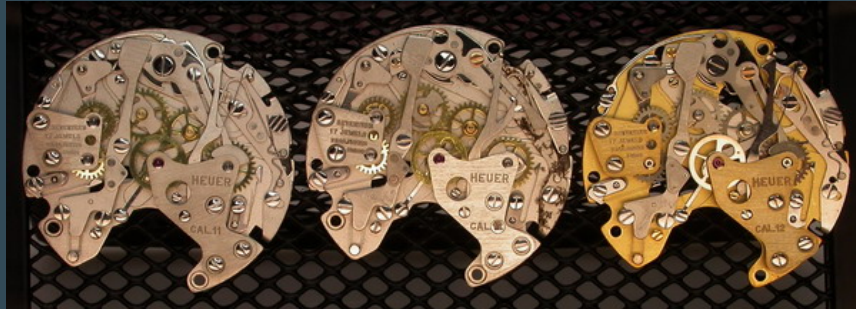


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Development of the Chronomatic Movements (Caliber 11, 11-I, 12 and 15)



Ask any vintage chronograph enthusiast what happened on March 3, 1969, and he will answer you quickly and with certainty, "That was the day that the Heuer, Breitling, Hamilton-Buren, Dubois-Depraz partnership introduced the world's first automatic chronograph, with press conferences in Geneva and New York City".

Ask Hans Schrag (then Heuer's head watchmaker in the United States) what happened during the afternoon of March 3, 1969, just hours after the New York City press conference, and he will tell you of another memorable event, "That was the time when the world's first automatic chronograph came into the service department for the first repair of an automatic chronograph." Press Hans for details, and some forty and one-half years later, he will tell describe for you the look of disappointment from the owner of the watch, the exact position of the malfunctioning 8140 operating lever, and his own shock to see an automatic chronograph (and especially the oddity of the crown at nine o'clock). Of course, the owner of the watch was also disappointed: he had won the watch in a drawing at the New York City press conference, but this marvelous new watch didn't even make it to the end of the afternoon before malfunctioning.

Indeed, it was the amazing speed with which the Caliber 11 movement was developed that allowed the Heuer-Breitling venture to win the race to introduce this horological marvel; this same speed also resulted in a movement that required immediate modification and improvement.

This webpage tells the story, not of how Hans Schrag repaired the world's first automatic chronograph -- that is another story for another day -- but of how the Caliber 11 series of movements was developed and improved, beginning in March 1969, to become a reliable workhorse for a generation of amazing chronographs.

Jeffrey M. Stein
November 6, 2009

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Thanks to Hans Schrag for providing the technical and historical information that allowed me to create this webpage; thanks also for providing the three chronograph modules show at the top of this page. As I keep reminding Hans: The more information he provides for these sorts of webpages, the less we will need to bug him with our dumb questions (and the more he will enjoy his retirement)!

Thanks to Abel Court for providing many of the photographs that illustrate this page, and for helping me puzzle through so many of the mysteries of the Chronomatic movements. Never before has the bi-metallic oscillating pinion been photographed so beautifully!

Thanks to all the readers, writers, bloggers, photographers, illustrators, dealers and collectors who comprise the OnTheDash / Chronocentric community. Your passion inspires these projects.

Background of the Chronomatic Movements (Caliber 11 / Caliber 12)

As described in our previous articles about the development of the Chronomatic (Caliber 11 / Caliber 12) movements, the joint venture of Heuer, Breitling, Buren and Dubois-Depraz "won the race" to market the world's first automatic chronographs, when the Chronomatic chronographs were introduced in March 1969 and offered for sale to the general public during the Summer of 1969. The Caliber 11 movement was an entirely new movement, developed on a "white board" basis by the joint venture partners, and in order to win the race to market, the movement was designed and developed very quickly. In addition to the innovation of being the first

automatic chronograph, the Caliber 11 had several advanced technical features. In view of the nature of the joint venture, the speed with which the movement was developed, and the technical features of the Chronomatic watches, it is not surprising that the Chronomatic watches suffered from a variety of technical issues when they were first sold to the public.

This webpage tells the next chapter of the story -- how the Caliber 11 movements were developed and improved after their introduction in 1969, to become the popular movements that powered a new generation of chronographs for Heuer, Breitling, Hamilton, Bulova, Zodiac and several other brands. We will see that while the Chronomatic partners lacked the luxury of fully developing this movement prior to its introduction, they continued to develop these movements so that they were the workhorse movements of the 1970's and continue as reliable movements, 40 years after their introduction.

