

Les Brocot

une dynastie d'horlogers

Richard Chavigny



Editions Antoine Simonin

The Brocots

A Dynasty of
Horologers

Presented by
John G. Kirk

Outline

- Introduction
- Background: Paris Clocks
- Brocot Genealogy
- The Men and Their Works
- Gallery

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Introduction

- This is a review of “Les Brocot, une dynastie d’horlogers” by Richard Chavigny
- Dean Armentrout asked me to discover the following:
 - How many/who are the Brocots who contributed to horology (see below...)
 - The years the famous innovations were made (and by whom) (see below...)
 - How the Brocot dynasty interacted with other clockmakers, for example the house of Le Roy (curiously, such interactions, if any, aren’t mentioned in the book)

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The Paris Clock (1 of 5)

- The term, la Pendule de Paris, applies to table/mantel clocks developed by Parisian clockmakers
- Beginning around 1810 and continuing well into the 20th century production of these clocks evolved into a highly industrialized process

The Paris Clock (2 of 7)

- Around 1810, Paris clocks were no longer fabricated from scratch in Paris except by the grand houses, such as Breguet, Le Paute, etc.
- A “mass” market for high quality, competitively-priced “Clocks of Commerce” developed based on ébauches completed and finished in Paris

The Paris Clock (3 of 7)

- The ébauches comprised
 - The two plates
 - The barrel (without spring)
 - The strike train complete with detents/ratchets
 - The dial train
 - The time train without the escape wheel
- They did not include
 - The escapement, including the escape lever and its bridge
 - The suspension and pendulum
 - The hammer, gong, and its support

The Paris Clock (4 of 7)

- All parts of the ébauches were rough from machining and required finishing to a level commensurate with the quality of the finished clock
- The clockmaker also had to provide the missing parts, adjust all parts to run smoothly, and regulate the clock to time

The Paris Clock (5 of 7)

- The source of the ébauches were factories in Provence
 - The best were produced by Honoré Pons and his successors at Saint-Nicolas-d'Aliermont and Vicenti (later Roux) at Montbéliard
 - The other Montbéliard producers, particularly Japy and Marti, were of significantly lower quality

The Paris Clock (6 of 7)

- The escapements, suspensions, and pendulums could be fabricated by a clockmaker, ordered from fabricators to the clockmaker's specification, or bought from supplier's stock
- Cases were supplied by case makers, ranging from special, unique cases through high-quality series-made cases, to mass-produced cases

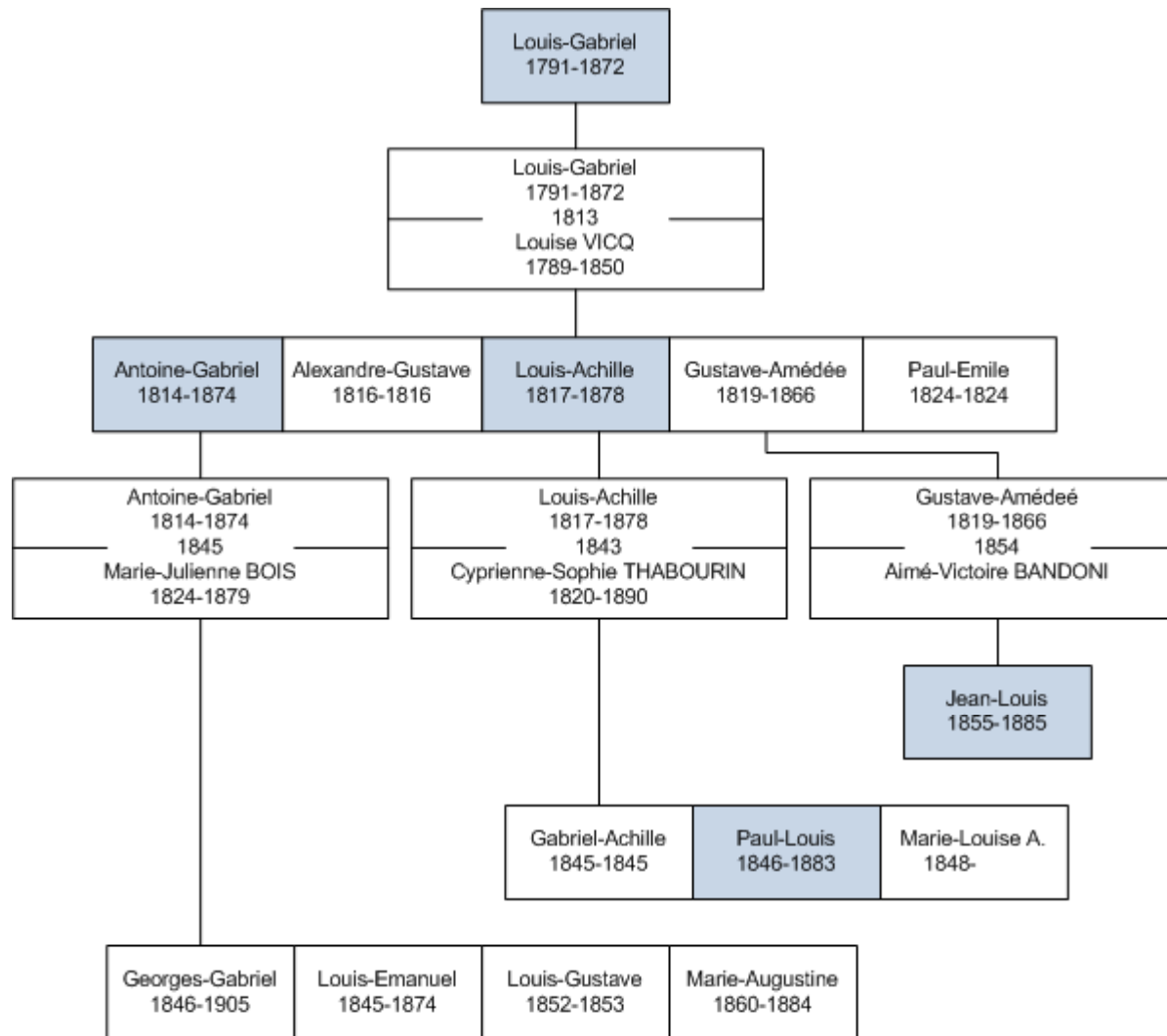
The Paris Clock (7 of 7)

- The result was mass production in the manner of Eli Terry or Seth Thomas, but of higher quality and prices for the French bourgeoisie

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- Introduction
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- **Brocot Genealogy**
- The Men and Their Works
- Gallery

Genealogy (1 of 2)



Genealogy (2 of 2)

- The Founder: Louis-Gabriel Brocot
- The Industrialist: Antoine-Gabriel Brocot
 - Eldest surviving son of Louis-Gabriel
- The Engineer: Louis-Achille Brocot
 - Middle surviving son of Louis-Gabriel
- The Artist: Paul-Louis Brocot
 - Son of Louis-Achille
- The Youth: Jean-Louis Brocot
 - Nephew of Antoine-Gabriel and Louis-Achille

Brocot Markings (1 of 4)

- In general, Brocot name plate stamps are
 - Brocot in “script” for Louis-Gabriel
 - See next slide
 - BROCOT in “block capitals” for Antoine-Gabriel
 - See second following slide
 - Brocot in “Old German” for Louis-Achille
 - See third following slide
- Stamps with initials in various designs were also used

Brocot Markings (2 of 4)



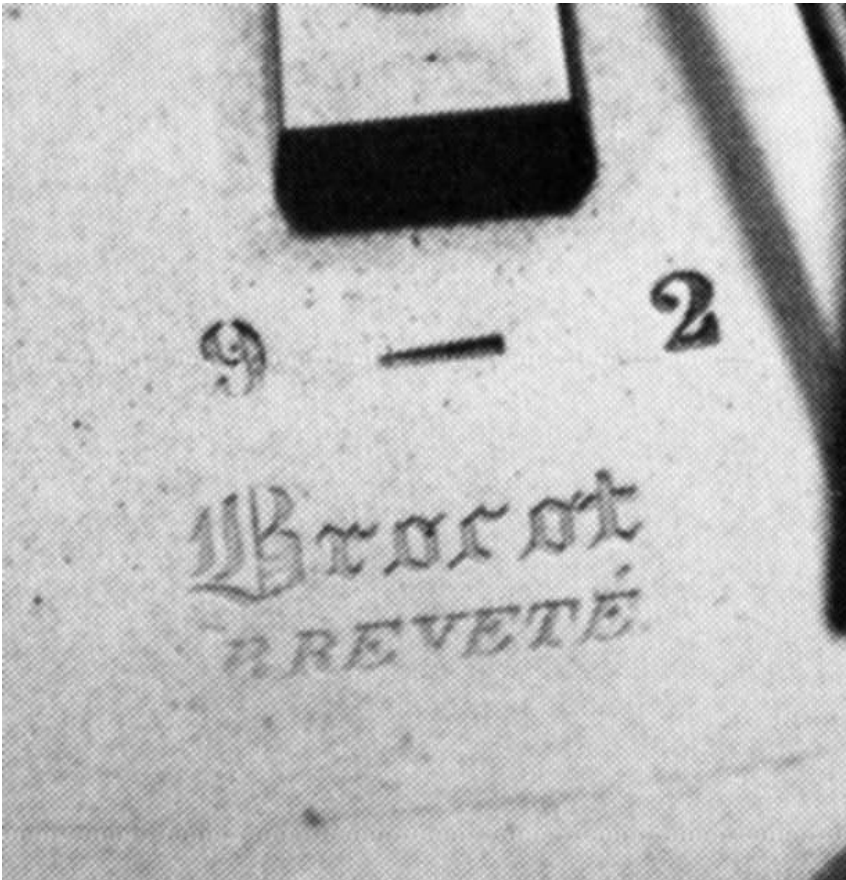
- Louis's name stamp
- The "8 7" is the pendulum length: 8 pouces (Paris inches), 7 lignes (a ligne is $1/12^{\text{th}}$ of pouce)
- "Breveté" means "patented"

Brocot Markings (3 of 4)



- Antoine's name stamp
- At 9 pouces 2 lignes the pendulum for this clock is a bit longer
- This clock has a different train count from the previous one

Brocot Markings (4 of 4)



- Achille's name stamp
- These are rare, note that the pendulum is the same length as the previous one

Brocot Dial Names

- Many Brocot clocks have no name or other names on the dials, usually a jeweler or other clock retailer
- Clocks with the maker's name on the dial are somewhat rare

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Louis-Gabriel Brocot (1 of 12)



- Louis arrived in Paris in 1803 not only being able to read, but with a good foundation in mathematics at a time when only 10% of the French population could even read
- After a horological apprenticeship, by 1812 he was an established clockmaker with an excellent reputation

