

# Design and Manufacturing of Cam Operated Springless Valve System for an IC Engine

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**Abstract**— This project presents the springless valve system used in the IC engines. Unlike the conventional valve system, springless valve system uses two cams for each valve with absence of spring. This mechanism has a closing cam which does not allow cam jump as conventional valve system. In this work first we are going to discuss conventional valve mechanism and its advantages and disadvantages and then we are going to discuss about springless valve system along with its advantages and disadvantages. It will help us to find out how springless valve system is better than conventional valve system. We are also going to find the real importance of this springless system at higher rpm of engine and need of this system at higher rpm. This system improves the performance of IC engine by reducing power consumption for overcoming spring stiffness and avoid cam jump at high speed.

**Keywords:** Valve, Cam, Follower, Springless Valve

## I. INTRODUCTION

IC Engines uses valves to handle charge in and out of the cylinder for their operation. There are intake valves and exhaust valves which are to spring less be operate at right time when needed and remains close to seal the cylinder when compression and combustion is occurred. To do this opening and closing of valves cam and follower mechanism is used. In conventional valve train valves are fitted with metal spring. Opening of valve is done by cam profile which has raised section on its profile to open the valve and spring helps during closing of valve to follow cam profile during return stroke of follower.

It is important to follow the cam profile by follower and this spring force press the follower tightly on cam profile to follow the profile of cam. But as rpm of engine increases valves has to open and close fast this cause valve float or cam jump to avoid this we have to use spring having more stiffness to fulfill the requirement and this leads to loss of engine power to overcome this stiffness of spring. These disadvantages are overcome in spring less valve system which does not use springs for their operation and there is absence of cam jump phenomenon which results in better engine operation and high power output from engine. This gives freedom to engineers to design engine for higher rpm with no cam jump.

The valves in a typical four stroke engine allow the air/fuel mixture into the cylinder at the beginning of the cycle and exhaust gases to be expelled at the end of the cycle. In a conventional four stroke engine, valves are opened by a cam and closed by return spring. An engine using cam follower mechanism has two cams and two followers, each of positive opening and closing without spring.

The common valve spring system is satisfied for traditional mass-produced engines that do not rev highly and are of a design that requires low maintenance. At the period

of initial spring less valve development, valve springs were a major limitation on engine performance because they would break from metal fatigue. The spring less valve system was devised to remedy this problem. Furthermore as maximum rpm increases, higher spring force is required to prevent valve float.

## II. PROBLEM STATEMENT

- This spring less mechanism is used in IC engine instead of conventional spring and follower mechanism. conventional system is useful up to a limit that is when engine rpms goes on increasing there is danger of cam jump and due to this valve starts to float. Generally the damage is due to floating of valve. Valves of IC engine opened by cam and closing of valve is totally depends on helical spring. There are chances of failure of springs at high rpm or there is chances of valve float.
- If this phenomenon is happens piston and valves collides on each other and this causes serious damage to engine. In case of multi cylinder engine damaged metal pieces goes to all cylinders from intake manifold. Due to this if one of a valve spring fails it causes damage to all engine. Conventional valve system operates on spring having some stiffness this stiffness is kept high to avoid valve float.
- Manufacturing of this spring is very risky job, strict inspection required so that there should not be any defect in spring and this increases cost of system. In valve spring mechanism there is positive opening of valve by cam but closing of valve is totally depends upon the spring. So we cannot control closing of valve by cam this causes valve float at high rpm and due to valve float we cannot control the valve actuation.
- For high speed engines to avoid cam jump we have to increase stiffness of springs to achieve this concentric springs are used. As springs are operates at higher speed there are chances of failure of springs due to any defect. To avoid this valve springs are manufactured very carefully there are many manufacturing processes are available to avoid defects. Strict inspection is also required. These processes are very costly.

## III. OBJECTIVES

The purpose of the modification of the valve system is to improve the efficiency of IC engine.