Caliber 11 -- The Early Problems

Some of the technical problems arose with the Caliber 11 movements arose from decisions made in designing the watches; others arose from poor engineering or a lack of development of the movement, as the partnership competed to bring the first automatic chronograph onto the market. The following were among the most significant design features of the Caliber 11 movement, along with the "technical" problems which were attributable to these features:

- Jumping Hours. While most chronographs of the period utilized a "jumping" minute recorder (meaning that the minute needle jumped every minute) and a "creeping" hour recorder (meaning that the hour needle moved continuously during the hour), the Caliber 11 used a jumping hour recorder as well as a jumping minute recorder. Accordingly, the hour needle "jumped" every 30 minutes, rather than moving continuously. Having both the minute and hour needles "jump" in one instant required incrementally more power than having the hour needle creep on a continuous basis.
- Jumping Date. The Caliber 11 was also designed so that the date disk would "jump" in a relatively short period of time (beginning at 11:45 p.m.), rather than beginning to change earlier in the evening (for example, at 10:30 p.m.). This jumping date disk also required incrementally more power than a disk that would move more gradually over the course of a longer period. Combined with the jumping minutes and hours, the movement required considerable power to "jump" the date disc in only 15 minutes between 11:45 and midnight.
- Banking. In order to provide the power that would be required for the Caliber 11 to operate -- with the chronograph running, the needles jumping, and the hour disk changing within a relatively short period of time -- the Caliber 11 required a strong mainspring. The mainspring used for the Caliber 11 turned out to be too strong, resulting in the problem of "banking" (or "rebanking"), meaning that the balance wheel had too much amplitude and caused the watch to run too fast.
- Bi-Metallic Pinion. The oscillating pinion used in the Caliber 11 movement (8086) was "bi-metallic", with a brass head on a steel shaft. (The Heuer-Breitling-Hamilton group used a bi-metallic pinion, because at the time that the Caliber 11 movement was being developed, the group did not have the ability to manufacture a one-piece, all-steel pinion). Because the head of the oscillating pinion engages with the chronograph runner wheel (8000) every time the chronograph is started (and disengages every time the chronograph is stopped), there were concerns that the pinion and wheel would wear out prematurely.

The Caliber 11-I Movement

As a result of these technical problems with the Caliber 11 movement, within a year of its introduction, the Chronomatic group (Heuer-Breitling-Hamilton) made the changes that resulted in the creation of the Caliber 11-I movement. (We are not certain, but can assume that the "I" designation indicated that the movement had been "Improved".) Changes from the original Caliber 11 to the improved Caliber 11-I included the following:

- Creeping Date Change. The date indicator driving wheel (jumper) (2556) was redesigned, so that the date changed more slowly. On the Caliber 11-I, the date change would begin at 10:30 p.m. and occurred over the next 90 minutes, with a "click" at midnight.
- Lighter (Weaker) Jumper Springs. The jumper springs on the minute (8270) and hour (8705) recorders were made lighter (weaker), so that less power was required for the needles to jump each minute and each 30 minutes.
- Weaker Mainspring. With less power required to drive the date wheel and the chronograph needles, the Caliber 11-I used a weaker mainspring than the Caliber 11. (The improved Caliber 11-I mainspring was housed in a nickel-plated barrel, whereas the Caliber 11 used a rose-colored barrel). Changes in the balance wheel also addressed the problem of "banking".
- All Steel Oscillating Pinion. The oscillating pinion (8086) was changed from being bi-metallic (steel and brass) to solid steel. In addition, the chronograph runner wheel (8000), which mated with this pinion, was changed from brass to a nickel-silver alloy.

The Caliber 12 Movement

Changes from the Caliber 11-I movement to the Caliber 12 movement included the following:

- Faster Beat. The "beat" of the movement was changed from 19,800 vibrations per hour (VPH) in the Caliber 11 and 11-I, to 21,600 VPH in the Caliber 12. The change to a higher beat was consistent with trends in the watch industry, suggesting a preference for higher beat movements. The change in the "beat" of the movement required a re-design of the mainspring and balance wheel, as well as corresponding changes in the fourth wheel (225), the escape wheel and pinion (705) and the pallet fork and staff (710). These components are unique to the Caliber 12, and earlier parts for the Caliber 11 or 11-I may not be interchangeable with these parts.
- Strengthening Other Components. Certain components of the Caliber 12 movement were made stronger or otherwise improved. For example, the fly-back lever (8180) was made wider, as the narrower levers on the Caliber 11 and 11-I had sometimes failed. One of the most visible changes from Caliber 11-I to Caliber 12 was in the reshaping and enlargement of the hammer (8220). In the Caliber 11 and 11-I movements, the hammer cam jumper (8356) rested against the lower section of this hammer (8220), but there was nothing to prevent the hammer cam jumper (8356) from "jumping" out of position, coming to rest above the

hammer (8220), which would result in the start / stop / reset being inoperable. In the Caliber 12 movement, the "head" of the hammer (8220) was made significantly larger, so that it "sandwiched" the hammer cam jumper (8356) in place and prevented it from jumping out of position. A large hole in the head of the hammer (8220) allows for oiling of the area of contact between the jumper and the hammer, and is an easy way to identify a Caliber 12 movement.