Louis-Gabriel Brocot (2 of 12)

- Louis produced first-quality “Pendules de Paris” using excellent ébauches made by Honoré Pons, selling well-received clocks to both the public and other vendors
- His premises became a gathering place for other clockmakers

Louis-Gabriel Brocot (3 of 12)

- The Paris clock of the era was not perfect
 - The silk thread suspension was unsatisfactory
 - The escapement could not drive pendulums heavy enough for good timekeeping
 - The count wheel strike mechanism was fussy and easily lost synchronism with the hands
- Louis solved the first two of these problems
 - Pons solved the third by devising the rack striking mechanism, which Louis helped him improve

Louis-Gabriel Brocot (4 of 12)

- Louis Brocot Patents:

Patent No.	Date	Inventor	Description
02903	1826-04-01	Louis-Gabriel	“Brocot” escapement and strike
11674	1840-08-10	Louis-Gabriel	Suspensions
11857	1840-09-22	Louis-Gabriel	Suspensions
13515	1842-02-23	Louis-Gabriel	Suspensions
13757	1852-06-02	Louis-Gabriel	Suspensions

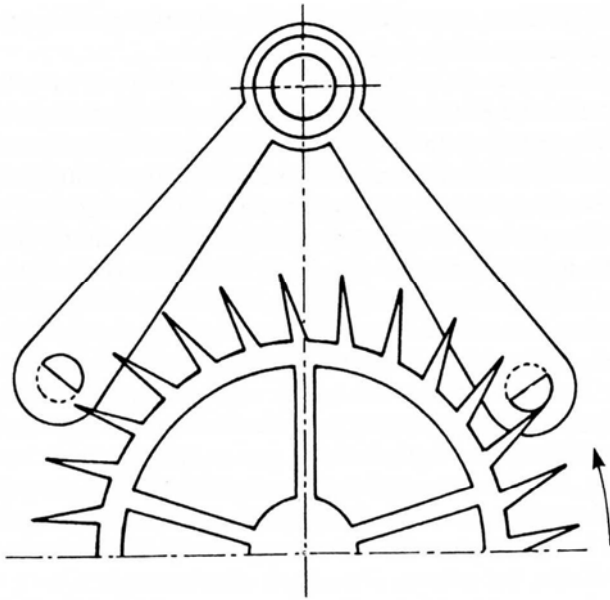
- Related Patents:

Patent No.	Date	Inventor	Description
02333	1823-10-26	César-Honoré Pons	Strike, rack mechanism and quarter
03948	1829-05-08	César-Honoré Pons	Strike and helical escapement

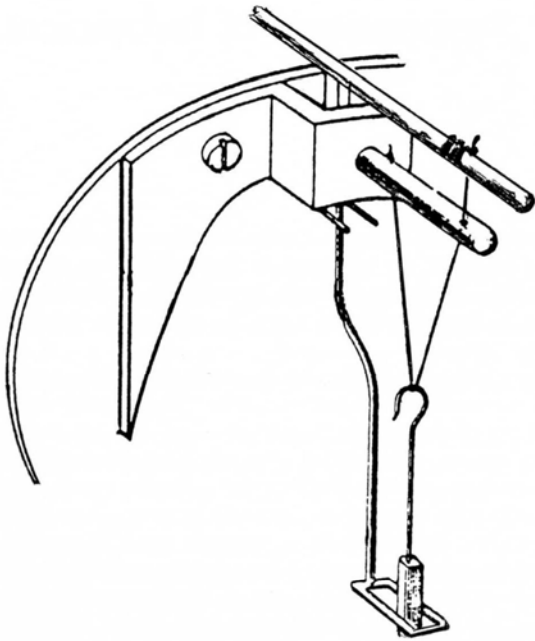
Louis-Gabriel Brocot (5 of 12)

- Louis's escapement (1826)

- More easily fabricated than pinwheel
- (Nearly) deadbeat
- Robust and reliable
- BUT suitable only for half-second pendulums or shorter (large angular amplitude needed)

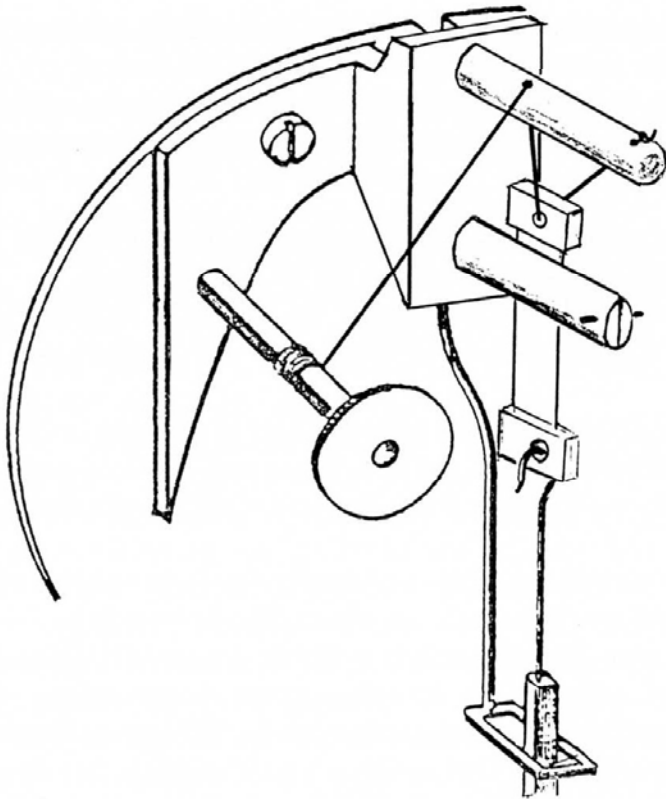


Louis-Gabriel Brocot (6 of 12)



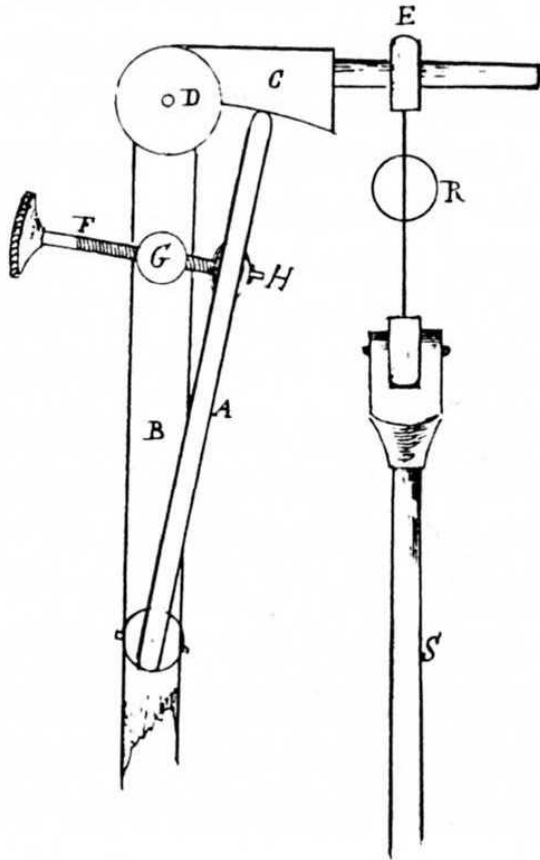
- Classic silk-thread suspension
 - Only silk will do in this application
 - Adjustment is touchy
 - Crutch operation is touchy
 - Will support only (very) light pendulums
 - Silk is relatively insensitive to temperature change, but quite sensitive to humidity change

An Aside: Silk and Spring...



- “Mixed suspension”
 - Silk thread supporting and adjusting a spring suspension passing through a slit block!
 - Chavigny claims this isn’t a joke, that these were actually made and sold beginning in 1830
- This is a foretaste of Louis’s adjustable spring suspension of 1840

Louis-Gabriel Brocot (7 of 12)



- Louis's first attempt at an adjustable, temperature-compensated spring pendulum suspension (as drawn by Louis-Achille)
- Adjusting the zinc-and-steel compensation is touchy
- The rate is not easily adjustable by the owner

Louis-Gabriel Brocot (8 of 12)

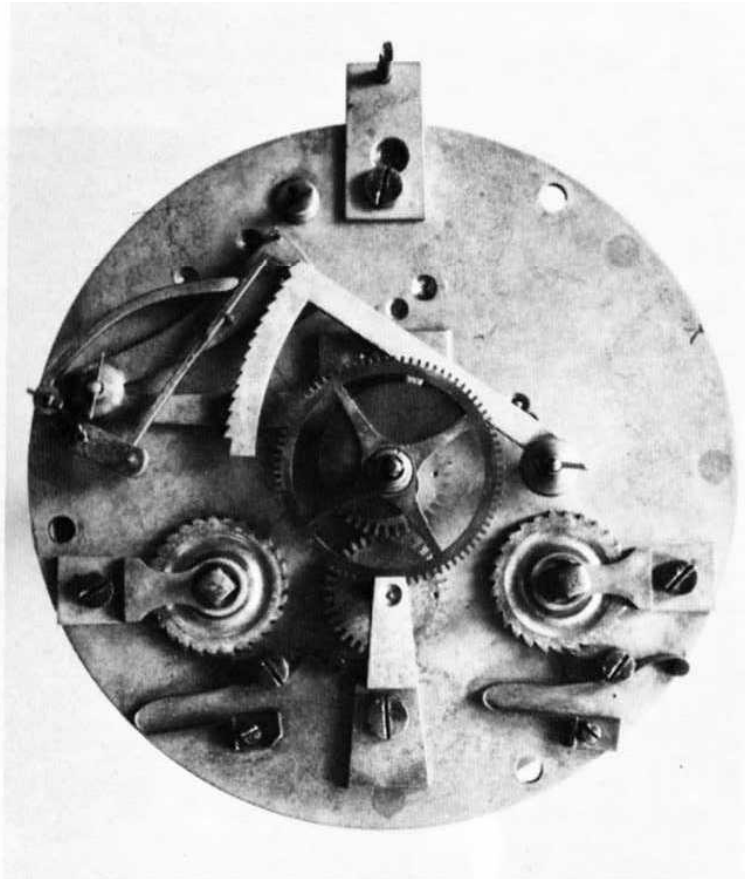
- Louis conducted extensive investigations into the metallurgy, design, and performance of suspension springs
- He and his sons Achille (Louis - Achille) and Antoine (Antoine - Gabriel) were responsible for the adjustable-length Brocot suspension and its development, beginning with Louis's patent in 1840

Louis-Gabriel Brocot (9 of 12)



- Very early strike mechanism
- Note the sickle-shaped rack, a fabrication and adjustment challenge

