LIFT, POSTITION, NUMBER, MAINTENANCE AND ALTERNATIVES OF CAMSHAFT LIFT

The camshaft "lift" is the resultant net rise of the valve from its seat. The further the valve rises from its seat the more airflow can be realised, which is generally more beneficial. Greater lift has some limitations. Firstly, the lift is limited by the increased proximity of the valve head to the piston crown and secondly greater effort is required to move the valve's springs to higher state of compression. Increased lift can also be limited by lobe clearance in the cylinder head construction, so higher lobes may not necessarily clear the framework of the cylinder head casing. Higher valve lift can have the same effect as increased duration where valve overlap is less desirable.

Higher lift allows accurate timing of airflow; although even by allowing a larger volume of air to pass in the relatively larger opening, the brevity of the typical duration with a higher lift cam results in less airflow than with a cam with lower lift but more duration, all else being equal. On forced induction motors this higher lift could yield better results than longer duration, particularly on the intake side. Notably though, higher lift has more potential problems than increased duration, in particular as valve train rpm rises which can result in more inefficient running or loss or torque.

Cams that have too high a resultant valve lift, and at high rpm, can result in what is called "valve bounce", where the valve spring tension is insufficient to keep the valve following the cam at its apex. This could also be as a result of a very steep rise of the lobe and short duration, where the valve is effectively shot off the end of the cam rather than have the valve follow the cams’ profile. This is typically what happens on a motor over rev. This is an occasion where the engine rpm exceeds the engine maximum design speed. The valve train is typically the limiting factor in determining the maximum rpm the engine can maintain either for a prolonged period or temporarily. Sometimes an over rev can cause engine failure where the valve stems become bent as a result of colliding with the piston crowns.

Position

Depending on the location of the camshaft, the cams operate the valves either directly or through a linkage of pushrods and rockers. Direct operation involves a simpler mechanism and leads to fewer failures, but requires the camshaft to be positioned at the top of the cylinders. In the past when engines were not as reliable as today this was seen as too much bother, but in modern gasoline engines the **overhead** cam system, where the camshaft is on top of the cylinder head, is quite common.

Number of camshafts

Main articles: overhead valve and overhead cam

While today some cheaper engines rely on a single camshaft per cylinder bank, which is known as a *single overhead camshaft* (SOHC), most modern engine designs (the *overhead-valve or OHV* engine being largely obsoleted from passenger vehicles), are driven by a **two camshafts** per cylinder bank arrangement (one camshaft for the intake valves and another for the exhaust valves); such camshaft arrangement is known as a *double* or *dual overhead cam* (DOHC), thus, a V engine, which has two separate cylinder banks, may have four camshafts (colloquially known as a *quad-cam engine*[6]).

More unusual is the *modern* W engine (also known as a 'VV' engine to distinguish itself from the pre-war W engines) that has *four* cylinder banks arranged in a "W" pattern with two pairs narrowly arranged with a 15 degree separation. Even when there are four cylinder banks (that would normally require a total of eight individual camshafts), the narrow-angle design allows the use of just four camshafts in total. For the Bugatti Veyron, which has a 16 cylinder W engine configuration, all the four camshafts are driving a total of 64 valves.

The overhead camshaft design adds more valvetrain components that ultimately incur in more complexity and higher manufacturing costs, but this is easily offset by many advantages over the older OHV design: multi-valve design, higher RPM limit and design freedom to better place valves, ignition (Spark-ignition engine) and intake/exhaust ports.

Maintenance

The rockers or cam followers sometimes incorporate a mechanism to adjust and set the valve play through manual adjustment, but most modern auto engines have hydraulic lifters, eliminating the need to adjust the valve lash at regular intervals as the valvetrain wears, and in particular the valves and valve seats in the combustion chamber.

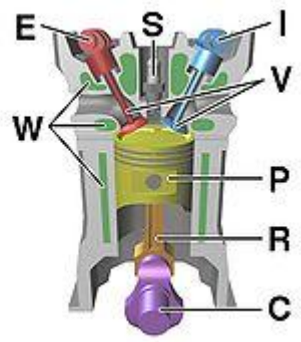
Sliding friction between the surface of the cam and the cam follower which rides upon it is considerable. In order to reduce wear at this point, the cam and follower are both surface hardened, and modern lubricant motor oils contain additives specifically to reduce sliding friction. The lobes of the camshaft are usually slightly tapered, causing the cam followers or valve lifters to rotate slightly with each depression, and helping to distribute wear on the parts. The surfaces of the cam and follower are designed to "wear in" together, and therefore when either is replaced, the other should be as well to prevent excessive rapid wear. In some engines, the flat contact surfaces are replaced with rollers, which eliminate the sliding friction and wear but adds mass to the valvetrain.

Alternatives

In addition to mechanical friction, considerable force is required to overcome the valve springs used to close the engine's valves. This can amount to an estimated 25% of an engine's total output at idle, reducing overall efficiency. Some approaches to reclaiming this "wasted" energy include:

- Springless valves, like the desmodromic system employed today by Ducati
- Camless valvetrains using solenoids or magnetic systems have long been investigated by BMW and Fiat, and are currently being prototyped by Valeo and Ricardo
- The Wankel engine, a rotary engine which uses neither pistons nor valves, best known for being used by Mazda in the RX-7 and RX-8 sports cars.

Gallery



Components of a typical, four stroke cycle, DOHC piston engine. (E) Exhaust camshaft, (I) Intake camshaft, (S) Spark plug, (V) Valves, (P) Piston, (R) Connecting rod, (C) Crankshaft, (W) Water jacket for coolant flow.

Double overhead cams control the opening and closing of a cylinder's valves.

1. Intake
2. Compression
3. Power
4. Exhaust

Valve timing gears on a Ford Taurus V6 engine — the small gear is on the crankshaft, the larger gear is on the camshaft. The gear ratio causes the camshaft to run at half the RPM of the crankshaft.

Source : http://nprcet.org/e%20content/mech/KM.pdf