Cam

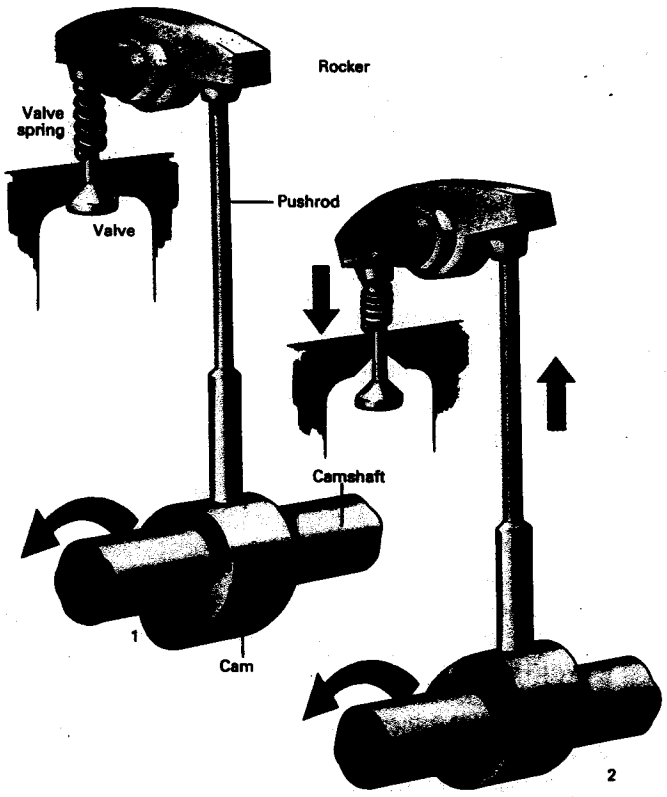
A cam is a device for converting rotary motion into linear motion. The simplest form of cam is a rotating disc with a variable radius, so that its profile is not circular but oval or egg-shaped. When the disc rotates, its edge pushes against a *cam follower*, which may be a small wheel at the end of a lever or the end of the lever or rod itself. The cam follower will thus rise and fall by exactly the same amount as the variation in radius.

By profiling a cam appropriately, any desired cyclic pattern of linear or straight-line motion can be produced. With most cams some form of spring action insures that the cam follower remains in contact with the cam. In practice, cams are not necessarily rotary in action. The same form of linear movement can be obtained from a cam profile that oscillates back and forth. In both cases the output movement will be at right angles to the forces that initiate the motion.

The idea of a cam goes back to Hero of Alexandria and it forms one of the basic devices in engineering. It has found innumerable uses throughout history to provide the oscillating action of bellows, the timing action of valves, as in steam engines, and in the control of windmills.

Today it finds uses in the internal combustion engine, machine tools, electromechanical timing gear, and a wide range of machinery, from juke boxes to computer equipment. In the internal combustion engine a set of cams on a rotating camshaft controls the opening and closing of the inlet and exhaust valves. The shapes and positions of the cams insure that the valves are opened and closed in the correct sequence and at the correct time intervals. Various systems have been adopted over the years, one of the most common being pushrod action in which the cam acts on a cam follower and from there on a vertical rod in a lubricated sleeve. Movement of this rod is then transmitted in turn through a pivoted rocker arm to the valve's stem. Other systems involve the elimination of the pushrod as in the overhead camshaft arrangement, where the camshaft is set on top of the cylinder block above the valves. Internal combustion engines operate at high speeds, so the spring force maintaining the cam follower in contact with the cam has to be exceptionally powerful – the faster the engine, the more powerful the spring. If the spiral spring used is insufficiently powerful, the inertia forces in the valve system will prevent the cam follower from maintaining intimate contact with the cam and an inefficient condition known as valve bounce will occur, giving a distinct noise.

Because the cam can be made with any desired profile and in almost any material, it provides a fine controlling device for machine tool cutting feeds where high stresses are involved. In effect, the cutting tool is made to follow the same path that the cam's profile would follow if it were stretched out in a straight line. Such cams can be expensive to make but the cost can be justified where the volume of production is large, such as in an automobile factory. The high manufacturing cost is due to the asymmetric, or even irregular, shape of some cams which must be machined in extremely tough, durable metals to give sufficient resistance to wear. One technique is to form the cam in mild metal, which is easily worked, then treat the finished cam to harden the metal. Any modifications to the cam profile, however, might require a new cam to be started from mild steel.



In a side-cam automobile engine, the cams are carried on a camshaft located beside the crankshaft. The drive for the camshaft is taken from the crankshaft through a timing chain, which keeps the cams synchronized with the movement of the pistons so the valves are opened or closed at the precise instant. In the overhead cam system, the camshaft is mounted vertically above the crankshaft so the cams act directly on the valves, eliminating the need for pushrods. The profile of the cams can be modified slightly to vary the time the valves stay opened.

See also: Internal combustion engine.