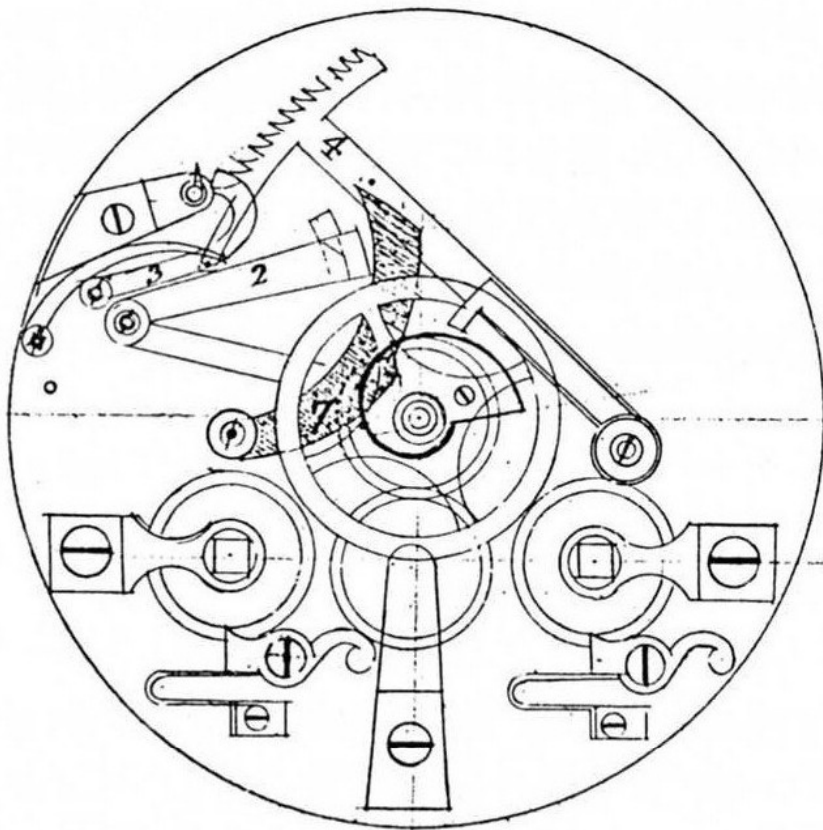
Louis-Gabriel Brocot (10 of 12)



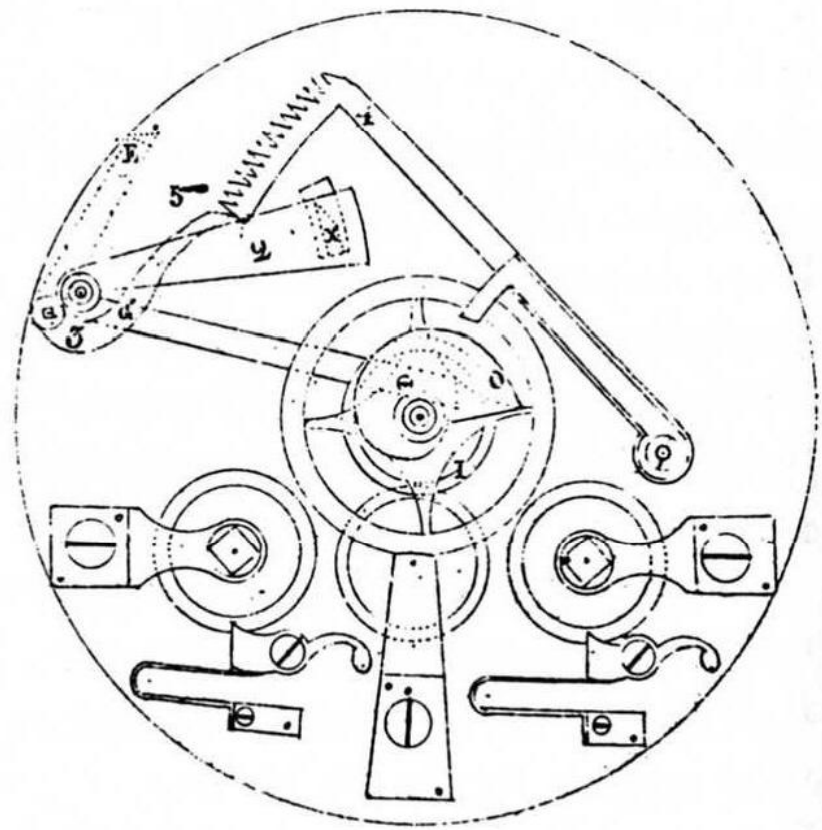
- Pons rack strike mechanism including improvements/rationalizations by Louis
- Pons eventually reduced the moving parts to eight
- Louis further reduced them to five

Louis-Gabriel Brocot (11 of 12)

Pons 1826

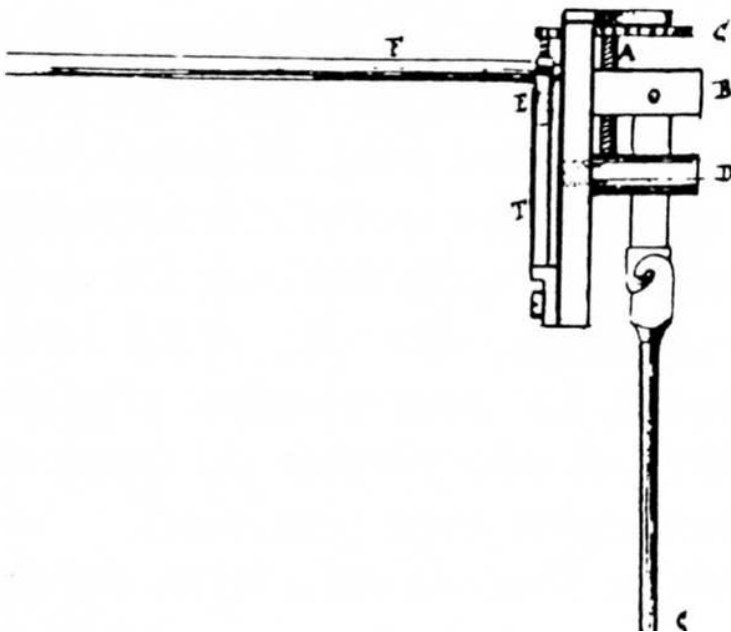


Louis definitive 1829



Louis-Gabriel Brocot (12 of 12)

- The 1840 patent drawing for the Brocot adjustable spring suspension, a collaborative effort of Louis and Achille



Antoine-Gabriel Brocot (1 of 6)



- Antoine, like his father Louis, bought Pons ébauches, added the escapement, hammer, crutch, and suspension, finished these parts, and added a pendulum to a case, dial and hands acquired separately

Antoine-Gabriel Brocot (2 of 6)

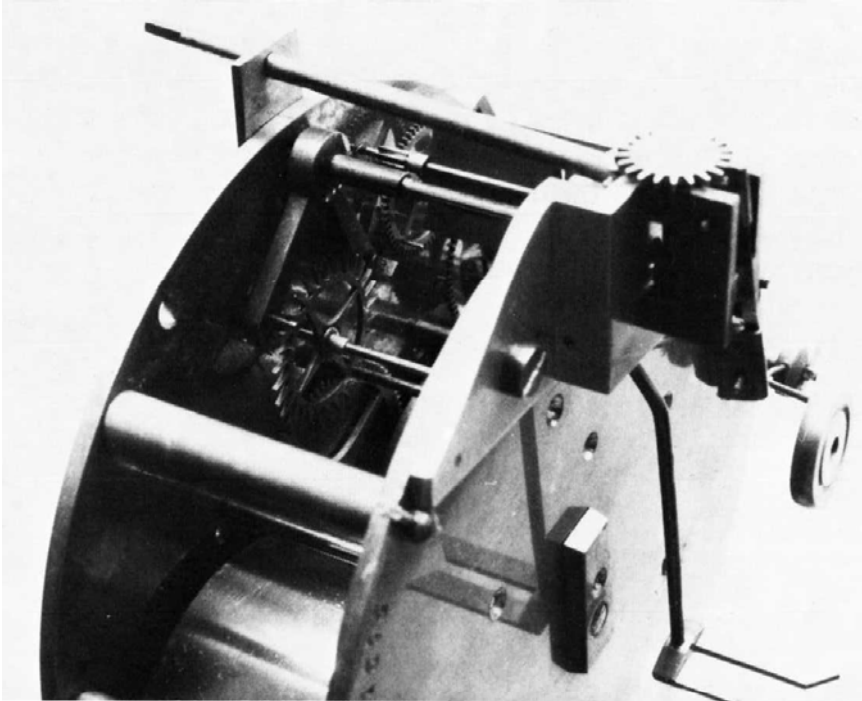
- Antoine was primarily an industrialist, manufacturing those parts of Paris clocks not provided by the ébauche makers, including
 - Hammers
 - Gongs/bells
 - Suspensions (particularly after his father discontinued their manufacture)

Antoine-Gabriel Brocot (3 of 6)

- Antoine Brocot patents:

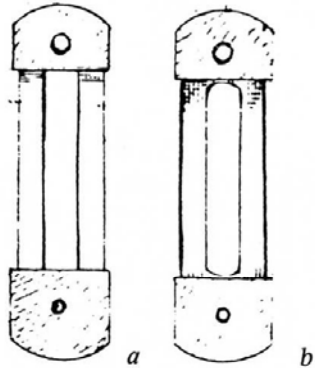
Patent No.	Date	Inventor	Description
38839	1858-11-24	Antoine-Gabriel	Machinery for suspensions
68261	1863-08-01	Antoine-Gabriel	Suspensions
68261	1866-02-16	Antoine-Gabriel	Suspensions

Antoine-Gabriel Brocot (4 of 6)

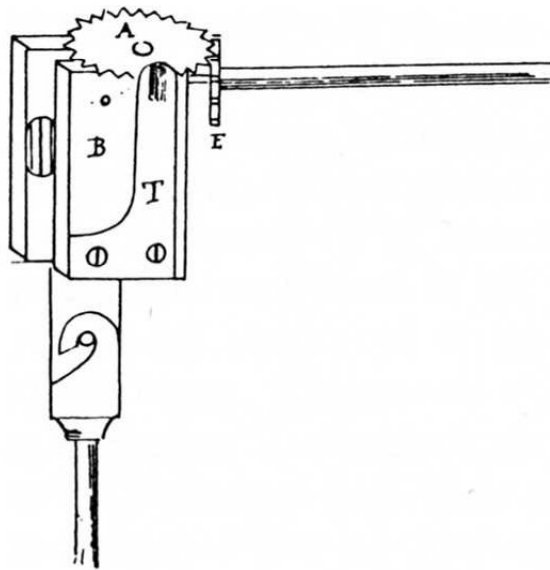


- Antoine movement with parts he manufactured
 - Suspension
 - Hammer
 - Fork
 - Brocot escapement

