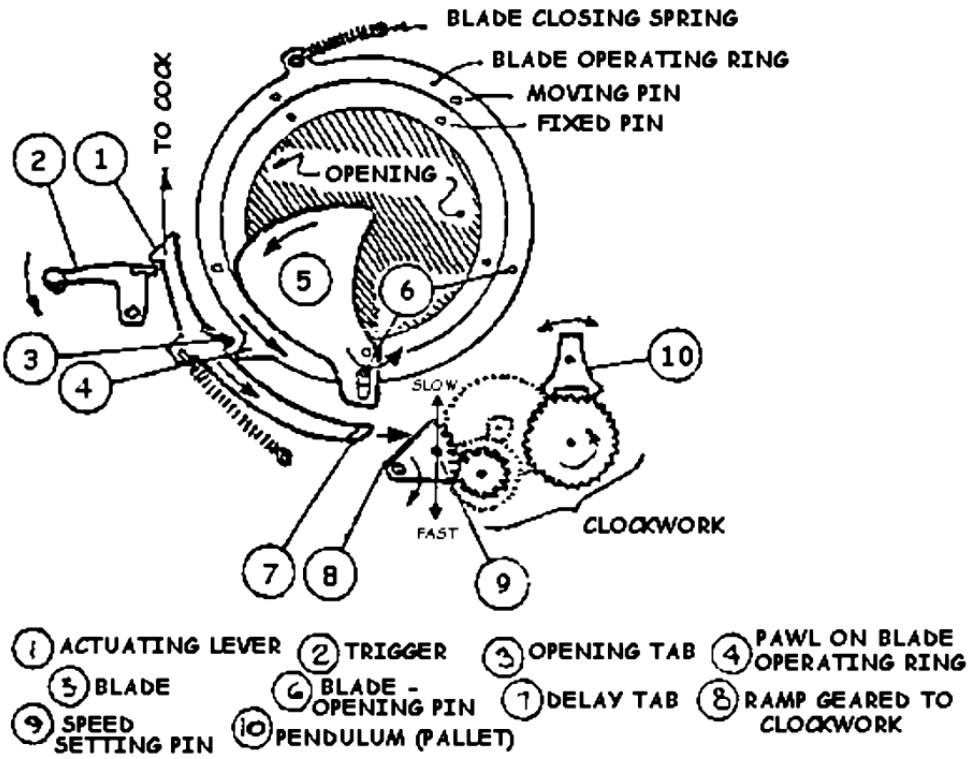
Typical Leaf Shutter (SHOWN COCKED AT SLOW SPEED)



HOW IT WORKS: Compur Leaf Shutter

The basic leaf shutter design, patented by Ilex in 1910 and made famous under such names as Compur and Prontor, combines quiet operation, broad speed range and excellent reliability in a compact, easily constructed and easily serviced package. Although complicated in appearance and often involving many rapidly moving parts, the operation of this type of shutter is simple – at least in principle.

The shutter blind itself is composed of metal blades, usually either 3 or 5 in number. All blades are opened simultaneously by a ring from which a pin engages a slot in each blade. The ring is spring-loaded in the closed position, and is rotated to the open position by an actuating lever.

To prepare the shutter for firing, it must be "cocked" by drawing the actuating lever (1) up until it catches on the pawl on the shutter release trigger (2). Trigger (2) is then depressed, and the actuating lever is allowed to fly forward (down and to the right in the diagram). As it travels, a tab (3) or link on the actuating lever engages a pawl (4) on the operating ring. The lever continues to travel, rotating the ring (counter-clockwise as viewed in the diagram) as it goes. As the ring rotates, pins (6) attached to it act in slots in blades (5). Near the slot in each blade is a hole, which is located on another, non-moving pin. As the moving pin (6) pushes on the side of its slot, the blade pivots about the axis of the non-moving pin, and rotates to an open position, retracted outward away from the center of the lens opening. One edge of the blade is shaped as a concave curve, so that when fully open all of the blades combine to define a circular opening exposing the entire lens.

