Modification and Analysis of Groove Type Camshaft With Ball Type Lifter

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***Abstract* - In internal combustion engines the cam play a very important role and also takes huge impact on itself. The failure of cam is major issue which happens due to the follower, this failure is also known as the lobe failure. Lobe is the surface of the cam on which the material removal is major issue and all the impact is made by the follower. This failure produces the great amount of wear and tear in the cam. To overcome the failure and to keep the cam safe from the huge impact the design plays the role. It keeps the cam profile protected from wear and tear produced by the follower. The follower and cam design provide the smooth operation with least impact resulting in the extremely low wear and tear. In this single groove cam and ball point type follower design the ball point of the follower has the advantage of rotating 360 degrees, so during any impact the follower rotates and provides no wear and tear to the cam profile. This new design has reduced the wear and tear up to 60% on cam profile and cam lobe. This design also increased the life of component and has provided the improvisation to the existing design for further future applications.**

***keywords* - Modified Cam, Single Groove Cam, Ball Type Lifter, Modified Lifter**

I. INTRODUCTION

Cams come in all shapes and sizes and are found in most branches of engineering. Simple cams form the basis of rotary cam timers which are used to control some household appliances, car engine would not work without the cams and many industrial machine tools rely upon them.

A cam is a rotating or sliding piece in a mechanical linkage used especially in transforming rotary motion into linear motion. It is often a part of a rotating wheel (e.g. an eccentric wheel) or shaft (e.g. a cylinder with an irregular shape) that strikes a lever at one or more points on its circular path. The cam can be a simple tooth, as is used to deliver pulses of power to a steam hammer, for example, or an eccentric disc or other shape that produces a smooth reciprocating (back and forth) motion in the follower, which is a lever making contact with the cam. A cam and follower mechanism is a profiled shape mounted on a shaft that causes a lever or follower to move. Cams are used to convert rotary to linear (reciprocating) motion. [1]

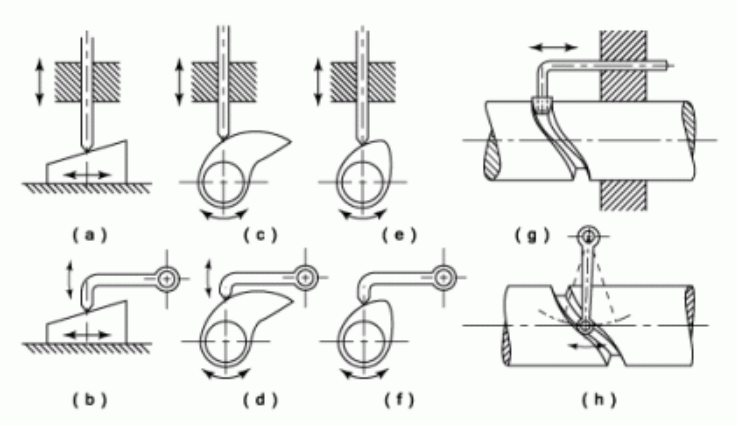

Fig. 1. Different Types of Cam and Follower

As the cam rotates, the follower rises and falls in a process known as reciprocating motion. The motion of the follower is restricted to a pre-determined pattern by a guide. The follower maintains contact with the cam through the force of gravity or by a spring. The range of movement of the follower will depend on the distance from the shaft supporting the cam to the upper and lower points of the rotation circle. Cams are commonly used in engines to control valves (in which the valve is the follower), sewing machines and many other mechanical applications. [2]

II. CAM SHAFT WEAR PROBLEM AND IDENTIFICATION:

'After some kilometers camshaft is getting failed and immediately camshaft fails cause of lobe wear and excessive friction between cam and lifter.'