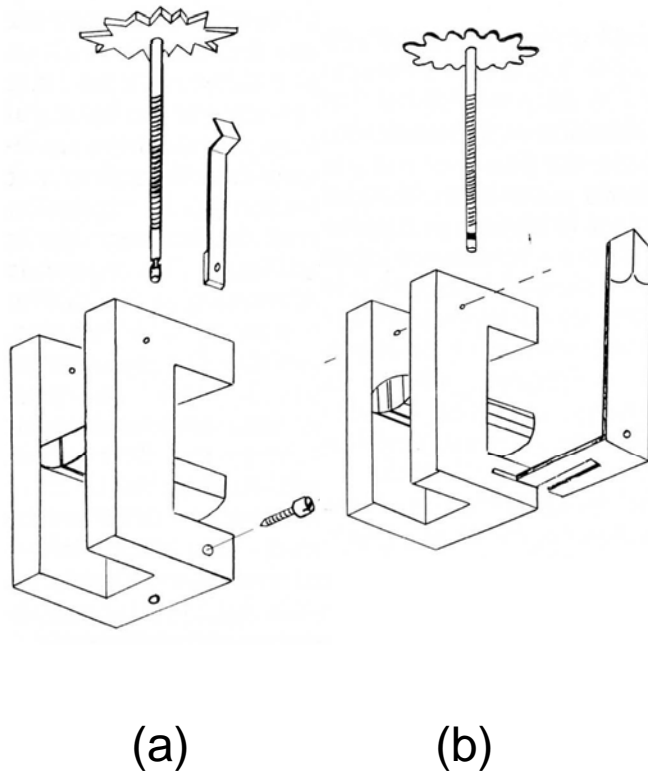
Antoine-Gabriel Brocot (5 of 6)



- Examples of Antoine's work
- Replacing two-piece suspension springs (a) with single, shaped spring (b)
- Rationalized Brocot suspension with rate adjustment



Antoine-Gabriel Brocot (6 of 6)



- Rationalization of manufacture of Brocot suspensions
 - (a) 1840 patent
 - (b) Fifth version, Antoine's 1866 patent
- Principal performance change (for the second version) were “floating” (half-slit) jaws to prevent pinching the spring

Louis-Achille Brocot (1 of 23)



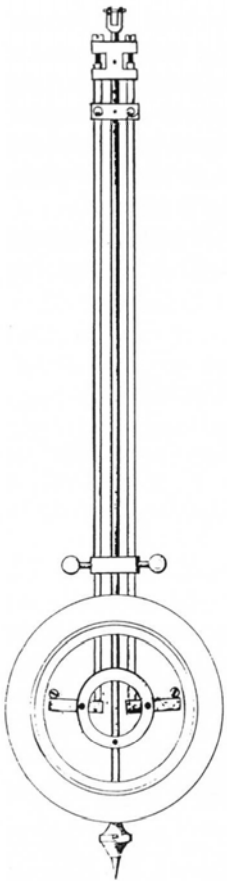
- L.-A. (Achille) was the most inventive of the Brocots
- He devised
 - thermal compensated pendulums,
 - variant escapements,
 - perpetual calendars,
 - equation of time displays,
 - long running (up to 4 years!) clocks

Louis-Achille Brocot (2 of 23)

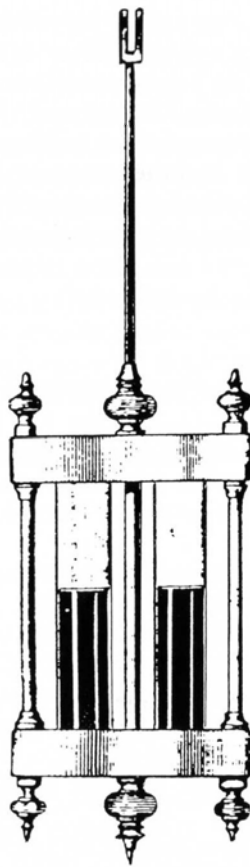
- Achille's patents:

Patent No.	Date	Inventor	Description
05275	1847-03-23	Louis-Achille	Pendulums
05275	1849-05-22	Louis-Achille	Calendar
05275	1852-04-06	Louis-Achille	Calendar and escapements
05275	1853-10-05	Louis-Achille	Center seconds and alarm
12482	1851-10-08	Louis-Achille	Calendar (text in windows)
50982	1861-08-28	Louis-Achille	Calendar and escapements
50982	1863-06-25	Louis-Achille	Alarm
69234	1865-10-19	Louis-Achille	Calendar (text in windows)

Louis-Achille Brocot (3 of 23)



(a)



(b)

- Achille patented the temperature-compensated pendulum (a), an Ellicott variant, in 1847
- It was made in quantity and worked well, but others thought it would be subject to mechanical binding
- To quell this argument, he eventually adopted Redier's 1855 mercury pendulum (b)

Louis-Achille Brocot (4 of 23)

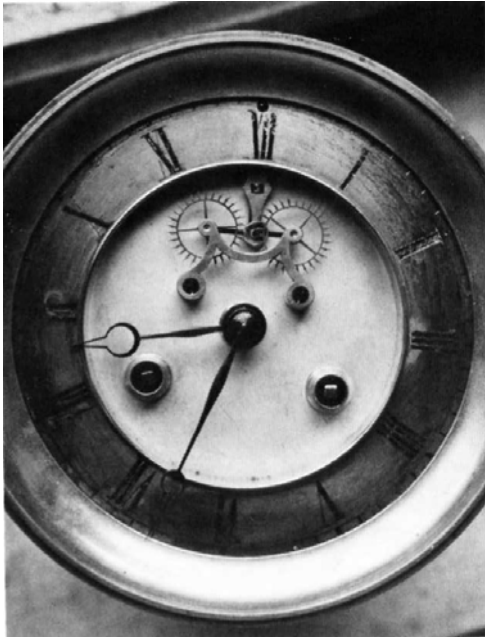
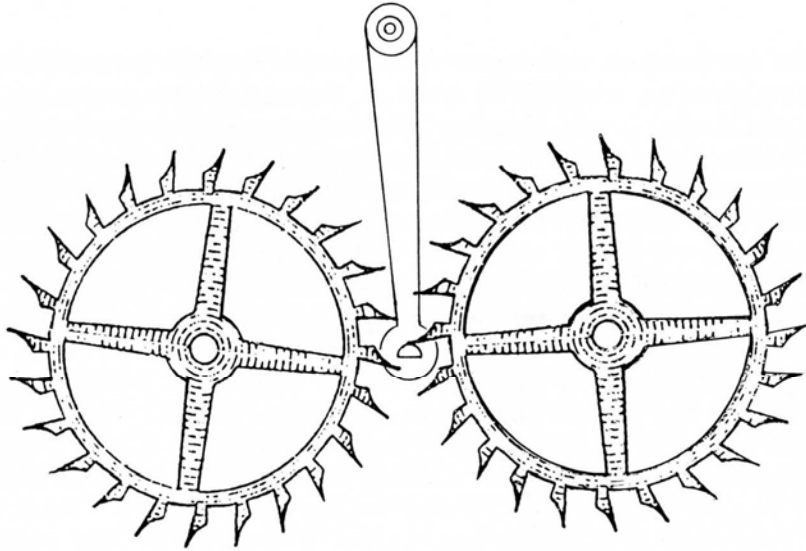
“Early “ Glass Regulator



“Late” Glass Regulator



Louis-Achille Brocot (5 of 23)

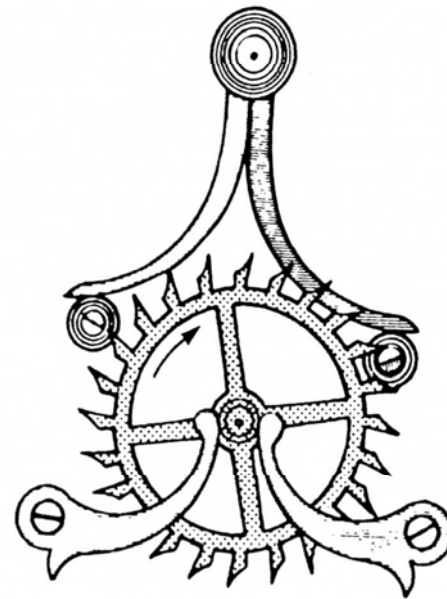


- Achille's double-wheel escapement (1839), prototyped for an exhibition that year, an example of his command of geometry
- The length of the lever is easily adjustable to control recoil to just that needed for good isochronism

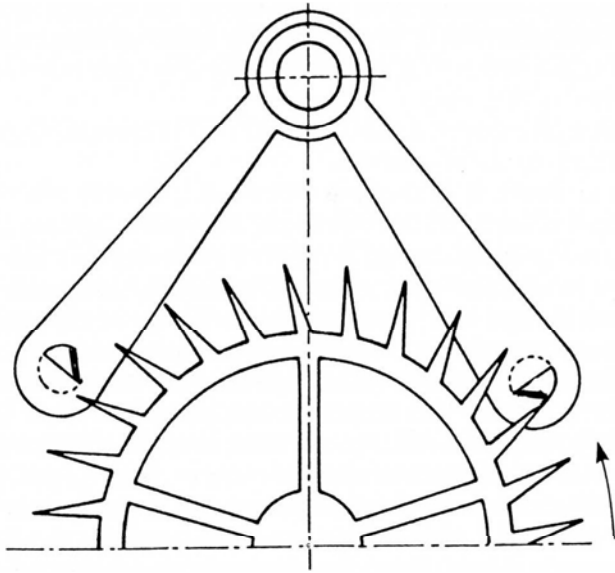
Louis-Achille Brocot (6 of 23)



- The visible escapement, inspired by the visible double wheel of 1839, was first offered in 1842