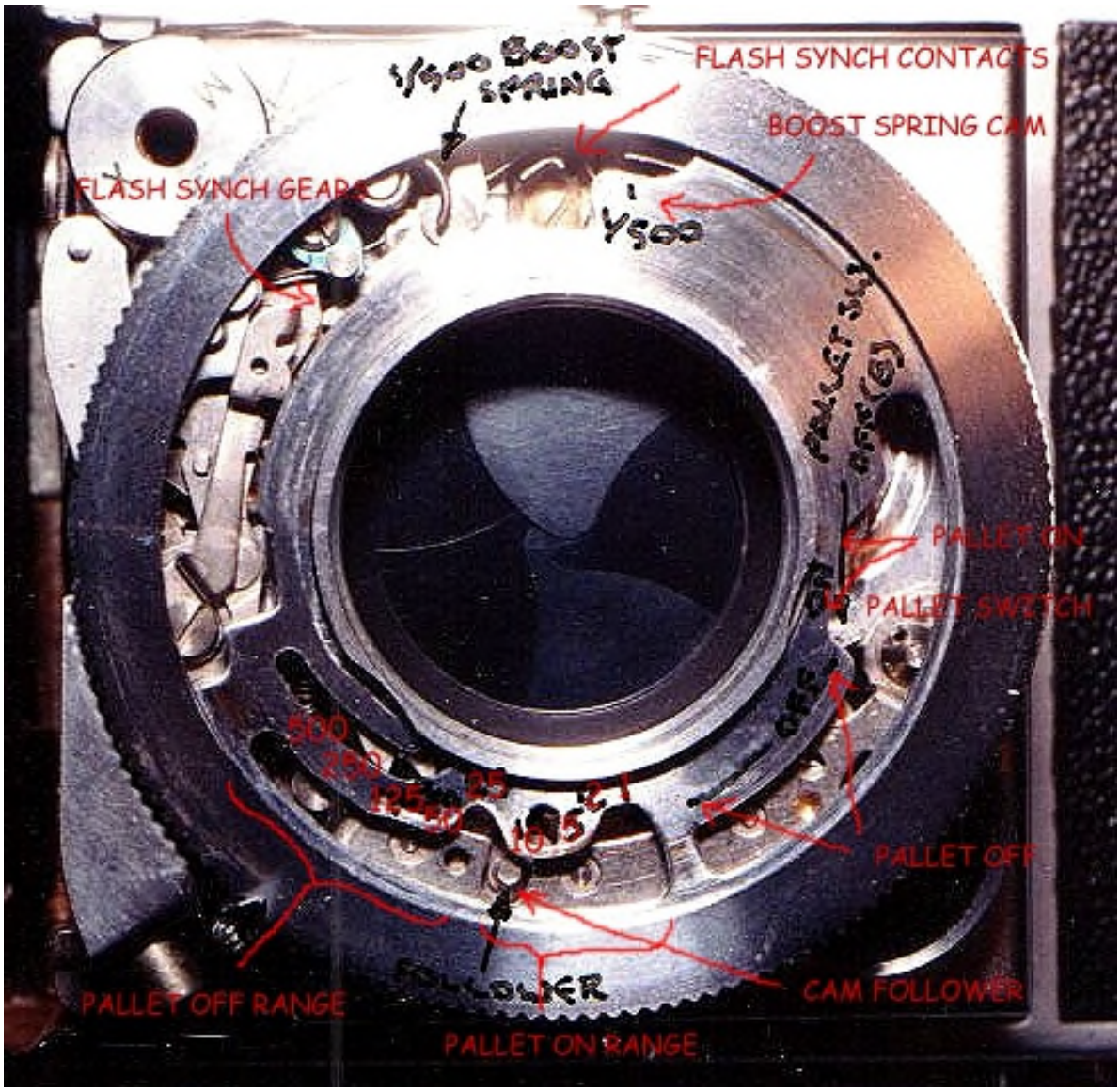
As the blades reach the fully open position, a tab (7) on the actuating lever strikes a ramp (8) and is momentarily slowed down. The force of the actuating lever causes the ramp to pivot out of the way, but this movement is opposed by a clockwork mechanism which uses a reciprocating pendulum, commonly referred to in shutters as a "pallet" (10) and gear train (the first gear directly engaged by the teeth of the pallet is referred to as a "star wheel") to control the speed at which the ramp is able to retract out of the path of the actuating lever. This speed is constant for all shutter speed settings within a given range, but multiple ranges may be provided by engaging more or less mass to pallet (10). Within each range, the shutter speed is changed by varying the distance that ramp (8) must travel to get out of the path of tab (7). This is done by changing the starting position of ramp (8), by means of a pin (9) whose position is established by a stepped slot in the face of the shutter speed ring (which is not shown because it would cover up all of the other cool stuff in the diagram). For the fastest speed available (usually about 1/200 – 1/300 second), ramp (8) is fully retracted from the start so that there is no delaying action in the movement of the actuating lever; and in the case of the Compur-Rapid, a booster spring is engaged to increase the velocity of the actuating lever for the additional 1/400 or 1/500 second speed.

Once ramp (8) is out of the way, the actuating lever proceeds forward and disengages from pawl (4). This allows the operating ring to return to its

original position, driven by its own return spring. As it returns, pins (6) push blades (5) back to their closed positions.

Perhaps the longest lived of all wide range shutter designs, this basic design in various forms fared well in head-to-head competition with all other types, and remained popular throughout the film era. Its primary handicap has been its location between the elements of the lens, complicating such features as interchangeable lenses, body-mounted shutter release, automatic shutter cocking and coupled exposure meters. All of these difficulties have been dealt with in various ways and with varying degrees of success. Its principal advantages have been quietness, reliability, compactness and its ability to synchronize electronic flash at all speeds. This last capability is due to the fact that, regardless of the speed set, there is always an instant at which the shutter is fully open ... unlike most focal-plane designs, which achieve high speeds by reducing the size of the opening to less than the dimension of the negative.

Fast approaching its 100th birthday, the leaf shutter remains current even into the digital age: this type of shutter is at the heart of Hasselblad's 31, 39 and 50-megapixel medium format digital cameras.



Here's a photo of a Synchro Compur shutter (in a Retina IIa), to illustrate how the different speeds are controlled. The chrome ring around the edge carries 3 contoured slots. I've marked the speeds around the cam slot at the bottom ... the shutter is set at 1/10 second here. As the ring rotates counterclockwise, the cam follower goes to the higher speed positions. You can see that the cam is shaped to allow the follower to move toward the lens as slower speeds are selected, from 1/500 to 1/25; then, at 1/10, it goes back out to about where it was at the 1/100 setting. The difference is that, in the slot at the lower right, a second cam has now turned on the pallet switch, engaging the pallet and making the delay gears run about 10 times slower than they do with the pallet disengaged. From 1/10 to 1 second, the speed cam follows roughly the same pattern it did from 1/500 to 1/25, but now with the pallet engaged the speeds are proportionately slower. At the fast end, at 1/250 the shutter is running essentially at full speed with no delay. The difference between 1/250 and 1/500 comes when the ring is turned fully counterclockwise and a step at the right hand end of the third slot, up on top, engaged the 1/500 booster spring and pushes its little tail toward the left. This speeds up the blades, changing the 1/250 second maximum speed to 1/500.