The different types of failure in camshaft or cam are:

1. Lobe wears:

Lobe wear is often caused by **60% of the failed cam lobe fails cause of lifter.**

Fig. 2. Cam Lobe Wear

Cause of failure to check clearances or correct valve train geometry issues, like coil bind, rocker to rocker stud, or rocker to adjustment nut clearance, retainer to valve seal, clearances or rocker geometry, use of the wrong spring load rates for the application, or failure to check valve train or push rods binding issues like rocker to retainer, push rods binding on guide plates or heads, etc. [3]

2. Improper Break-In:

After the correct break-in lubricant is applied to the cam and lifters fill the crankcase with fresh, non-synthetic oil. Use motor oil with an engine break-in additive (ZDDP or ZINC camshaft additive), especially with flat tappet camshafts.

Prime the oil system with a priming tool and an electric drill so that all oil passages and the oil filter are full. Preset the ignition timing and prime the fuel system. Fill the cooling system. Start the engine, run it between 1,500 and 3,000 rpm, varying the rpm up and down in this range for 20 minutes. During break-in, verify that the pushrods are rotating, as this will show that the lifters are also rotating. If the lifters don't rotate, the cam lobe and lifter will fail. Sometimes you may need to help spin the pushrod to start the rotation process. [4]

3. Old Lifters with a New Cam:

Use new lifters on a good used cam, but never pair used lifters with a new cam.

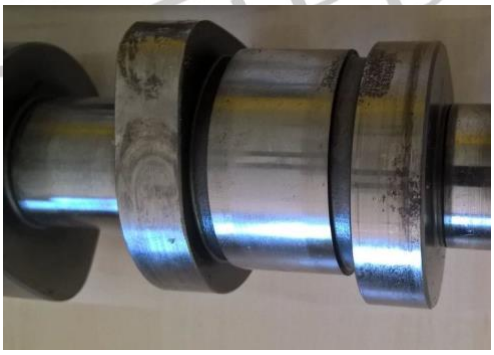

Fig. 3. Cam Lobe Wear cause of Lifter

4. Broken Cam:

A broken camshaft is usually caused by a connecting rod or other rotating part coming loose and striking it. Sometimes the cam will break after a short time of use because of a crack or fracture in the cam due to rough handling during shipping or improper handling prior to installation.

5. Damage From the Lifter/Followers:

It is possible to have lobe damage caused by an improperly functioning lifter. You will most likely notice gouging on the lobes, as well as damage on the lifter itself. This can be caused by a lifter being out of position and striking the lobe, weak valve spring pressure, lack of oil pressure, or from stressful operating conditions like over speeding.

Fig. 4. Lifter Impact on Cam Lobe

There are other types of damage a camshaft or its associated parts can incur besides just lobe wear. Many of these results from improper install techniques. To prevent install-related damage, ensure your camshaft is properly positioned and placed. Read our install guide for more information. We have a large selection of camshafts if you notice that yours needs to be replaced. [6]

III. DESIGN, METHODOLOGY AND IMPLEMENTATION:

A. Modification of Single Groove Cam With Ball Point Type Lifter:

Fig. 5. Single Groove and Ball Point Type Lifter

Different types of followers are used in an automobile. But in every cam and follower, friction and heat generation occurs.

Due to this friction and heat generation, follower life decreases. A cutting effect on the surface of the cam is also the result of friction. Because of these reasons arrangement and a successive pair of cam and follower get affected. Successive Pair of cam and follower remains incomplete. In every mechanical component, there is no such system that lubrication would be provided at each place because of this there is a decrease in camshaft's life.

In existing rocker arm and in lifter the roller is rotate only in 2 Direction X & Y. but in this system rocker arm and lifter rotate 360° means X, Y and Z Direction. This system manufacturing cost is cheapest. The Ball point type follower is rotate in 360° like ball pen type so it will reduce the friction cause of rotation of ball.

