A RESEARCH PAPER ON DEVELOPMENT AND IMPROVEMENT OF OVER HEAD CAMSHAFT BEARING IN GASOLINE ENGINE

MOHMADSOHEL NIZAM BHAI MALEK
PG Scholar Mechanical Department,
PIET, Parul University, Vadodara, India

GANGESHWAR DIXIT
Engineer, Technical Department,
Atul Auto Limited, Ahmedabad, India,

Guide
IMRAN MOLVI,
Professor, Mechanical Department, PIET, Parul University.

Abstract: - This Study investigates methods of improving and enveloping cam shaft bearing of overhead camshaft of petrol engine three wheelers four stroke air cooled engine by analysis, field complaints with finding root cause of bearing failure. As the engine running up to certain km problem arises cam shaft bearing fails. After this due to disproportionate play occurs between parts ball bearing and outer race, which breaks outside the alignment at engine head with the tappet of engine head of petrol engine. *A*iming at subterranean improvement describing influence with various method and process improvement to sustain ball bearing position w.r.t. cam shaft housing of engine head. Ball bearing pressing tool mandrill modified to maintain bearing position w.r.t. bore depth in main cam shaft on engine head assembly. While adding shield on bearing and pressing references are modified from outer race to inner race of this ball bearing. The impression of expansion imitates on routines and engine plane cam shaft successively.

Keywords: - Cam shaft, Bearing, Overhead cam shaft, Design, Gasoline engine, Simulation.

I. INTRODUCTION

ATUL AUTO LTD, a leading three-wheeler automobile manufacturing industry across India. Vehicles parts developed, assembled, manufactured & propelled in new model of Gemin Prem. in multi-fuel range i.e. Gasoline, Diesel, LPG, CNG & Electronic in both people carry and goods carry vehicles. Atul Auto Lim. had launch new model name Gemin Prem. Passenger automobile three vehicle running on gasoline/petrol. While testing on-road through various developing departments, the problem of bearing failure in engine and engine failure is narrated. Accurately number of automobiles are on thoroughfare testing and number of glitches information also increased [1].

Overhead camshaft is a part of Engine Assembly which is mounted on top of engine main frame. The cycle of control spread in gasoline engine takes place as follow:

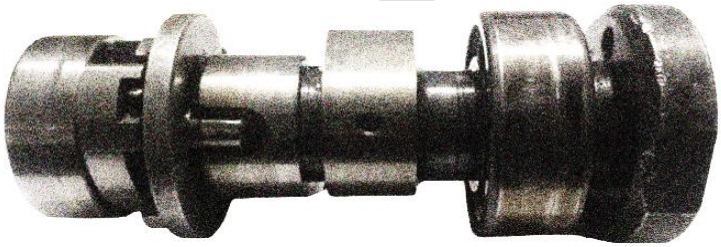


Fig 1. Overhead cam shaft mechanism

Piston - Crank Trough – Reduction Gear - Clutch Assy.- Small Cluster Gear – Main Speed Gear/ Speed Main shaft - Reverse Gear -Differential Assembly – Final Rear Axle.

6.

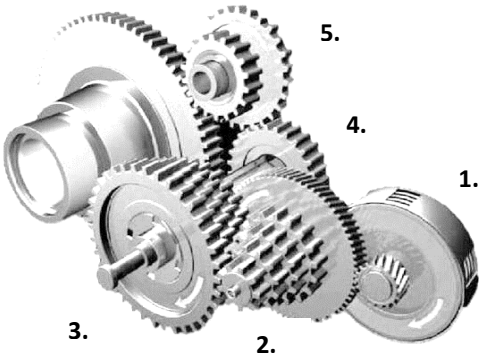


Fig 1.2 Normal position

Sr. No.	Part Name
1.	Clutch Assembly
2.	Small Cluster gear
3.	Main Speed gear/Main shaft
4.	Reverse gear shaft and gear
5.	Idle gear
6.	Differential gear assy.