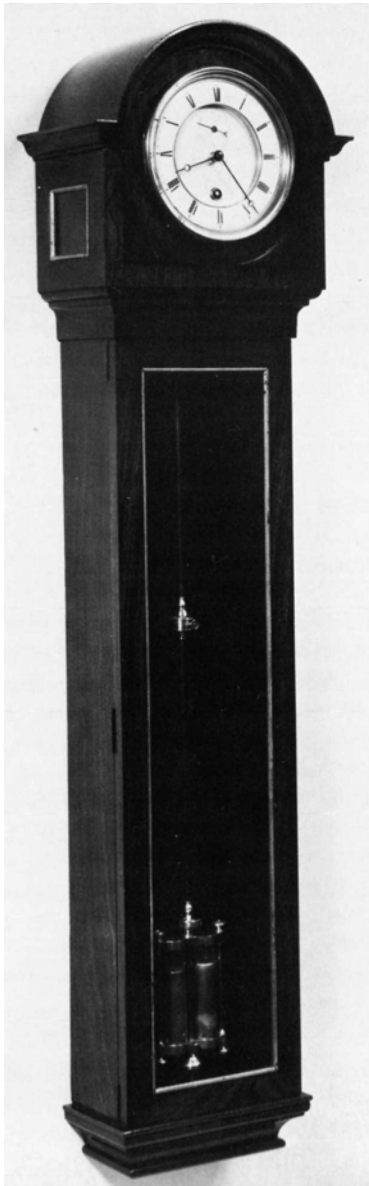


Louis-Achille Brocot (7 of 23)

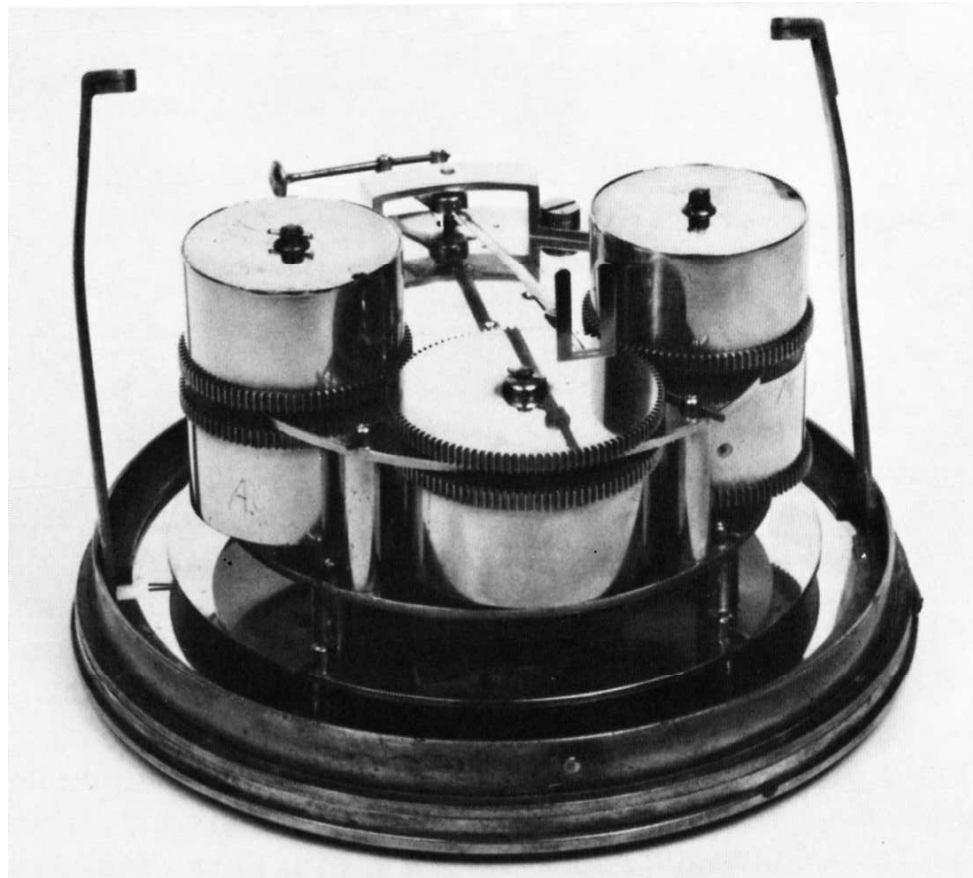


- In 1848, Achille replaced Louis's pallets with triangular ones similar in operation to Graham's to reduce the amplitude of the pendulum.
- This escapement was used in the superb regulator made for the 1849 exhibition, shown on the next slide

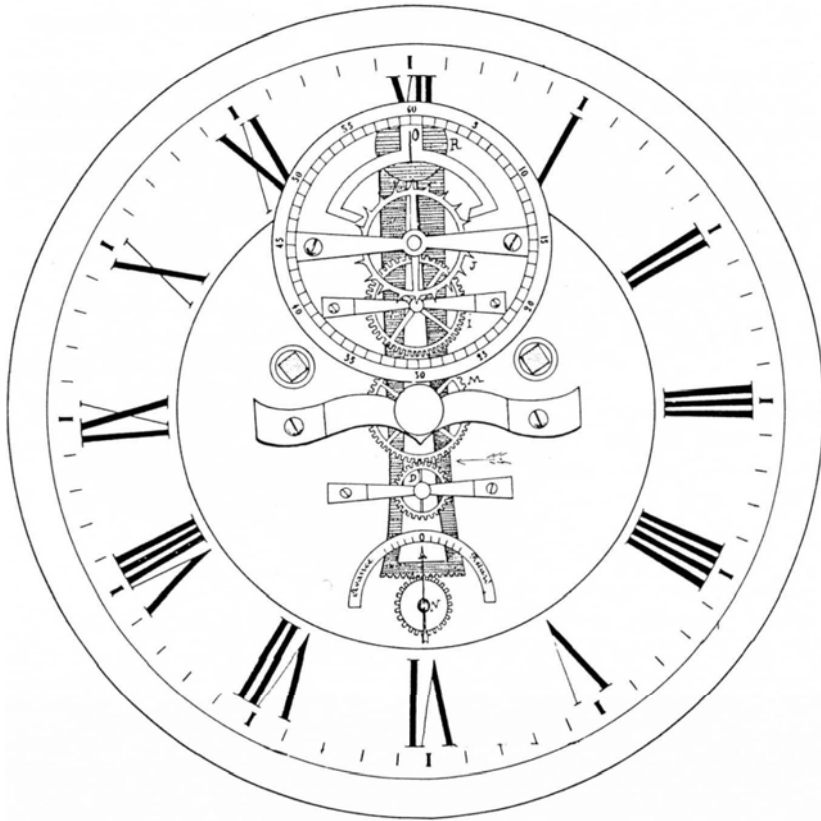
Louis-Achille Brocot (8 of 23)



- 1849 year-plus running Hg pendulum regulator and five barrel movement



Louis-Achille Brocot (9 of 23)



- In addition to a substantial number of “gadget” escapements, Achille devised this unsuccessful ultra-complicated constant force escapement
- Its elaborate double-pendulum mechanism was beyond mortal skills to regulate

Louis-Achille Brocot (10 of 23)

- In 1849 Achille patented his first “perpetual calendar”. In horological usage, this means a (Julian) calendar capable of representing the four-year cycle of lengths of the months, including February 29th in leap years, but not including the Gregorian calendar complication that only those even century years divisible by 400 are leap years.
- He also devised mechanisms to represent the Muslim calendar
- His calendars often included Moon phase or age, and/or the equation of time.

Louis-Achille Brocot (11 of 23)

- Achille's perpetual calendars are of seven types, designated by Roman numerals I through VII
- In addition to devising mechanisms for regulating the lengths of the months, he devised a quite-accurate gear train, error ~ 1 minute/year, for the length of the Moon's synodic month, the length of the cycle of its phases
 - He published a paper, reproduced in this book, that I've translated, and later a book on a practical method for calculating geartrains to match desired input/output ratios using pencil, paper, and log and prime number tables

Louis-Achille Brocot (12 of 23)

- The calendar mechanism is a separate movement from that of the time and strike trains, and is impulsed by the strike train if the clock has one (which most Paris clocks do)

Louis-Achille Brocot (13 of 23)

- Summary of principal features for each type (1)
 - I: Perpetual calendar, Moon phase (“penny” Moon). Equation of time sometimes marked on dial
 - II: As I, but added subsidiary dial for Julian calendar in addition to Gregorian. Sunrise-sunset times for Paris marked on dial
 - III: As II, but added equation of time cam and revised dial layout

Louis-Achille Brocot (14 of 23)

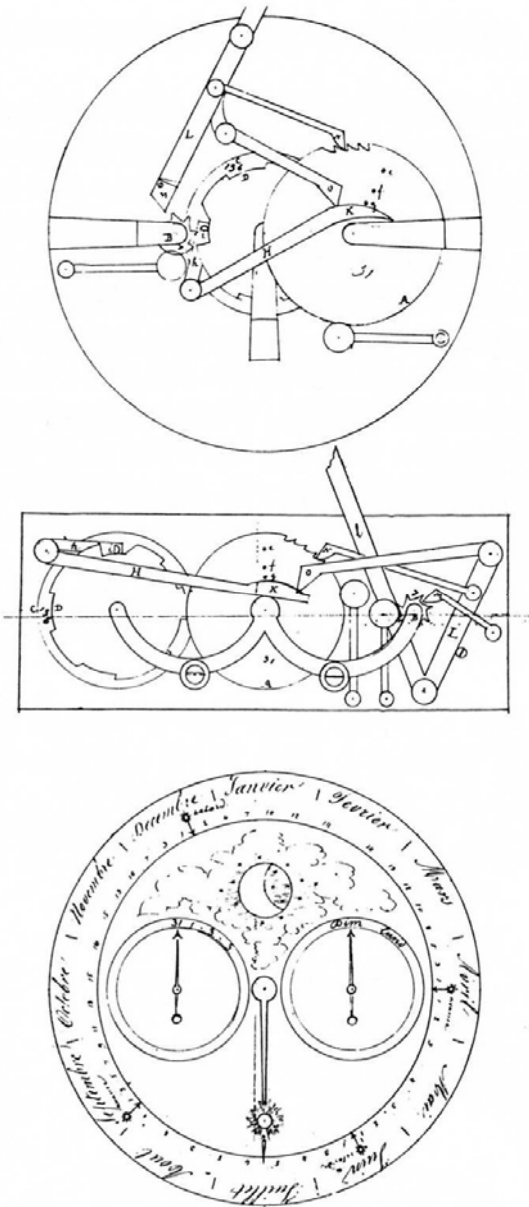
- Summary of principal features for each type (2)
 - IV: As I, but added equation of time cam; “simplified” mechanism. Less accurate lunar display
 - V: Annual calendar (lengths of months always those of non-leap years), month names apparently not displayed, different (not “penny”) Moon phase display

Louis-Achille Brocot (15 of 23)

- Summary of principal features for each type (3)
 - VI: “Astronomical” perpetual calendar, on two dials with “numerical” calendar, including year, displayed in windows between two dials:
 - On left, solar dial with time on double-12 hour dial showing sunrise and set plus equation of time, driven by time train
 - On right, phase and age of the Moon, and time of its meridian passage
 - VII: “Digital” calendar in two versions, one annual, the other simple (all months 31 days)