- Color Change. The most visible change from the Caliber 11 and 11-I movements to the Caliber 12 movement was that the main plates of the movement were changed from a nickel / silver color to a gold tone. The Caliber 12 looks like a gold tone movement, compared with the silver tone of the Caliber 11 and 11-I. (There are, however, certain Caliber 12 movements that use the same nickel-silver plates as the Caliber 11 and 11-I. In these instances, the "11" on the chronograph bridge (8500) is over-stamped with a "12".)

The Caliber 15 Movement

In order to be able to offer their automatic chronographs at lower prices, in 1972 Heuer and Breitling modified the Caliber 12 movement so that it was offered as the Caliber 15 movement. The most obvious difference between the two movements is that the Caliber 12 movement has a 12-hour recorder and a 30-minute recorder, whereas the Caliber 15 movement has only the 30-minute recorder. [mention re running seconds at ten o'clock] In addition to the deletion of the 12-hour recorder -- which saved considerably in the cost of parts and labor -- the following changes from the Caliber 12 to the Caliber 15 allowed the Caliber 15 to be produced on a more economical basis:

- Brass Balance Wheel (rather than Glucydur). The Caliber 12 movement used a Glucydur balance, while the Caliber 15 movements used a brass balance. Glucydur is a tradename for an alloy made of beryllium, copper and iron. This material features excellent hardness and high stability over a range of temperatures, and is resistant to deformation or damage.
- KIF Shock Protection (rather than Incabloc). The Caliber 12 movement used the Incabloc shock protection system, whereas the Caliber 15 movement used the KIF system. The primary difference between the Incabloc and KIF shock protection systems is in the shape of the spring which holds the cap jewel in place; both springs are hinged so that the jewel can be removed without removing the spring.
- Deletion of Isochron Regulation (Micro-Regulation). The Caliber 12 movement used the Isochron micro regulation system, which derived from the regulation system used in the Buren Intramatics. The Isochron system uses two sets of eccentric screws and forked levers to move the regulator (307/1) and the hairspring stud (364) with great accuracy. This system allows the adjuster to put the watch into near perfect beat and regulation without many frustrating back and forth movements of the regulator (curb pins) and stud carrier. This regulation system is not used on the Caliber 15 movement, making it more difficult for the watchmaker to regulate the watch accurately.

The use of the Caliber 15 movement rather than the Caliber 12 movement allowed a Caliber 15 Carrera to have a retail price of \$170 (versus \$185 for the Caliber 12 model); the Cal 15 Autavia's were priced at \$185 (versus \$200); and the newly-introduced Calculator retailed for \$200 with the Caliber 15 (versus \$220 for the Caliber 12 model). [add re Monaco]

The following table summarizes the primary differences between the Caliber 11, the Caliber 11-I and the Caliber 12 movements, as described in more detail above.

	Caliber 11	Caliber 11-I	Caliber 12
Period of Production	from March 1969 until late 1969	from late 1969 until 1973	from late 1971 until 1980
Easiest Ways to Distinguish Caliber 11 / Caliber 11-I / Caliber 12 Chronographs			
Marking on Movement	Cal 11 on chronograph bridge (8500)	Cal 11 on chronograph bridge (8500); small "I" under balance wheel	Cal 12 on chronograph bridge (8500)
Color of Main Plates	nickel silver	nickel silver	gold-colored (usually)
<u>Marking on Case</u>	no special mark	small star or arrows on back of one lug	no special mark
Date Change	jumping (starts at 11:45)	gradual / creeping (starts at 10:30)	gradual / creeping (starts at 10:30)
Beat (vibrations per hour / VPH)	19,800 VPH	19,800 VPH	21,600 VPH
Major Changes in Parts of the Movements			
Minute and Hour Jumper Springs	heavier (stronger)	lighter (weaker)	lighter (weaker)
Color of Barrel	rose	nickel-plated	nickel-plated
Oscillating Pinion	bi-metallic (steel and brass)	all steel	all steel
Chrono Runner Wheel	brass	nickel / silver alloy	nickel / silver alloy
Hammer (8220)	smaller	smaller	larger, with hole for oiling