The followings are the important objectives,

- To add the cam instead of spring in valve closing mechanism
- To avoid the over jump of the system of valve in IC engine.

### A. Future Scope

Many internal combustion engines, such as those operating on four stroke principle are provided with at least one intake valve and at least one exhaust valve. The intake and exhaust valves are disposed in intake and exhaust passages. They are actuated to open and close the passages in order to control the flow of air and fuel into a combustion chamber of the engine and the flow of exhaust gases out of the combustion chamber. Various mechanisms exist to actuate the movement of the valves.

Spring less valve system is one of the mechanism which gives better solution to actuate the valve. In this system due to two i.e. opening and closing cams valve actuation is positive means without cam jump as in case of conventional mechanism closing of valve is totally depends on spring.

In high speed engine there is risk of cam jump which results in various failures this damages the engine but in case of spring less system it is avoided hence this system can operate at high speed without any risk.

Due to the Norms for Controlling Pollution we have to refine our engine to perform it better with minimum pollution, to achieve this objective we have to adopt new technologies such as variable valve timing. In spring less valve system we can also adopt this technology by some mechanism which gives us better performance at any speed with minimum pollution.

#### IV. STUDY OF IC ENGINE VALVE MECHANISM

- Valve

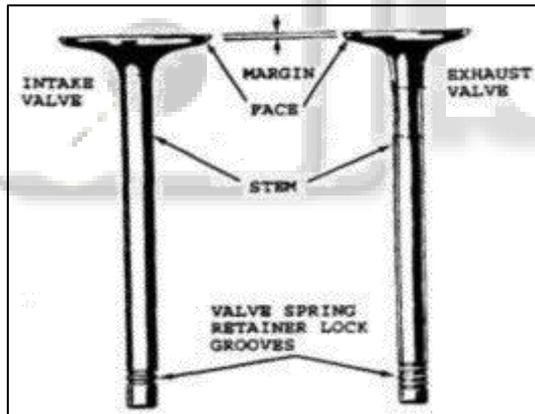


Fig. 1:

- In IC engine there are two types of valves intake and exhaust valves they are as shown in fig. intake valve is little bigger in diameter because it has to operate at lower pressure that is intake valve is opens when engine starts to suck the charge due to this there is some negative pressure during suction stroke of engine therefore to avoid restriction to flow intake valve is kept little bigger in diameter. Where exhaust valve is operate at higher pressure hence it is little smaller in diameter than intake valve. There is more heat generation at exhaust valve due to exhaust gases which are at higher temperature therefore we need better cooling at exhaust valve.
- As discuss earlier exhaust valve is smaller diameter hence there is less area which is in contact with valve seat this arrangement create problem during heat transfer therefore cooling is very important in case of exhaust

valve and there is no such problem in case of intake valve because incoming air which is relatively cooler it helps in cooling of valve and also the area of contact between valve and valve seat is also more than exhaust valve. Due to this there is problem of burning of valve.

#### V. VALVE GUIDE

Valve guide is provided for each poppet valve in the cylinder head, it is provided to make proper contact with valve seat. Valve guide is a cylindrical piece of metal pressed or casted into cylinder head and valve reciprocate into this guide. It also helps to conduct heat from the valve. Because of this there is proper selection of material to the guide so that it should good conductor of heat and can stand against wear therefore bronze is commonly used. The clearance between valve stem and guide should proper for good operation of engine. If this clearance is too little valve is going to stick. And if there is too much clearance valve may not seat.

#### VI. VALVE SEAT

Valve seat is the surface where intake and exhaust valve rests during its operation. This is the critical component of engine if this is improperly positioned valve leakage will occur which will adversely affect the engine compression ratio and therefore engines efficiency, performance, exhaust emissions and engine life. Valve seat is press fitted in engine head and then machined with proper angle to seat the valve properly. Valve seat also helps in heat transfer from valve to head.

