1893

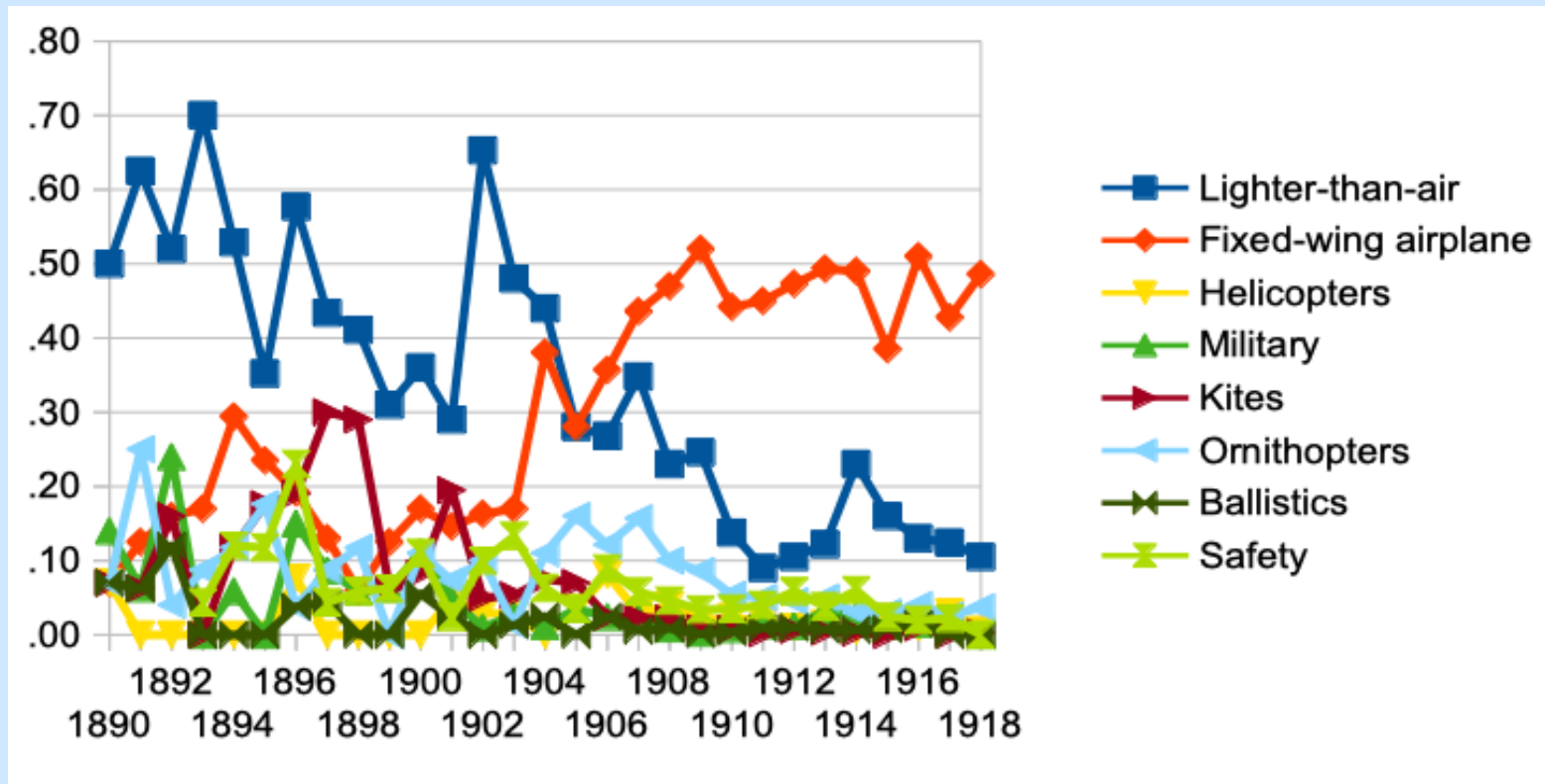


Chanute-Herring glider, 1896



Wrights, 1901-2

# Proportions of patents by design/topic



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



# 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

The spike is associated with the success of airplane design

Airplane activity outgrows balloon and ornithopter activity before 1906

Airplane manufacture has begun, circa 1908.

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