The appropriate study and suitable process improvements is needed done to upsurge the engine lifespan and vehicle stand in modest market. In this study paper, an applied approach has been complete to design, development and expansion of a conformist cam shaft and bearing, through which recompenses of using conformist design with contemporary science. Predictable design will give broad-mindedness and cost efficiency. To suite cam shaft and bearing by proper running at most engine life efficient time to increase engine life rate.

Table 1.1 Parts of cylinder head assembly and its function.

Part no.	Part name	Function
1.	Cam shaft	The inlet and exhaust valves of the engine at the correct time
2.	Rocker arm	Turns into the up-and-down movement opens and closes the valves
3.	Chain and sprocket	Used to transmit motion and force from one sprocket/gear toanother
4.	Spark plug	Power to ignite the air/fuel mixture
5.	Sprocket cover	Prevent the dust particle which entered in to the head
6.	Tappet cap	Ease in tappet setting

Amongst power transmission, regulator and transported in four stroke engines. Transmitting power switched from crank shaft by chain on gear to interfacing overhead camshaft, control is main stream cylinder head assembly. Cam shaft is the principle transmission and power production through correct timing of opening and closing valves assembly of overhead camshaft. During power transmission through chain drive in over head cam shaft, due to vibration and disturbance in camshaft, ball bearing loses balls and breaks down the camshaft assy. Through which all system breakdown.

The suitable analysis with process enhancements is vigorous to increase the camshaft bearing life lifespan and sustainability in contemporary modest market. The followings field grievances that are renowned while on road tough of automobile.

1) Cam shaft bearing broken in 2-piece failure.
2) Bearing broken in oval/damage.
3) Main housing of cylinder head damage by excessive vibrations
4) Engine head crack/damage owing to additional vibration.
5) Oil leakage from crash and damaged valves in engine head.

2. OBSERVATION

Overhead all hitches rise due to camshaft & ball bearing failure. On road automobile running with multi-speed paraphernalia, play occurs between ball and outer race along with inner race. Outstanding to which camshaft & ball bearing damages during engine running. As an undesirable impact of spoiled bearing disturbs stoichiometric alignment of combustion process for engine power with cylinder head faulty which in results un even meshes of piston on cylinder head and damages additional portions as a big disappointment. Touching component barrel and piston head with excess play and vibration dissatisfies running structure, results to evolving interaction fatigue which happen since the repercussion the bearing damage on shaft created. Amid task and parts that include in arrangement dissatisfaction of gliding component. Static force examination, oil heaviness, ever-changing bearing position working, attire pattern of fitment, key structure, converse overhanging, stuck concluded load on vehicle etc. were the likelihoods to find the disappointment of camshaft & ball bearing in engine head and prevent from compensations. During comment, following possessions had been identified,

- Huge Vibration in Engine head cylinder after certain thousand km
- Main bearing case damage from inside.
- Engine head damage
- Barrel and piston damage.
- Tappet broken and damage.
- Inlet and exhaust valves worn out.

3. ROOT CAUSE

Due to rough forces, abrupt load and pressure advanced at bearing, cylinder head and convinced joining sequences, deep scrapes are engendered and outer ring along with steel balls worn out. Due to this blow & deep grazes in worn out in fragments, head and joining parts. Injured tappet freely passages in engine head between inlet and exhaust valves. Consequential to this the

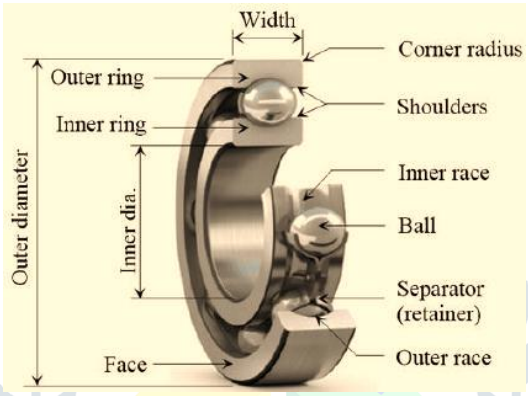
supplementary failure and portion damage materializes and last whole engine from head broke apart. The failure of bearing jams the engine barrel and piston along with engine head housing in the engine body. At high torque with high rpm, the bearing damages while become free and unbalanced which accommodates more head damage & other parts of engine.