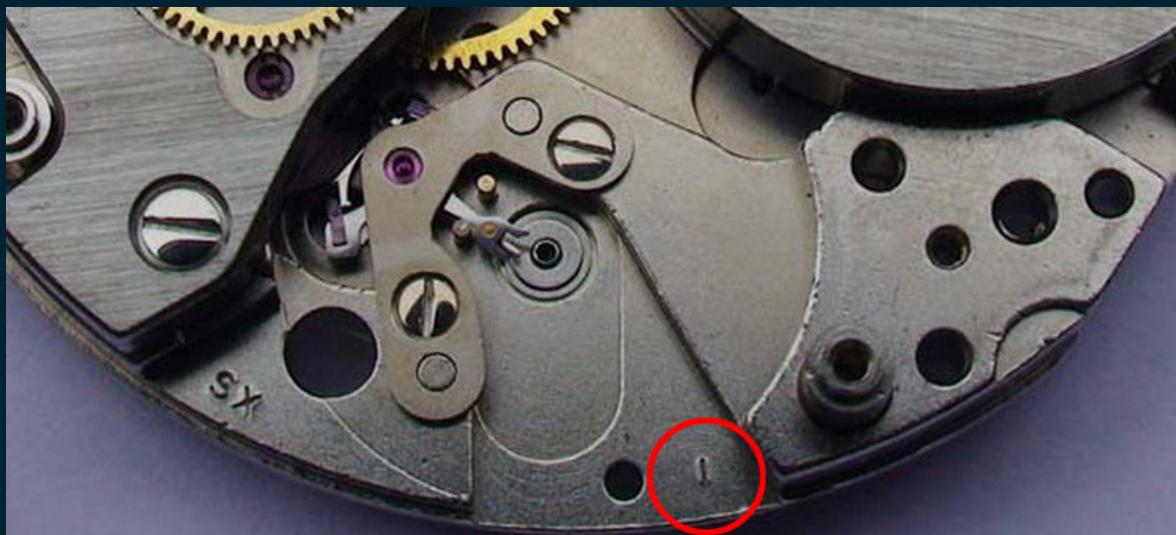
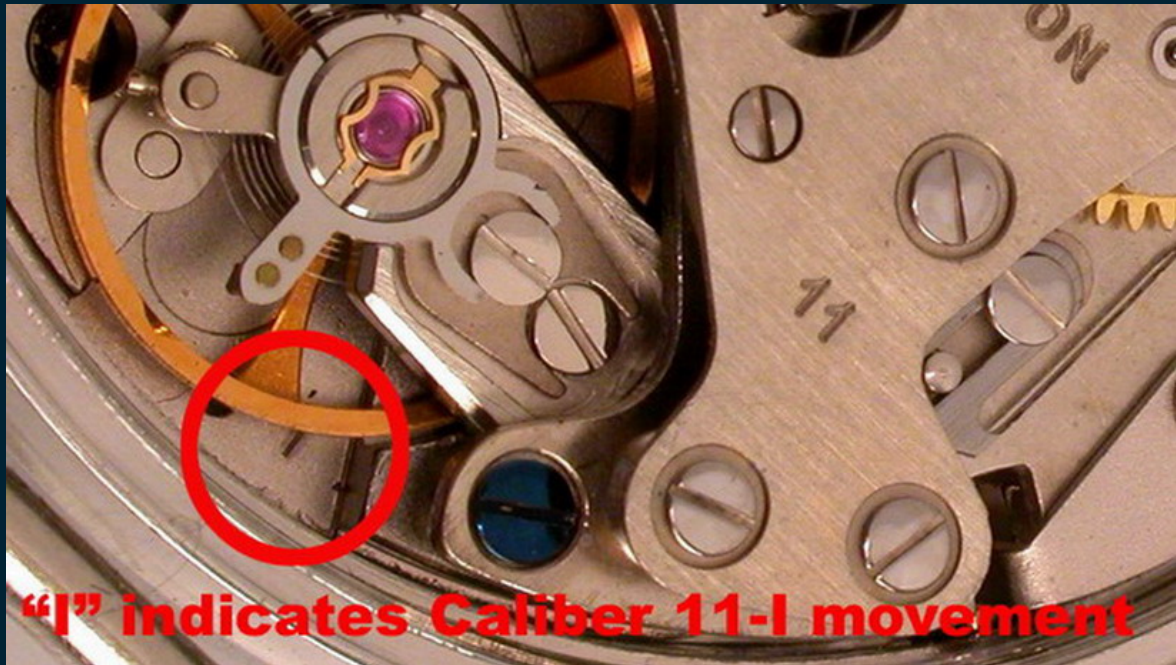
Some notes regarding these movements:

- The "periods of production" for the Caliber 11, 11-I and 12 movements are not precise, and there is overlap in Heuer's use

of the movements. For example, the Caliber 12 was introduced late in 1971, but many Viceroy Autavias (Ref 1163V) produced in 1972 and 1973 continued to use the Caliber 11-I movements. Accordingly, we find otherwise identical chronographs from this sort of transitional period with both the Cal 11-I and the Cal 12 movements.