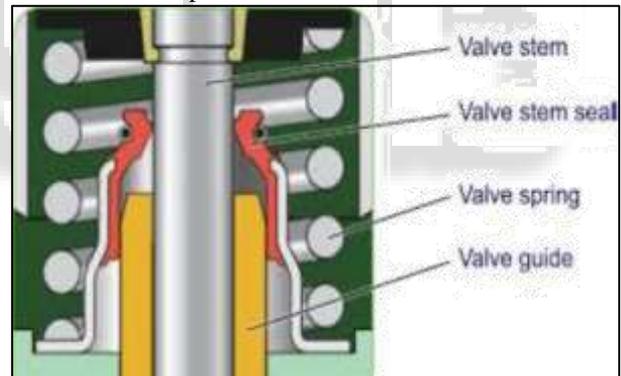


Fig. 2:

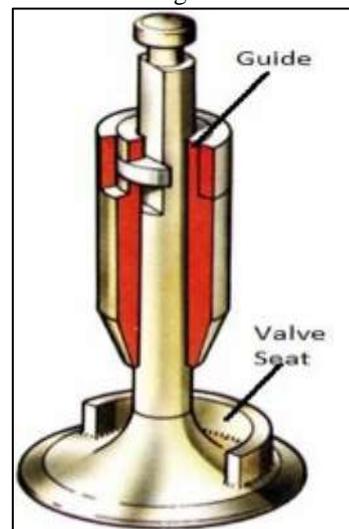


Fig. 3:

## VII. CAMS AND FOLLOWERS

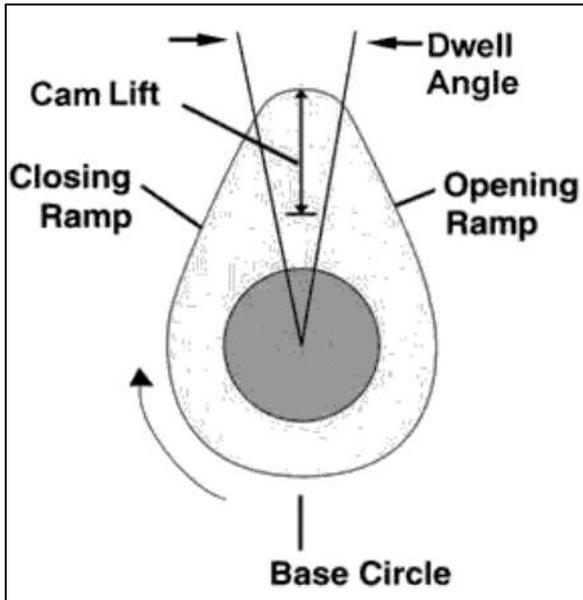


Fig. 4: Cam

To operate the valves at right time cam and follower mechanism is used as shown in above figures. As shown in fig. cam has lobe shape at one of its side.

This cam is present on camshaft the profile of cam is milled into the shaft called as camshaft. This camshaft is connected to crankshaft of engine by chain and sprocket or gear mechanism as shown in fig. cam is kept on follower.

## VIII. DESIGN OF SPRINGLESS VALVE SYSTEM

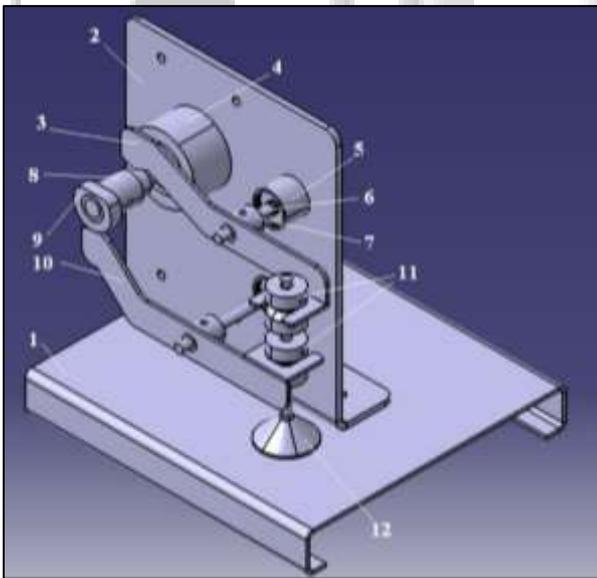


Fig. 5: spring less valve mechanism

- 1) Base Plate
- 2) End Plate
- 3) Opening rocker Arm
- 4) Bearing Holder 1
- 5) Bearing Holder 2
- 6) Shaft
- 7) Bush
- 8) Cam Bush
- 9) Cam