In Engine head, housing is provided to install the cam shaft assembly. While running at uneven loads and running numerous cycles, attire and tear happens between camshaft bearing and housing case as the case getting enlarge and outcomes in play between bearing and housing. Due to indecorous fitment, bearing produces vibration and underneath this ailment, when the rpm changes, bearings outer shell cracks and damages in many parts with damaging cam shaft housing and engine head components. While running, when bearing damages, the tappet breaks with more vibration creating inefficient power with knocking and detonation in barrel piston assembly Producing the vibration transpires in other parts, it stops and damages engine.

1) Less clearance between Camshaft bearing & housing, dimension to maintained in cylinder head.
2) In maximum disappointment outer shell rubbing with housing & tear apart from cam shaft assembly & get enter in consecutively arrangement outcomes arrangement failure.
3) Bearing assembly already displaced at assembly line.
4) Attachment not proper
5) Trade defect at casing plant.
6) Due to shuddering and axial play in housing and bearing, fitment procedure needs to modify.

4. DIMENSION

The face width, circular pitch, working depth, and the tooth thickness are same for reverse gear, idle gear and differential crown gear. Below given table shows the dimensions of fork and different gears.



Camshaft Bearing Bigger End code: 6203
Inner dimension: 17 mm
Outer dimension: 40 mm
Width: 12 mm

Camshaft Bearing Smaller End: 6002
Inner dimension: 15 mm
Outer dimension: 32 mm
Width: 9 mm

By policies to progress thorough and leisurely investigation while concerning through the base design constituents with process mass media along morphologies, little scale bumpy area fragments and under organization settings development of key drivers to settle down failure, almost gadgets were deliberated, and measured counter actions are projected.

5. ACTION TAKEN

All problems arise due to vibration of reverse fork and improper reverse gear meshing with idle and differential crown gear. After some cycles due to excessive play occurs between system & this will disturb alignment transmission power to differential gear. Vibration occurs in fork due to play generated resulting wear and tear between reverse fork, key, idle gear, differential gear system, main housing and differential cover. The clearance between reverse gear fork and housing is needed to adjust so that the vibration between fork and gear decreases. The increase in vibration increase sudden load in parts and wear and tear with number of failure increases.

1) O ring material improved and taking care at fitment of tappet cover preventing oil leakage.
2) Excessive play removed in bearing and head assembly.
3) Maximum torque applying on engine head bolts should be not more than 3.5 Kg-m.
4) Protection shield on bearing added both sides to prevent Emre or chip entering in it.
5) CMM program adapted to cover up all perilous dimensions to GB assy.
6) Surface hardness increased from 58 Hrc to 62 Hrc for fin tempered throughout thickness in lobe 16MNCr6.
7) Cut off no.: **SGD83RlC8B5950283, Engine No.: V 1705 N 87.**

6. MODIFIED PARTS

1) O-RING OF TAPPET COVER MODIFED: - Engine head assembly,1st 'O ring' located at Inlet valve on engine head with 'O ring' sitting slot in tappet cover & 2nd 'O ring' located in exhaust valve on engine head with 'O ring' sitting slot in tappet cover head. Before modifying 'O ring' oil leakage problem noted in Engine head assembly. Cam shaft bearing and engine head assembly mounting position will be consuming measurable permission, after adjusting bearing position always steady and mainstay wrt. to Housing.

Fig. 1.2 O-ring improved

2) CAM SHAFT BEARING MODIFIED: Shield protection provided from both sides in ball bearing at long edge of camshaft while assembly on cam shaft assembly. As a result, purposeful operation of rpm take place under contented affluence. In existing bearing, no advantaged environments like shield is provided as in modified part on. While effective on cam shaft, smooth spread of rpm with less vibration in bearing and housing.