- We say that the main plates of the Caliber 12 movement are usually gold-colored, but there are Caliber 12 movements that use the nickel silver plates from a Caliber 11 or 11-I movement. In these instances, we see that the "11" on the chronograph has been "blanked" and a "12" marked in place of the "11". Such renumbered Caliber 11 bridges, in the nickel silver color, do not seem to be transitional, but were also used later in the production of the Caliber 12 movement.

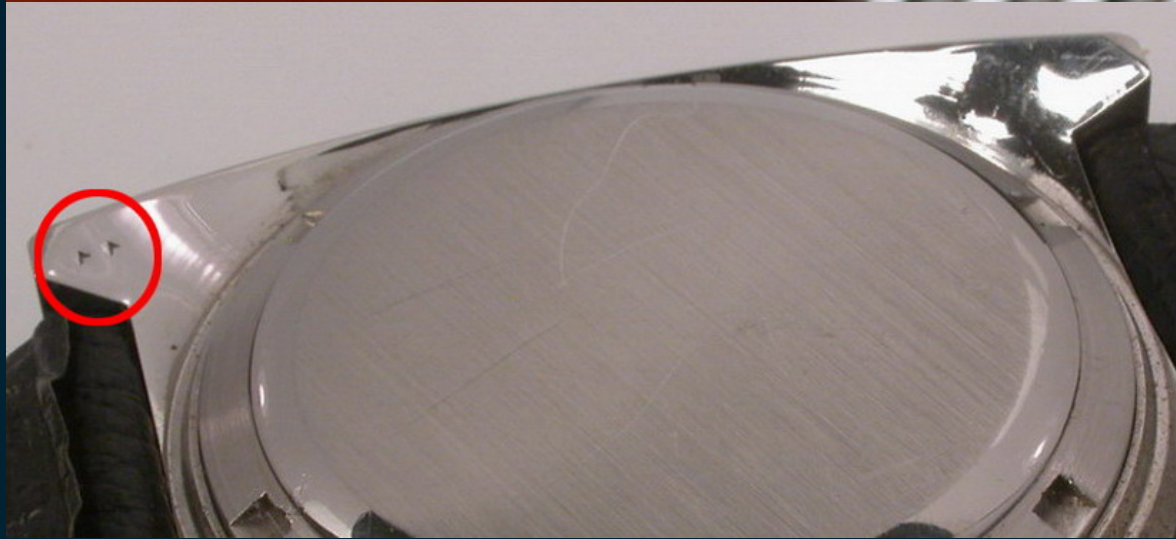
Caliber 11-I has Special "I" Mark under Balance Wheel



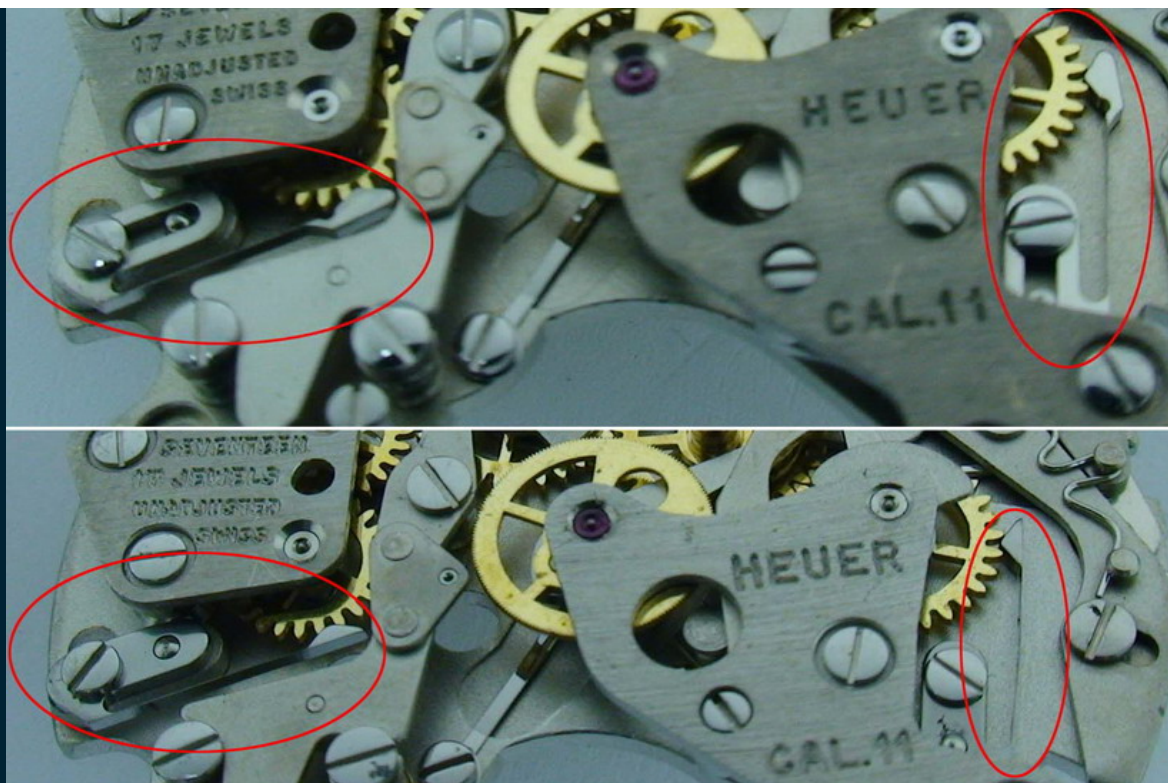
Caliber 11-I has "Arrow" Marks on Back of Lugs