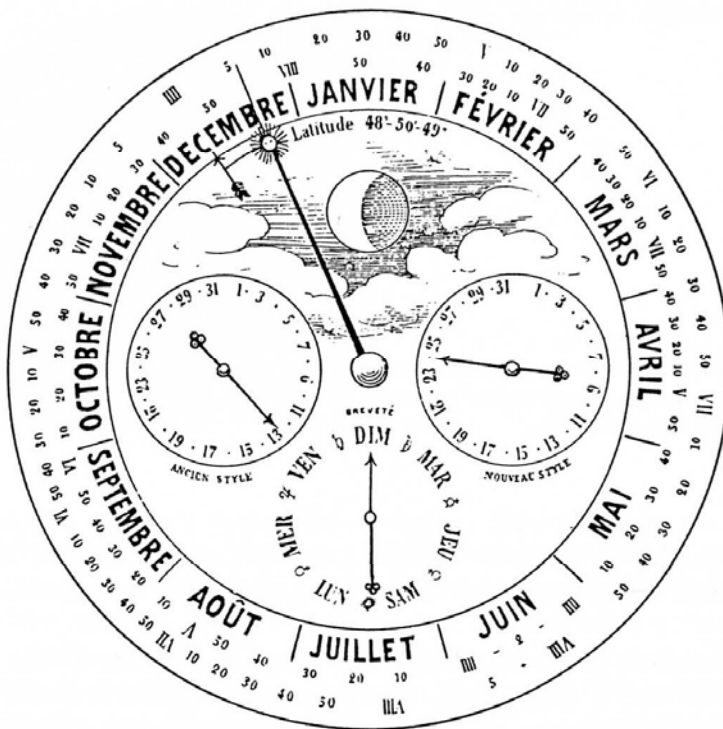
Louis-Achille Brocot (16 of 23)

- Type I calendar dial and two possible movement designs, circular and horizontal rectangular, from his 1849 patent application

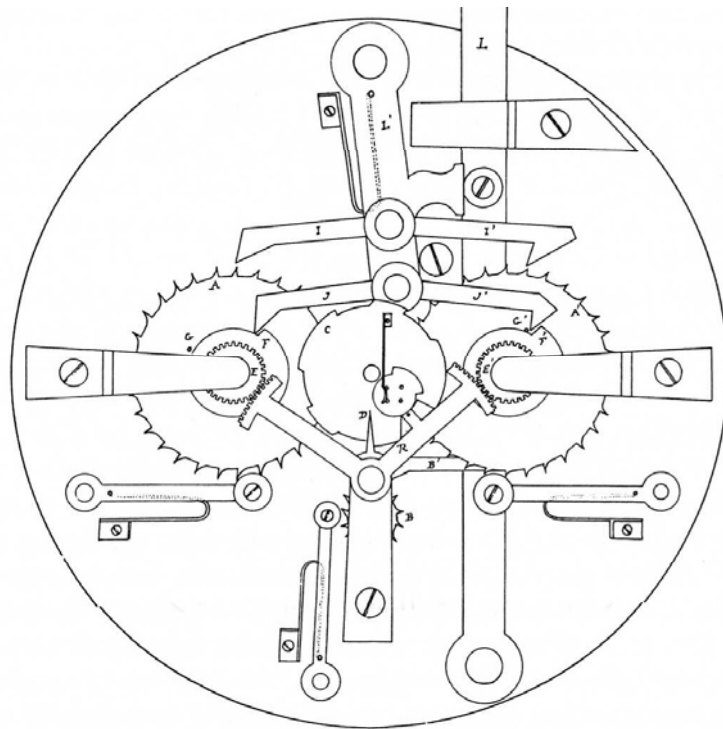


Louis-Achille Brocot (17 of 23)

Type II dial

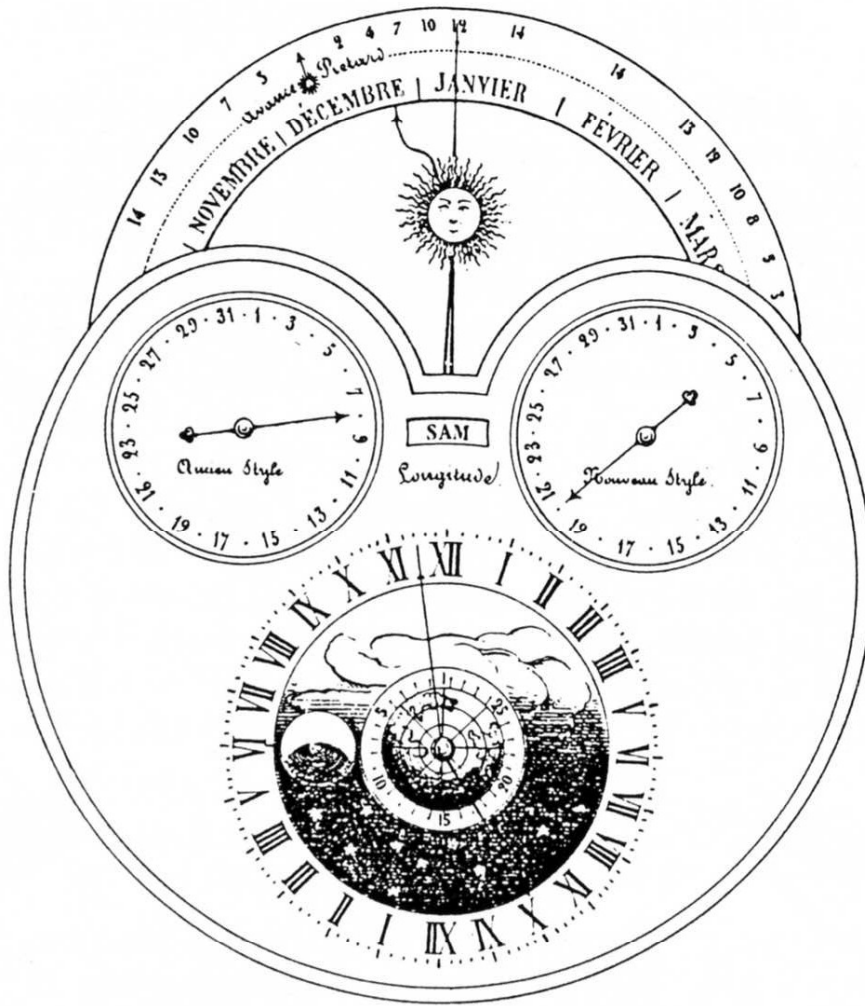


Type II mechanism

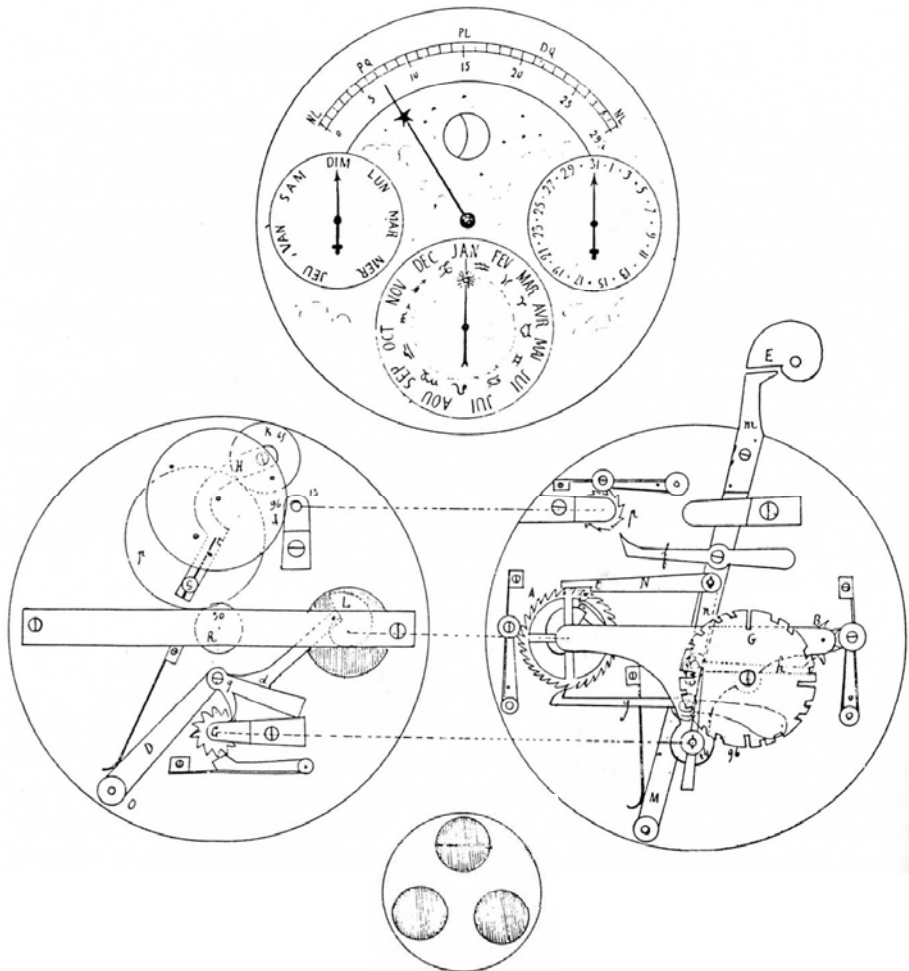


Louis-Achille Brocot (18 of 23)

