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Failure of Camshaft

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Abstract*— *Camshaft can be defined as a machine element having the curve outlined or a curved grooved, gives the predetermined specified motion to another element called the follower. In automotive field, Camshaft and its follower take importance roles to run the engine. Nowadays the car maker have developed the vary schemes of cam profile to match with the engine performance. Since the system deals with high load and high speed and many analyses have been carried out on the failure of the components. The analysis is done either by experimental or finite element analysis. The result from the finite element analysis is an approximate of the component failure. In the mean time, the software development is improving in this few decades.

Index Terms*— *Cams and followers; engine; failure of camshaft; material; valves.

I. INTRODUCTION

Camshaft is one of the key parts or components in the engines of automobile and other vehicles. The performance is to control the open and close intervals of the inlet and exhaust poppet valves by its cams. Due to the cyclic impact loading on the contacting surfaces of the cam and the follower, it often gives rise to premature wear of cam profile and affects a routine run of the valve gear such as the rotational speed, valve displacement and the torque. On the other hand, simultaneously the most serious, under cyclic bending and torsion, fatigue fracture of camshaft initiating at stress concentration easily occurs. Therefore it demands the camshaft has not only excellent wear resistance but also adequate anti-impact toughness.[7]

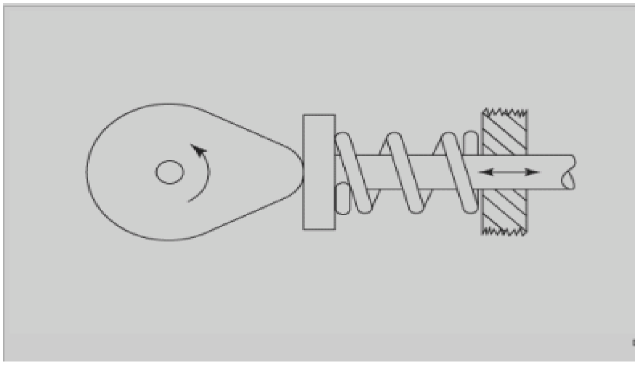

Fig.1: working of cam

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II. CLASSIFICATION OF CAM

A. Radial or Disc Cam-

In radial cams, the follower reciprocates or oscillates in a direction perpendicular to the cam axis.

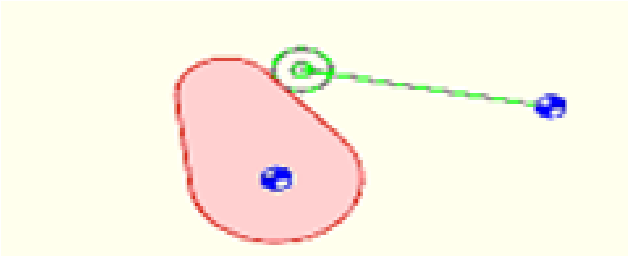


Fig.2: Radial Cam

B. Cylindrical Cam-

In cylindrical cams, the follower reciprocates or oscillates in a direction parallel to the cam axis.

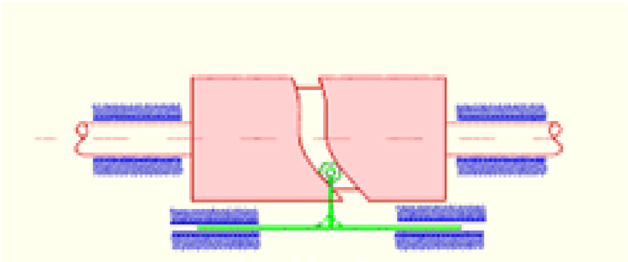
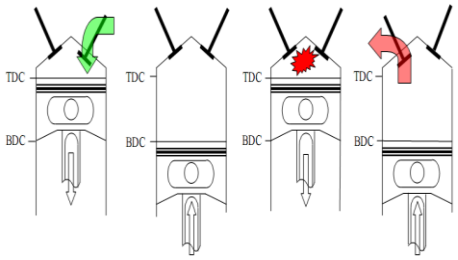


Fig.3: Cylindrical Cam

III. WORKING

The key parts of any camshaft are the lobes. As the camshaft spins, the lobes open and close the intake and exhaust valves in time with the motion of the piston. It turns out that there is a direct relationship between the shape of the cam lobes and the way the engine performs in different speed ranges. As the piston starts moving downward in the intake stroke (TDC), the intake valve would open. The intake valve would close right as the piston bottoms out. The exhaust valve would open right as the piston bottoms out (BDC) at the end of the stroke, and would close as the piston completes the exhaust stroke. When the intake valve opens and the piston starts its intake stroke, the air/fuel mixture in the intake runner starts to accelerate into the cylinder. By the time the piston reaches the bottom of its intake stroke, the air/fuel is moving at a pretty high speed. If we were to slam the intake valve shut, all of that air/fuel would come to a stop and not enter the cylinder. By leaving the intake valve open a little longer, the momentum of the fast-moving air/fuel continues to force air/fuel into the cylinder as the piston start its compression stroke. So the faster the engine goes, the faster the air/fuel moves, and the longer we want the intake valve to stay open.