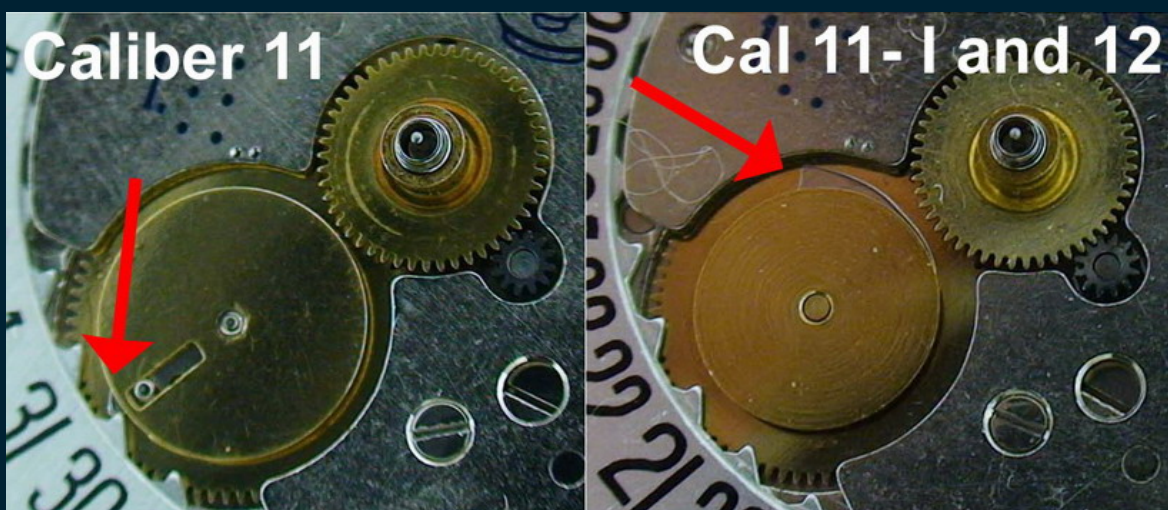
Arrows or Star indicates Caliber 11-I movement