- 10) Closing Rocker Arm
- 11) Valve Holder
- 12) Valve

Spring less IC engine valve mechanism consists of a poppet valve to handle charge in and out of combustion chamber of IC engine. Operated by two links which are pivoted at Centre and controlled by two cams i.e. opening and closing cam at one side and valve is attached to other side. The shaft on which links are pivoted is hold stationary by using end plate, this end plate is attached to base plate by using bolts as shown in fig. the shaft on which cams are mounted is connected to the electric motor by using gear pair and this shaft is supported in bearings. The shaft on which cams are mounted is called as camshaft. The electric motor is used to simulate the power transmission from the crankshaft to camshaft in practical working valve mechanism of IC engine.

## IX. WORKING

- The electric motor is started and power is transmitted to the camshaft through gear pair and camshaft start to rotate. In case of IC engine this power is given by crankshaft of engine by connecting camshaft and crankshaft by chain, belt or gear. The cams are fixed on camshaft and therefore they also starts to rotate with shaft. There are two cams opening cam and closing cam. These cams operates rocker arms as opening cam pushes the opening rocker arm this tends to push the valve and opens it at the same time closing rocker arm does not restrict the moment of opening rocker arm and it support the valve and avoid free falling off valve.
- When valve lifts from its seat fully then it starts to return on seat i.e. it starts to close this is done by closing cam. closing rocker arm starts to lift the valve by following the curve of closing cam at the same time opening cam does not restrict the movement of closing cam, to achieve this objective we have to design the cam profile such that the valve should operate smoothly therefore there is relation between these two cam profiles. In this manner the opening and closing of valve is done without cam jump because the closing of valve does not depends on spring as in conventional valve spring mechanism.
- Spring less mechanism uses two separate cams one is for open and other is for close the valve. This mechanism eliminates the cam jump phenomena which reduces the risk of engine damage at high speed. As in conventional valve spring mechanism some power of engine is lost to overcome the spring force to operate the valve this loss is minimized in case of spring less valve mechanism which results in more shaft output.

## X. ADVANTAGES

- 1) Absence of valve spring- Spring less valve does not use any spring for its operation. Therefore does not consume power from engine to overcome spring force.
- 2) Increase in engine output-due to absence of spring power taken from crank by camshaft to operate valves also gets reduced this increases engine output.
- 3) Prevention of valve float- the system uses opening cam and closing cam that is there is positive opening and

closing of valve. Therefore at high revolutions of engine there is no any chance of floating of valve.

- 4) Avoid damaging to system- as valve floating is avoided valve operates positively without failure this avoid damage to system.
- 5) Does not allow combustion gases to escape-in case of conventional system due to floating of valve cylinder is not totally sealed during combustion this causes combustion gases to escape but in case of spring less this is totally avoided even at very high speed.
- 6) Avoid overheating- spring less system does not allow valve to float this ensures that even at high speed valve returns to its seat this causes better heat transfer and avoid overheating of valves.
- 7) Efficient mechanism- as engine output is increased due to reduction in power consumption by camshaft this system increases efficiency of engine.

#### XI. DISADVANTAGES

- 1) Complex mechanism-there is increase in number of parts required for operating valves this system becomes complex.
- 2) Expensive-due to increase in number of parts system becomes expensive
- 3) Wear- due to more number of links wear is more.

#### XII. CONCLUSION

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