B. Modified Single Groove Camshaft:

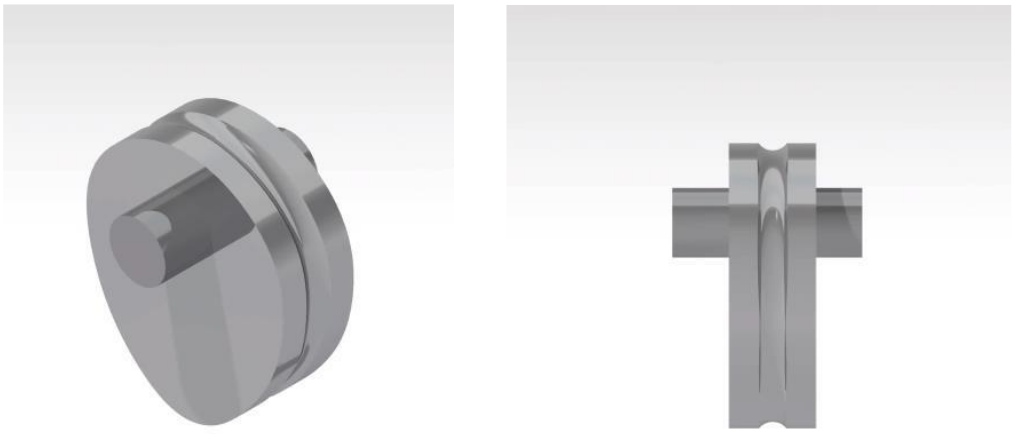

Fig. 6. Single Groove Cam Catia Model

- In this type of design of cam, instead of the flat surface of cam, it is replaced by the undercut. Due to this Follower will work smoothly and when engine vibration will occurs camshaft may not be damage.
- In this cam not changing cam profile of existing cam just undercut with same depth so it will not change.

C. Modified Lifter / Rocker Arm:

- Ball point type follower design is inspired by the point of a ball pen.

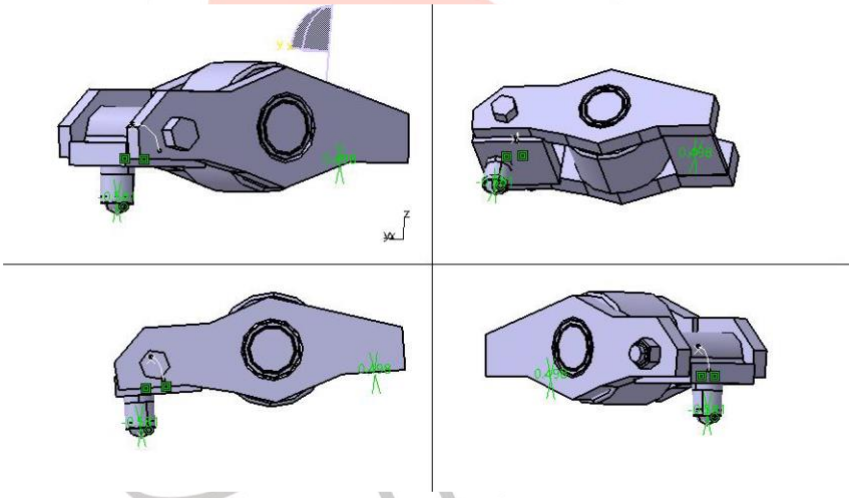

Fig. 7. Ball Point Type Follower model

- This design works on the principle or mechanism of a ball pen. As in a design of ball pen rolling of ball it happens same in a case of ball point type follower. Cam's groove comes in contact with that ball point.
- Heat generation is less between cams and followed. The decrease in friction. And considering all these parameters, single groove cam and ball point follower is designed.