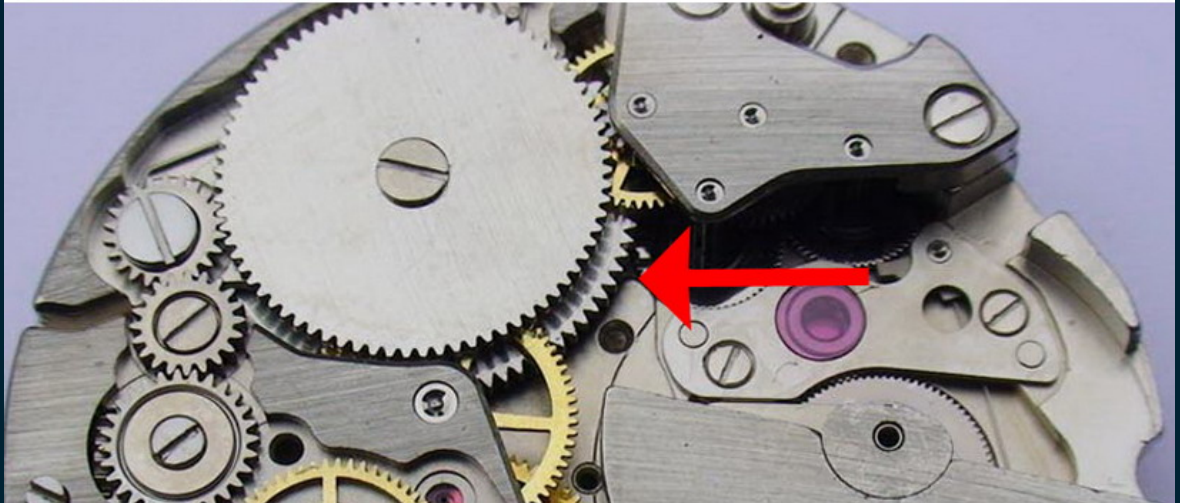
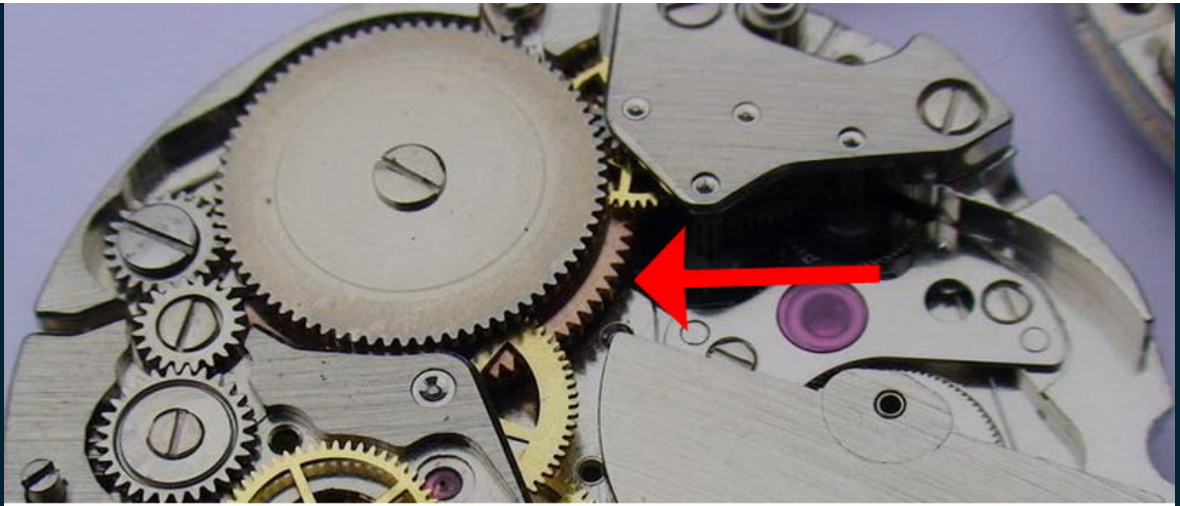
**Jumper springs (8270 and 8705) are larger (heavier) on Caliber 11 (above);
smaller (lighter) on Caliber 11-I and Caliber 12 (below)**



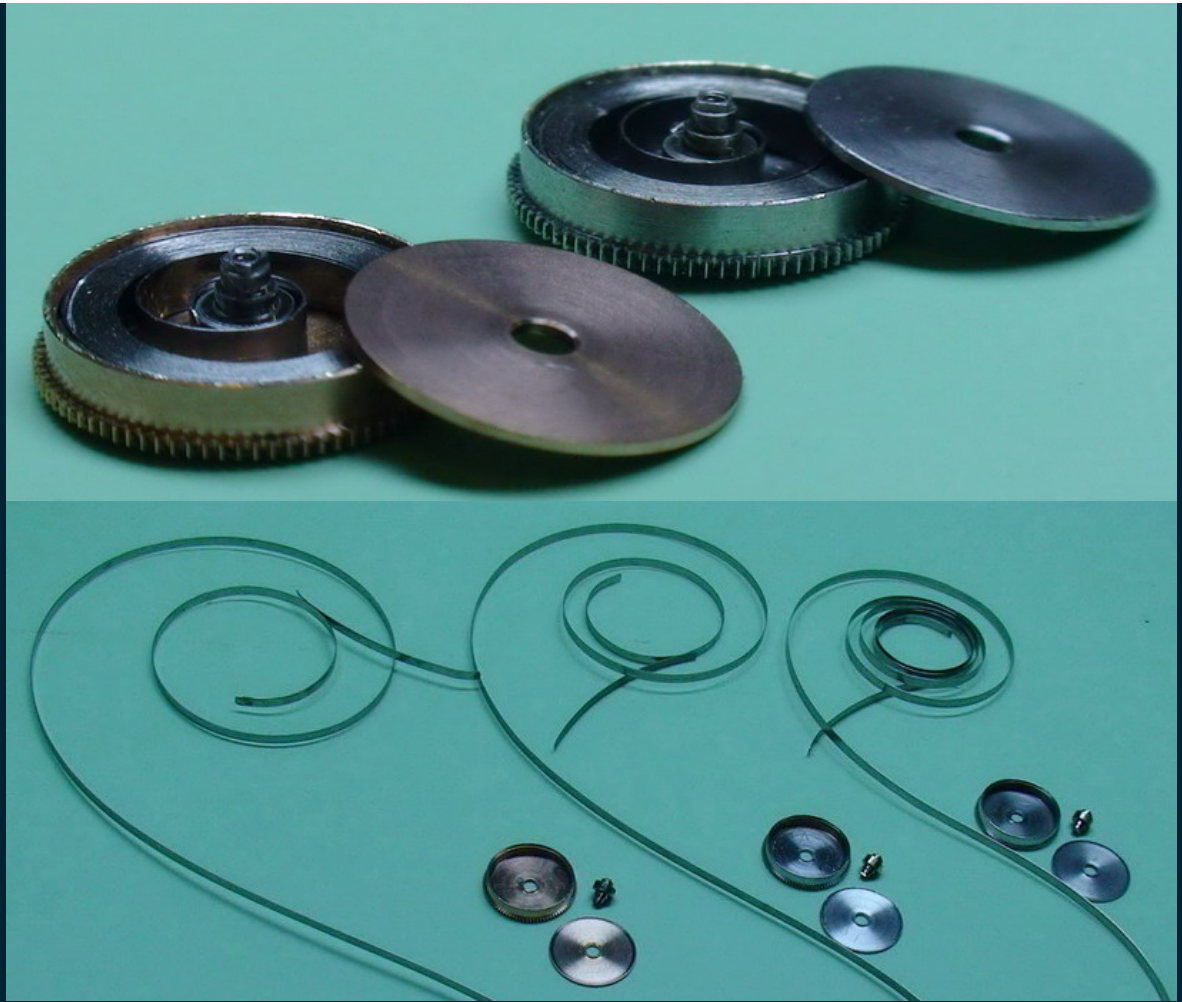
**Date indicator driving wheel (2556) provides for rapid date change on Caliber 11;
slower, more gradual date change on Caliber 11-I and Caliber 12**