- Type III dial



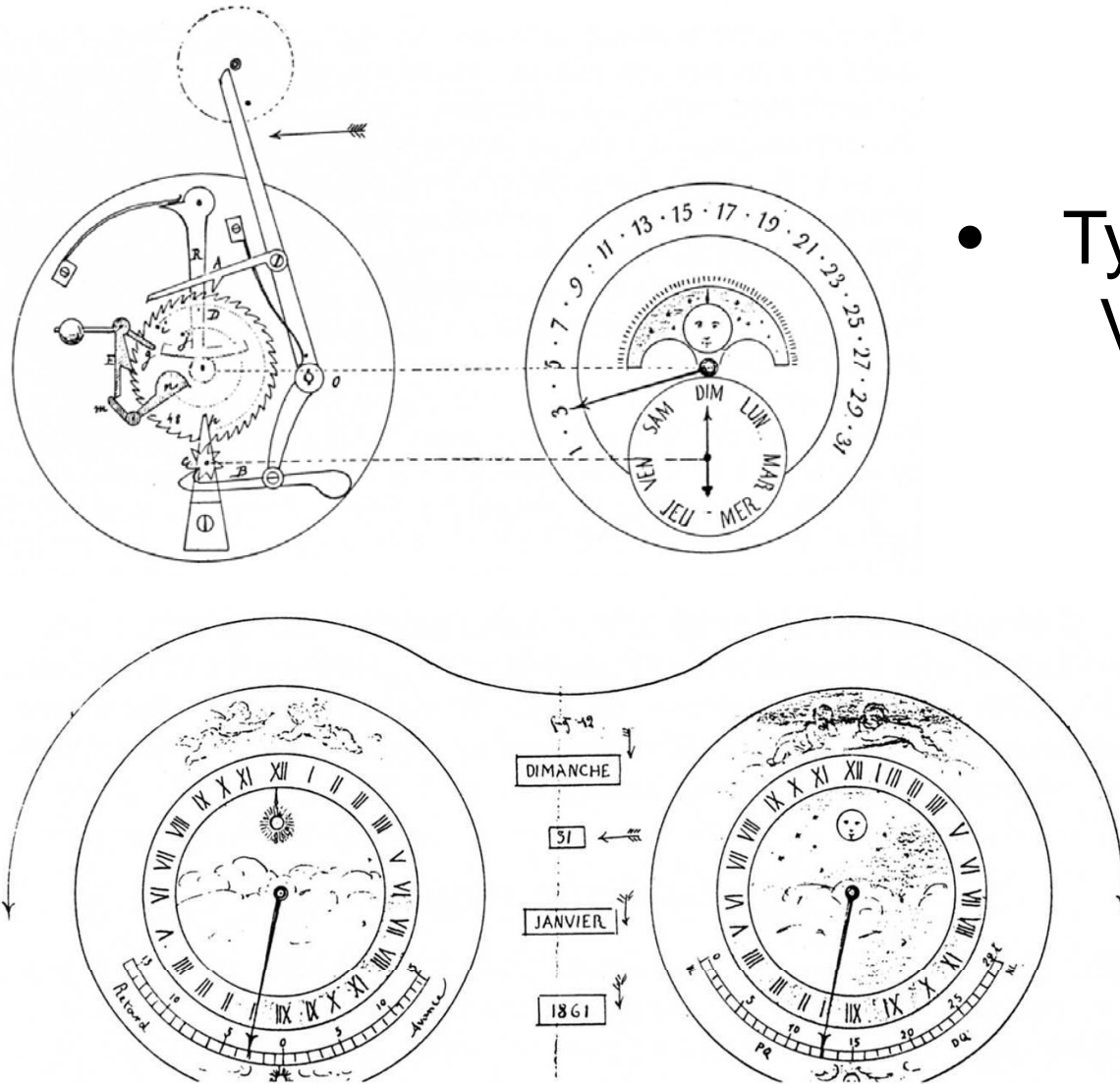
Louis-Achille Brocot (19 of 23)



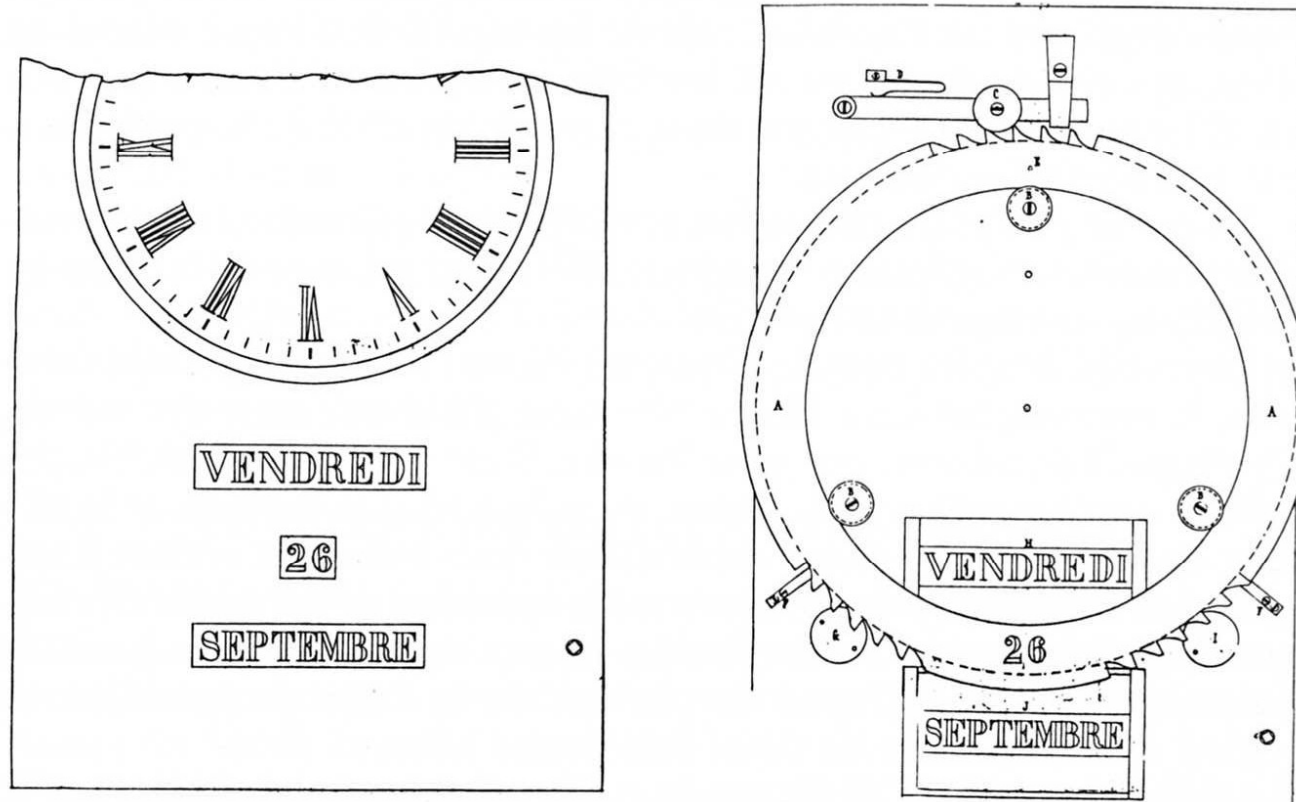
- Type IV calendar dial and simplified movement (1861)
- This calendar is the type most commonly seen
- Note the “penny Moon” dial; the three circles are the night sky, not the Moon

Louis-Achille Brocot (20 of 23)

- Types V (above) and VI (below) calendars

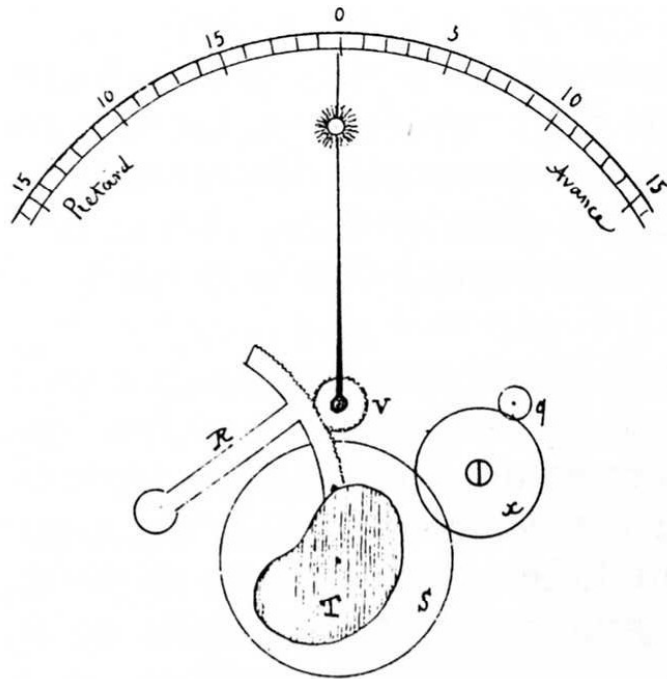


Louis-Achille Brocot (21 of 23)



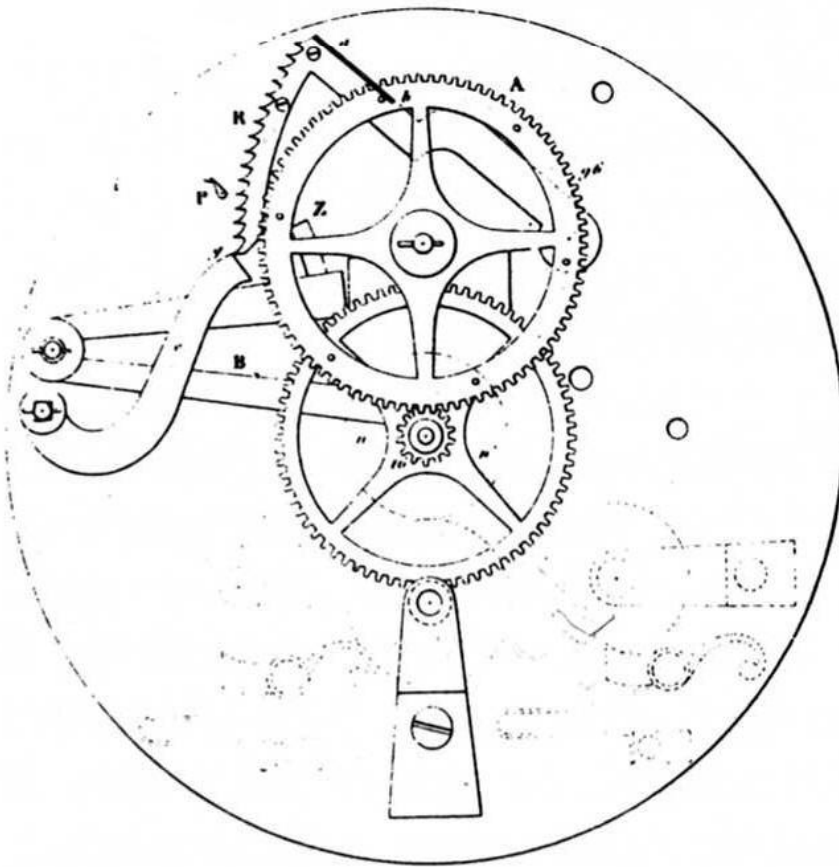
- Type VII calendar

Louis-Achille Brocot (22 of 23)



- Achille's equation mechanism
 - Previously, most cams were made by copying somebody else's
 - Achille constructed his by dividing a circle into 366 rays, then lengthening or shortening each ray in proportion to the tabulated difference:
Apparent time – Mean time

Louis-Achille Brocot (23 of 23)



- A very clever strike mechanism devised by Achille on geometrical principles. Compare with Pons's and Louis's versions on Slide 34

Paul-Louis Brocot

- Paul-Louis was primarily a very successful artist/dealer in bronze statuary and Paris clocks
 - His father, Achille, trained him in horology, which he understood, but his primary interests were not in that area
- No horological innovations have been attributed to Paul, nor any patents

Jean-Louis Brocot (1 of 3)

- Jean-Louis, the son of Gustave-Amédée, a successful hatmaker, received the same education as his cousin Paul, and was familiar with the horological work of his grandfather Louis and uncles Achille and Gabriel
- He preferred mechanics to hatmaking

Jean-Louis Brocot (2 of 3)

- Reactivating the patents of his grandfather and his uncle Antoine, he established a successful factory to manufacture (only) complete suspensions and replacement suspension springs
- He was issued the following patents:

Patent No.	Date	Inventor	Description
16915	1877-02-07	Jean-Louis	Suspensions
16915	1878-11-09	Jean-Louis	Suspensions
16915	1879-03-25	Jean-Louis	Suspensions

Jean-Louis Brocot (3 of 3)

- His inventions were controversial
 - All were quite minor revisions of his grandfather's and uncle's adjustable suspension patents
 - Some horologists claimed that the “improvements” weren't, that they did not work as well as what was “improved”
- Upon his untimely death at age 30 in 1885, his widow sold his business to the Thièbles. They continued to sell his designs to his former clients until 1914.