Suction compression ignition exhaust
Fig.4: Engine Working

IV. TYPES OF ARRANGEMENT

A. Single Overhead Cam (SOHC) –

This arrangement denotes an engine with one cam per head.

B. Double Overhead Cam (DOHC) –

A double overhead cam engine has two cams per head. Usually, double overhead cams are used on engines with four or more valves per cylinder.[7]

V. MATERIALS USED FOR CAMSHAFTS

Camshafts can be made out of several different types of material. These include:

A. Chilled Iron Castings-

This is a good choice for high volume production. A chilled iron camshaft has a resistance against wear because the camshaft lobes have been chilled, generally making them harder.

B. Billet Steel-

When a high quality camshaft is required, engine builders and camshaft manufacturers choose to make the camshaft from steel billet.[1]

VI. TYPES OF CAM FAILURE

A. Dry Wear of Camshaft –

The wear was determined as weight losses of the samples as a function of wear test duration and loads. The variation of camshaft profile was captured by a level sensor during the wear. The profile variation was continuously monitored on the computer screen throughout the tests. It was found that the wear mechanisms of the cam surface change along the contact surface. The maximum wear value was obtained just to cam tip.[4]

B. Contact Fatigue-

Generally, one surface moves over the other in a rolling motion as in a ball rolling over a race in a ball bearing. The contact geometry and the motion of the rolling elements produce an alternating subsurface shear stress. Subsurface plastic strain builds up with increasing cycles until a crack is generated.[5]

C. Diesel Engine Cam Galling –

Heavy Duty diesel engines typically use roller followers in contact with the cam to reduce friction and accommodate high Hertzian stresses. When the rolling contact slips into sliding, cam galling can occur that may lead to major cam failures. Oil traction has been identified as a possible source to cause slipping.[6]

VII. REASONS AND CAUSES FOR CAM FAILURE

A. Incorrect Break-In Lubricant –

Use only the Moly Paste, Part Number 99002-1 that is included with the cam. This Moly Paste must be applied to every cam lobe surface, and to the bottom of every lifter face of all flat tappet cams. Roller tappet cams only require engine oil to be applied to the lifters and cam.

B. Correct Break-In Procedure –

After the correct break-in lubricant is applied to the cam and lifters fill the crankcase with fresh non-synthetic oil. Prime the oil system with a priming tool and an electric drill so that all oil passages and the oil filter are full of oil. Pre-set the ignition timing and prime the fuel system. During this break-in time, 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.

C. Spring Pressure –

Normal recommended spring seat pressure for most mild street-type flat tappet cams is between 85 to 105 lbs. More radical street and race applications may use valve spring seat pressure between 105 to 130 lbs. This high spring pressure causes the heat created at the cam to be transferred to the roller wheel, resulting in its early failure. [3]

VIII. CONCLUSION

Camshaft is one of the key parts or components in the engines of automobile and other vehicles. There are various factors which causes failure of camshaft viz., material properties, engine speed or load on engine, lubricant properties, etc. To prevent premature wear and failure of the camshaft, we need to consider all the factors which may causes failure of camshaft and design it.

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REFERENCES

[1] J. Michalski), J. Marszalek, K. Kubiak "An experimental study of diesel engine cam and follower wear with particular reference to the properties of the materials" Received 9 August 1999; received in revised form 17 February 2000; accepted 17 February 2000

[2] Li ping, Li Ping , Li Fengjun, Cai Anke and Wei Bokang "Fracture analysis of chilled cast iron camshaft", , Received: 2008-10-10; Accepted: 2009-02-20

[3] "Camshaft Installation and Degreeing Procedure" manual by comp cams

[4] R. ˙Ipek, B. Selcuk ,"The dry wear profile of camshaft" Journal of Materials Processing Technology 168 (2005) 373–376

[5] W.A. Glaeser and S.J. Shaffer, B a t t e l l e Laboratories "contact fatigue", ASM Handbook, Volume 19: Fatigue and Fracture, ASM Handbook Committee, p 331-336

[6] Mandeep Saini and Frances E. Lockwood, The Valvoline Company and Jerry C. Wang and Carl F. Musolff, Cummins, Inc., "Contribution of Oil Traction to Diesel Engine Cam Galling", Society of Automotive Engineers, Inc.

[7] Merriam-webster.com. 2010-08-13. Retrieved 2010-11-07.