D. Comparison Of Existing Cam And Lifter With New Modified Cam And Lifter:

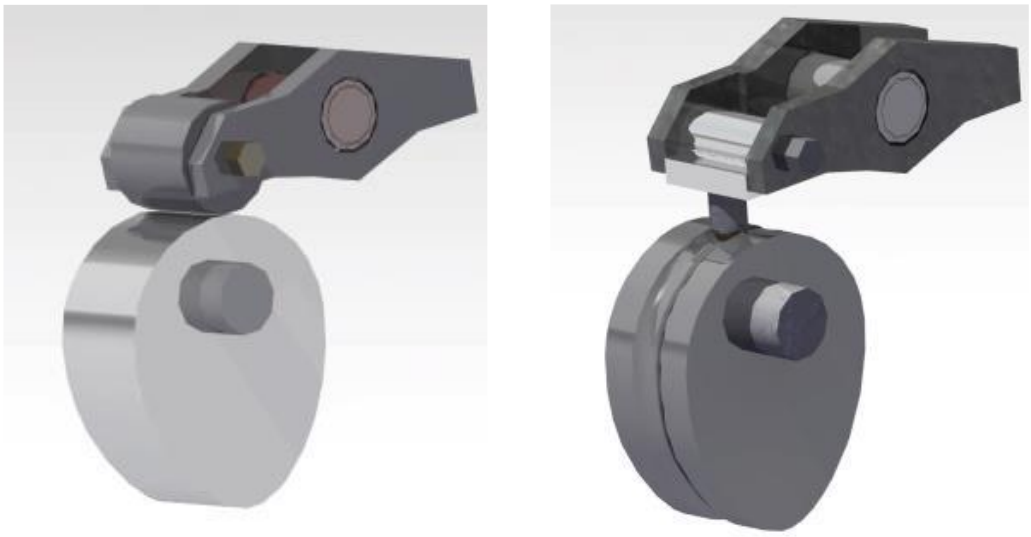

Fig. 8. (A) Existing Cam Mechanism (B) Modified Cam Mechanism

As shows above figure (A) is existing cam mechanism and (B) is modified cam mechanism. In existing cam during operation of valve lifting cause of valve pressure the cam lobe is worm out after some cycle. And major effect on cam during vibration lifter roller rotate only in 2 - Axis cause of that wear pattern generate on cam lobe. In modified cam mechanism during vibration ball point type lifter ball rotate 360° means 3 - Axis during engine vibration and prevent the camshaft lobe. And causes of cam groove restrict moment of rocker arm Lifter.