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Louis: Tortoiseshell (1 of 3)



- This pretty little clock has a “seconds” dial, with 60 divisions, but the hand makes a turn in 30 seconds
- It has a not-visible Brocot escapement between the plates

Louis: Tortoiseshell (2 of 3)



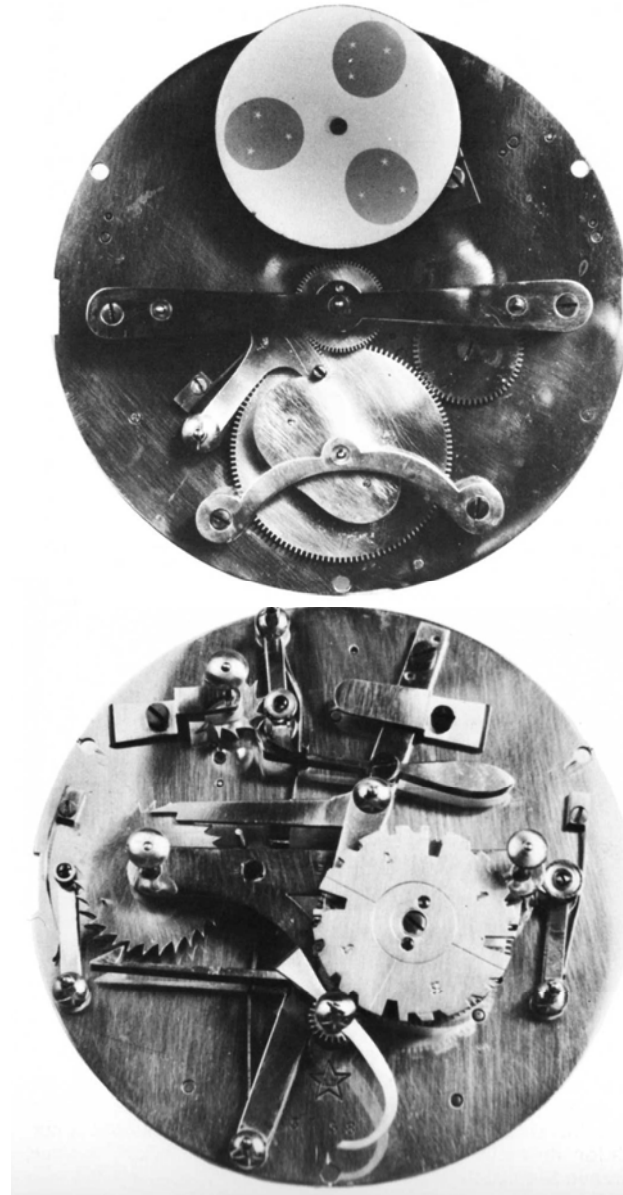
- Back of movement, showing spring suspension
 - This was originally a silk thread suspension, converted to spring
 - Note that it does not have the Brocot spring adjustment mechanism

Louis: Tortoiseshell (3 of 3)



- Detail of early strike mechanism
- As noted above, this mechanism was later rationalized by Honoré Pons and Louis-Gabriel

Achille: Four Year Runner, IV Calendar



Achille: English market table regulator



- Note the second style visible escapement and Type IV perpetual calendar with age and phases of the Moon

Achille: Year Runner (1 of 2)



- The dial is marked “Regulator Going One Year Achille Brocot”
- Note single winding square: This clock does not have a strike mechanism
- Type IV perpetual calendar

Achille: Year Runner (2 of 2)



- Note the five-barrel special movement and *uncompensated* pendulum

Achille: The Temple (1 of 6)



- Achille Brocot year-running with mercury pendulum, strike, perpetual calendar, Moon phase, equation of time, aneroid barometer (all working!)

Achille: The Temple (2 of 6)



- Type IV perpetual calendar, Moon phase, equation of time

Achille: The Temple (3 of 6)

**Perpetual calendar
movement, rear**



**Perpetual calendar
movement, under dial**



Achille: The Temple (4 of 6)



- Achille Brocot stamp on calendar movement
- Note serial number 2778
 - Number on time movement is 2777

Achille: The Temple (5 of 6)



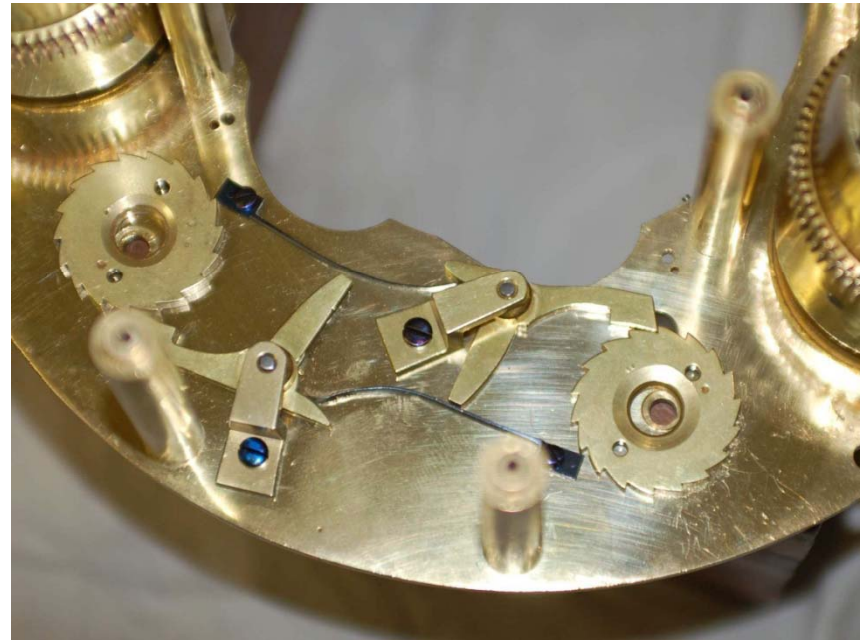
- Back of movement
- Eight barrels each for strike and time trains
- Barrel frame surrounds standard Brocot movement with internal time and strike barrels removed

Achille: The Temple (6 of 6)

Ratchet wheels on strike and time movement end barrels



Clicks on barrel frame



“Chas. Frodsham” (1 of 3)



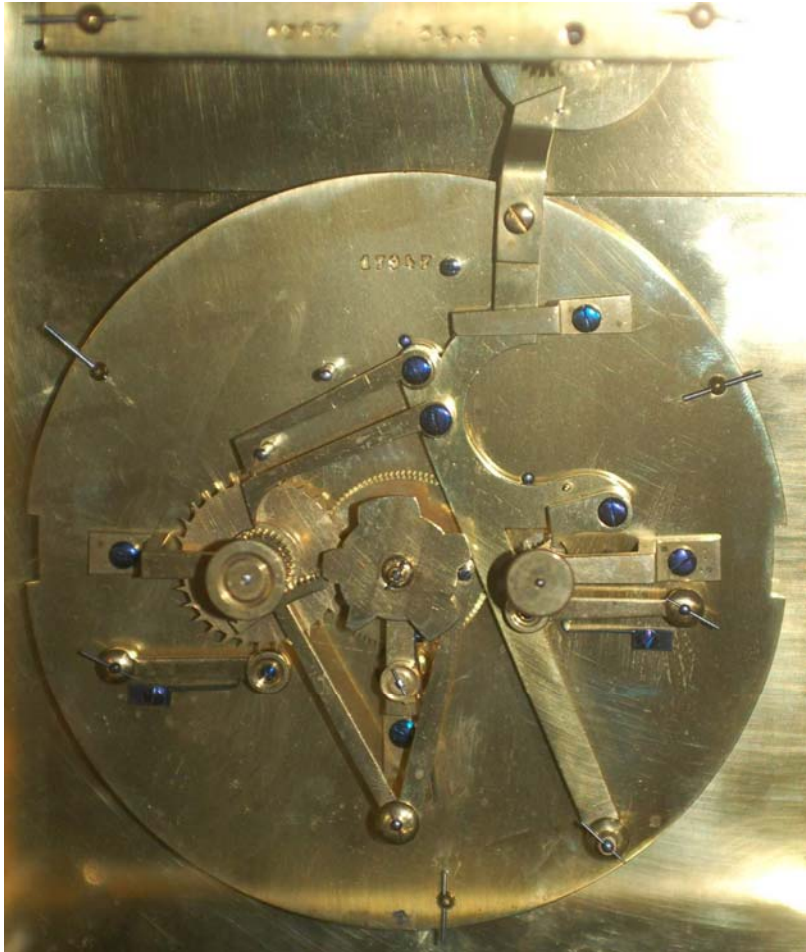
- This lovely clock appears to be a Brocot made for the English market
- The movement is rectangular, which might indicate that it is a special or experimental, and is engraved “Chas. Frodsham...” in script on the back plate

“Chas. Frodsham” (2 of 3)



- This rear view shows the back of the rectangular plate movement, the Brocot adjustable suspension, and the Brocot compensation pendulum

“Chas. Frodsham” (3 of 3)



- The lower dial is that of a Brocot Type I calendar
 - This, the Brocot pendulum, and the Breguet hands on the time dial suggest early manufacture, perhaps shortly after 1847
 - The calendar mechanism is a simplified Type I
 - Achille constantly experimented with time, strike, and calendar mechanisms to improve them

Achille Brocot



- Fire-gilt bronze case, Type I perpetual calendar, visible escapement 1855-60
- Signed on dial "E. et E. Emmanuel"
- This lovely clock was made for the English market

Want a copy?

- If you would like a copy of this presentation, please send an email to me at:

jkirk@geartrains.com,

the copy will be a PDF file without the Brocot escapement animation