**Barrel (180) is rose colored on Caliber 11 (above and left);
nickel-plated on Caliber 11-I and Caliber 12 (below and right)**



Mainspring in the Caliber 11 is too strong (which contributed to banking); mainspring in Caliber 11-I and 12 is weaker, so that watch keeps proper time



Oscillating Pinion

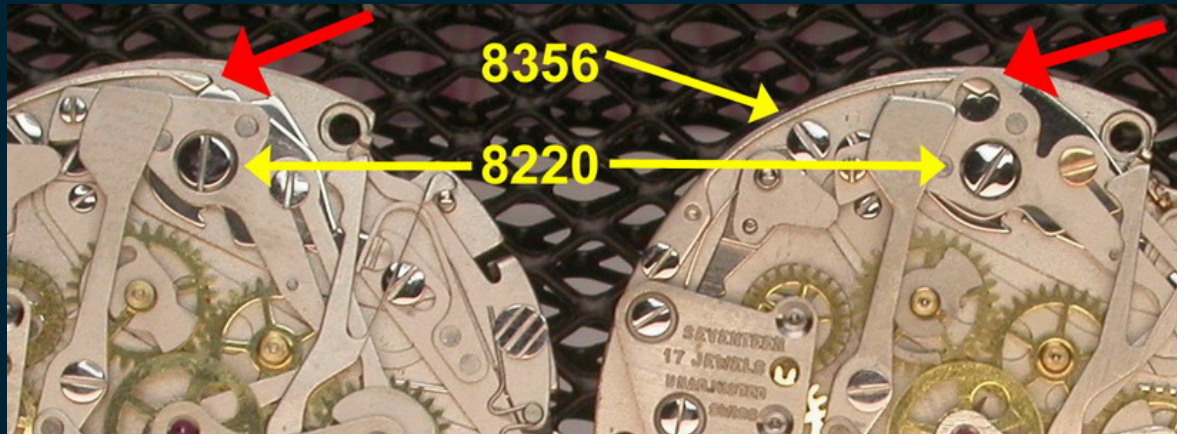
Caliber 11: Bi-Metallic
(Steel and Brass)



Caliber 11-I
and Caliber 12
(All-Steel)



The hammer (8220) in the Caliber 12 was redesigned and enlarged, so that the hammer cam jumper (8356) is held in place between the "head" of the hammer (8220) and the main chronograph plate (8281). The hole in the head allows for oiling.



Three differences between the Caliber 12 and the Caliber 15 include, (A) the Caliber 12 uses a Glucydur balance, and the Caliber 15 uses a brass balance, (B) the Caliber 12 uses Incabloc shock protection, and the Caliber 15 uses a KIF system, and (C) the Caliber 12 has fine (micro) tuning in its regulation (through two screws on the balance bridge), and the Caliber 15 does not provide for micro regulation.

