Aeronautical patents and aviation history from 1880-1916

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Goals and questions

Airplanes have a long pre-history. There is vast documentation – bibliography, letters, exhibitions, clubs, patents.

We know eventually airplanes will be valuable.

What processes led to their invention and the startup industry?

What does the patent stream look like?

New here: combined aeronautics patent data set from many sources
Aeronautics and aviation from 1880

1880: aeronautics/aviation is a niche activity – maybe hopeless, useless, dangerous

Clubs and journals and exhibitions associated with ballooning exist especially in Paris, London, and Berlin

Interest in “aerial navigation,” wings, and “flying machines” gathers there

1890s Public glider flights; survey book defines field

Many designs were shared and discussed - open source practices

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

1908-11 Big exhibitions. Industry arises

1914 World War I begins
Balloons and bird-like designs

Balloons, since 1783

Balloons contest 1895

Ornithopters have flapping wings

Brearey’s 1882 patent

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

Hargrave 1891 model ornithopter
Fixed wing shapes

Le Bris 1868 *Albatross* was pulled by a horse and lifted off from the cart.

Penaud, ~1872
Wind-up model with tail

Mouillard 1881

Lilienthal 1870s-1880s

Hargrave box kites 1893

Chanute-Herring glider, 1896
Data on aero patents

- EPO’s Patstat / Espacenet data
  - Coverage back to 1910 or earlier, varying by country
- Data before 1910 is eclectic, from a dozen sources, aero-focused, classified variously
  - INPI: French vintage patent database online; *L’Aerophile*; *AÉRO-MANUEL 1914*; *Catalogue des brevets d’invention*, 1880s; SUBJECT-MATTER INDEX OF PATENTS FOR INVENTION (1883)
  - google patents & USPTO
  - Brewer and Alexander, 1893, *Aeronautics*
  - *Aeronautical Journal*
  - coverage of German patents is incomplete
  - Some duplication too
- 13,500 patents here total
Beim unter Nr. 77916 geschützten Flugapparat hat sich der Übelstand 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 Durchseilen der Luft gehärtet, 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 a b nach unten, etwa bis in die Lage c d (Fig. 2) herabwenden, durch einen Luftdruck von unten aber wieder bis in die Lage c e erheben. Durch federnde Organe f f hat das schraffierte 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, dass das vordere Flächenstück in die gebogene 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 schraffenen Fläche c e die federnden Organe die Fläche selbst nach unten drücken, wodurch der verminderete Luftdruck sich wieder ergänzt und aufrecht gestellt 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 dass er sich beim Nachlassen des von unten wirkenden Luftdruckes nach unten dreht und dadurch ein den Apparat aufrichtendes Moment erzeugt.
Patent differences across countries

- Core: France, Britain, Germany, and US
- Patent docs per se look similar in terms of length, claims, description, diagrams, definition of inventor and agent, time to approve
- Many rules similar along lines of 1883 Paris Convention
- German and US systems require more “examination”
  - Novel, non-obvious, useful
- France and Britain sometimes just “register” an application
- “Patent controversy” – some countries didn’t have patent systems; some inventors avoided patenting
- Aeronautics classified differently
  - In France: “marine/aerostation” category
  - In Germany: “Sport”
Aero patents grew to 1906, then spike
Year is from grant date (not application date)
Supplementary patents are counted like first patents here – “additions”, foreign filings
These patents cover aeronautics, but not engines
Maybe 75% coverage of those

Why do they patent before 1900?
Uncertain. Most of these seem to expire quickly
Professional identity / activity, tradition, to get the word out, to be remembered and credited
Most-cited early experimenters published and patented

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Copying from previous designs – so not really intellectual property

- Lilienthal’s glider
- Penaud’s tail
- Hargrave’s box kites
- Pratt truss for bridges
- Chanute-Herring glider, 1896
- Wright brothers 1901-2 kites and gliders
- Wright 1903 powered glider
Aeronautical patents decline after 1912 especially in war

Companies are increasingly funding development and applying for patents.

No obvious effect of Wright lawsuits in U.S. circa 1911

In World War I: aviation technology is dangerous to share
Aero publications show similar trends

Source: Brockett’s *Bibliography of Aeronautics* (1910, 1921)

1907 – Interest in new industry; 1914 – notable drop during the war, especially in French, German and Italian. *L’Aerophile* explicitly reduced frequency of publication.
Classifying technology in a patent

- Patstat / Espacenet patents usually have standard CPC categories
- Colleagues and I have read and categorized many earlier ones
- Many here are classified by finding key words in title (for now)
- About half have been categorized
Spike in several flight technology topics

Patents per year, in any country

Overall peak: 1910
As proportion of aero patents, wings/airfoils/airplanes take over from other ways of lift and flight.
Military low: not clearly distinguished, not mainly aeronautic, and furthermore patents make information public which is not helpful for military intent.
Long trends in aero patents to the present

The 1910 peak in aeronautical patent filings globally was not reached again until 2000. It was a kind of frenzy of opportunity.
Long term transition from individual applicants to companies
By this measure, the 1910 peak was never exceeded.
Conclusions

Three big phases of patenting

- Scientific / hobbyist “open source” period to 1906 -- growth
- Startup industry period to 1914 -- boom
- Decline into World War I period

Burst of patents across aeronautic/aviation topics starting in 1907
Publications, clubs, and exhibitions boom then too

Technology topics focuses on airfoil/fixed-wings especially
Inflow of companies and interest in that topic, not mainly change in focus
Military interest important for business but not as visible in patents