Essl 290 2021

Lecture 18

Mon: Read Monsch 75-86 Barnett. pg 82-88

Next HW Mon 11 Oct

The key aspects of the early development of mechanical clocks (~1250 → 1400) have been:

1) purely mechanical clocks using verge + foliot mechanisms to regulate appeared at some stage in the period 1250 → 1400
2) early mechanical clocks were driven by suspended weights.
3) typically mechanical clocks indicated time by striking bells (hour striking mechanism)
4) mechanical clocks mostly appeared in public places (church towers, clock towers).

During this period the proliferation of mechanical clocks in urban areas in Europe resulted in significant changes to social aspects of time use: (in urban areas!)

1) timekeeping was no longer dominated by the church. Public officials would increasingly be charged with maintaining time.
2) timekeeping became much more widely used by many sectors of the public (in urban areas). General time-consciousness began to appear.
3) timekeeping became a process dominated by machinery rather than natural celestial processes. Time became abstracted away from such processes.
4) our current system of equal hours and division of the day emerged

These all represent a major transition from ancient (Greek, Roman, etc.) schemes and notions of timekeeping, to our present notions.
In the centuries since then these changes have become ingrained.
The remaining major developments have since taken the form of:

1) efforts to miniaturize clocks and timekeeping devices.
2) efforts to improve the performance, especially in terms of accuracy, of timekeeping
3) efforts to render personal timekeeping devices accessible to increasing numbers of people.
4) increasing standardization of timekeeping schemes.
5) increasing intrusion of timekeeping into aspects of life that are not obviously related to timekeeping.

Miniaturization of clocks

In principle a verge and foliot clock driven by a suspended mass could be miniaturized - one would merely need to make all the components smaller.

Landes pg 89→

1 Miniaturizing early mechanical clocks

Consider the prospect of miniaturizing an early verge and foliot clock. Recall that key aspects of large-scale versions of these clocks were:

- the clocks were driven by slowly falling suspended masses;
- the machinery was usually made from cast iron, whose composition and hardness could vary; and
- the accuracy of the clocks depended on the accurate interplay between all the mechanical parts.

What difficulties might these aspects of early clocks present with regard to miniaturizing clocks?

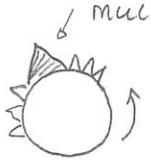
suspended masses – these still need to drop over a larger distance and this makes miniaturizing difficult

– these need to be heavy to drive the heavy machinery of the gears,... —e.g. 1000lb (Landes pg 89)

cast iron – the manufacturing process is such that it is difficult to machine small parts.

– there will naturally be irregularities in gears, etc. made of cast iron

accuracy – an inaccuracy of a fixed size in a larger gear will be less important than an inaccuracy of the same size in a smaller gear



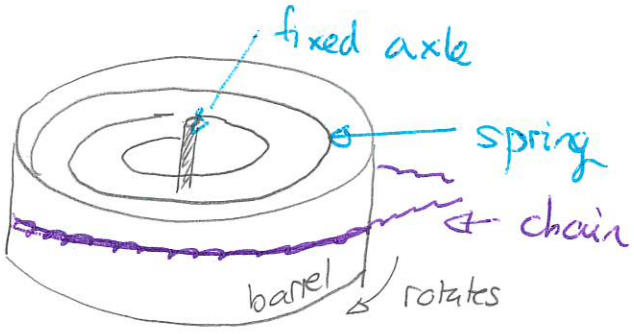
Spring driven clocks

An important step toward addressing the issues associated with suspended masses was the development of a clock drive using a spring. These consist of a coiled metal strip that tends to uncoil itself.

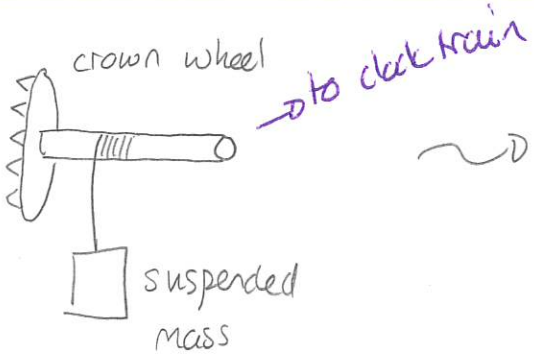
Demo: How at Watch works ~ around 0:30
- shows mainspring uncoiling

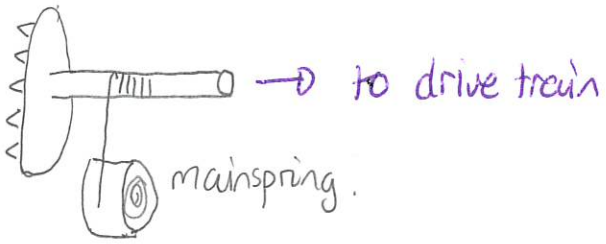
Demo: Hodinkee page.

Usually the spring is connected to a barrel and the spring drives the barrel. The spring is initially coiled tightly and then causes the barrel to rotate. A chain wrapped around the barrel will then drive the clock gear train.



This would replace the suspended mass in a clock.





2 Weight driven vs. mainspring clocks

a) What advantages would a clock driven by a mainspring provide compared to that driven by a suspended mass?

* It is smaller.
* It is relatively easy to minimize the mainspring

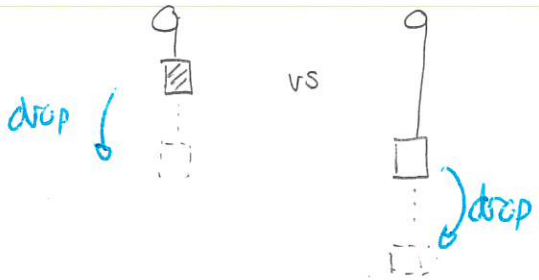
b) What difficulties would arise with a clock driven by a mainspring versus that driven by a suspended mass?

* Fabrication of the steel for the spring mechanism. – requires special skills.
* more prone to catastrophic breakage.
* more difficult to drive heavy components

c) Consider the driving forces in each type of clock. As the suspended mass "steps" down toward the ground does the driving force change? As the mainspring clock unwinds does the driving force change?

Suspended mass

* No
* Same every incremental drop

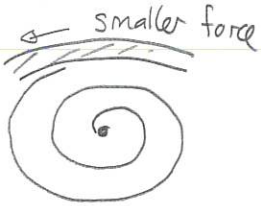


same drop, same force

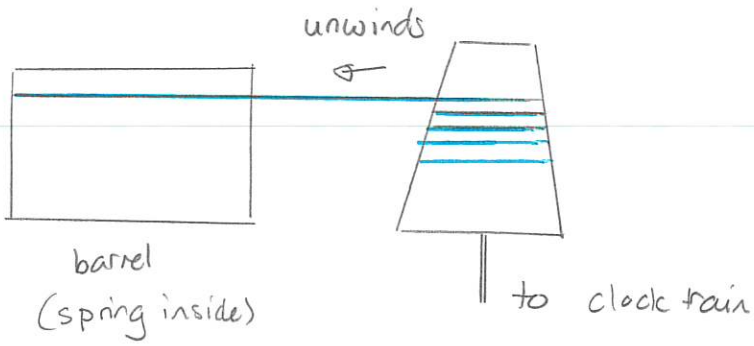
Mainspring

* Yes
* decreases as spring unwinds

larger force



The issue of the variable force was addressed via a tapered drum called a fusee that connected the mainspring drum to the clock train



Demo: James Swift video.