IV. ANALYSIS OF DESIGN:

A. Wearing Analysis Of Existing Cam Mechanism And New Modified Cam Mechanism:

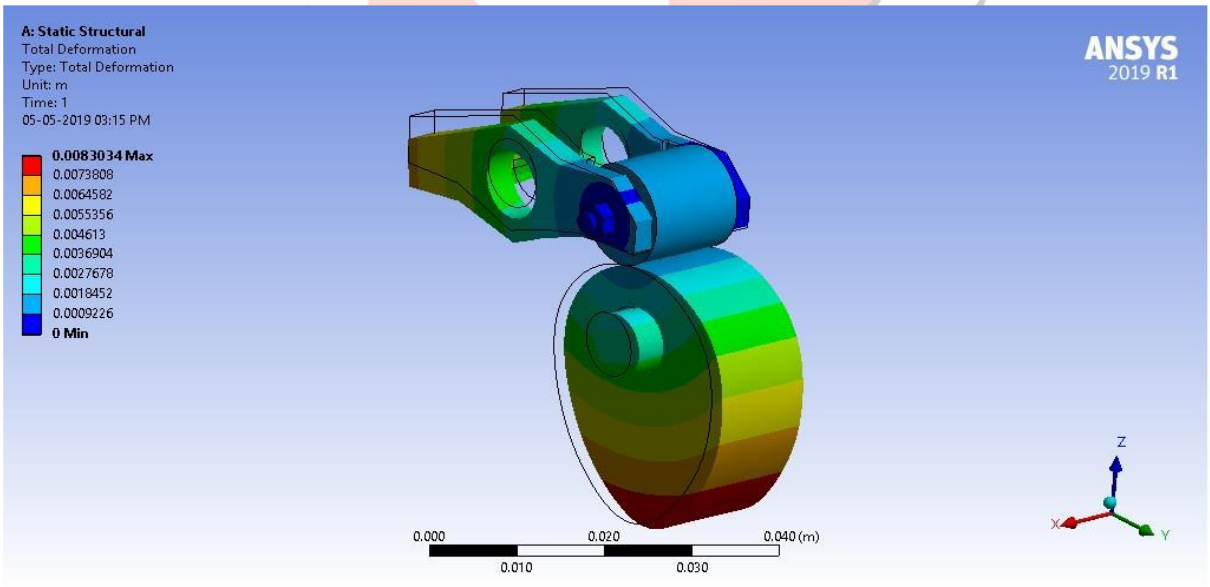

Fig. 9. Existing Cam Wear Analysis

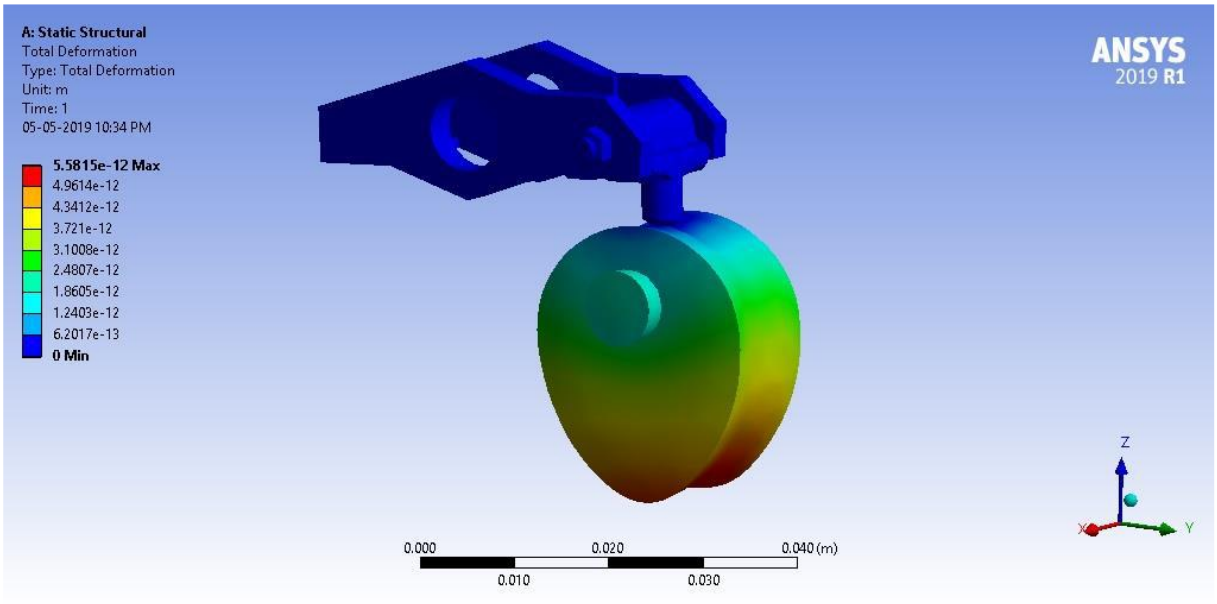

Fig. 10. New Modified Cam With Wear Analysis

B. Implementation in Engine Cylinder Head:

1.1. Engine Specification:

Engine type	Single Cylinder
CC	150 cc
Camshaft Type	Over head camshaft
Valves	2 valves
Lift angle (Inlet valve)	135°
Lift angle (Exhaust valve)	105°
Rocker arm Lifter Type	Roller

Fig. 11. Engine Head with Cam Assembly

Fig. 12. Assembly of Camshaft with Modified Lifter and Cam

V. CONCLUSION

As we seen the cam failure major cause is lobe wearing. From that I conclude that on this design of single groove cam and ball point type lifter the contact between the cam and lifter friction and heat generation is less than the others and this is a new concept for mechanical and automobile industries. When both components are on moving and rotating motion the wear and tear are affects on cam lobe. There are different types of followers like a knife edge, roller, flat type followers, but in all these types more friction and wearing takes place. So in concern to this friction and wearing issue, Single groove cam with ball point type lifter design is presented. In this design heat generation, friction, wearing will be lesser comparatively from other mechanism it reduce from 60% to 70%.

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