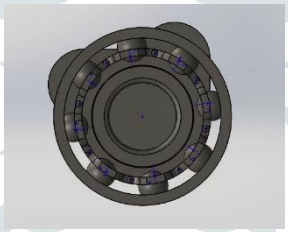


Fig 1.3 Camshaft bearing modified with protective shield

3) ROKER ARM HARNESS INCREASED: Failure analysis of cam shaft bearing incudes the failure part of tappet. Due to uneven vibrations rocker arm splits/breaks in two parts causing major problem in cylinder head. Surface hardened from 58 HSc to 62 HSc as shown in figure.

Fig 1.4 Tappet hardness increased

Cam Shaft Analysis						
Surface Hardness	Core Hardness	Case Depth	Case Microstructure	Core Microstructure	%RA	Material
58 to 60 HRc	36 to 37 HRc	0.94 mm	Fine Tempered Martensite	Low Carbon Martensite	5.56	SAE 8620
59 to 61 HRc	37 to 39 HRc	1.01 mm	Fine Tempered Martensite	Low Carbon Martensite	4.48	SAE 8620
58 to 59 HRc	37 to 38 HRc	0.84 mm	Fine Tempered Martensite	Low Carbon Martensite	4.02	SAE 8620

Fig 1.5 Tappet hardness

4) ENGINE HEAD FITMENT: - Engine head assembly fitted on engine by tightening four nuts on four stud of engine body. Maximum torque applying on engine head bolts is guided that should be not more than 3.5 Kg-m.

7. EFFECT OF MODIFICATION

Alteration carried out on Cam shaft bearing and engine head assembly in order to avoid failure of Engine head.

1) Modified ball bearing with both side protective shield given for protecting Emre entering in it, during waged, Oil leakage at a standstill and life cycle of cam shaft with contact to engine head housing augmented. The play stirring is decreased and also upsurge in lifecycle of both part with a reduced amount of vibration existence. Also, effectiveness with performance of power transmission inflamed.
2) The modified O Ring is provided to increases purposeful operation, smooth lubrication without any leakage issue as well with smooth controlled transmission.
3) Engine head assembly with modified camshaft assembly runs up to max km at uneven rpm with max life span on vehicle on road testing.
4) Appreciable lessening in circuitous stress value for rounded root shield design in comparison of roundabout stress value in unmodified ball bearing design.

8. CONCLUSION

The current effort establishes tentatively viability in modified part. Modification which supported out on cam shaft, tappet and cylinder head assembly in order to counteract disappointment of engine power transmission. This recurrent development & enhancement is done to progress engine control transmission parts robustness. New amendments ae given of adapted parts. Part interchangeability progression is now in progression for new improved automobiles. Process improvement as well as improvement circulars on course and modified cylinder head parts are being introduced in new portion of finest automobiles.

For future researches of engine head assembly, cam shaft and cam shaft bearing analysis, it is suggested to simulate all supplementary operative parts with diverse boundary circumstances in order to accomplish more structures available in software. For futuristic instance, other analysis like applied torque on different rotating parts, fatigue analysis can be carried out for better consequences. At judgement, analysis results besides reports associated to parts plan to their accurateness, simulation may unpretentious structures is recommendable. Confirming ease and clear revealed, arranged measured calculation thru reminiscent conclusions, additional used absolute values will be associating the simulation consequences.

9. ACKNOWLEDGMENT

We specially blessing of our age group at ATUL AUTO LIMITED, providing know-how, detailed educative statistics greatly helped for the IDP development research effort. Also, would comparable thank to our gratitude to all subdivisions of ATUL AUTO LTD. for distribution, guiding thru educative pearls of perception while the progression of master's course for this exploration in automobile arena, and also, we especially thank for all assessors for their delight's insight. IDP Industry Distinct Project done and efficaciously accomplished at Atul Auto Ltd. & corresponding faculty associates of PIET, Parul University for this IDP project which is appreciatively well accredited.

REFERENCES

[1] Jason Bleach, "A Durability Assessment of Rolling Element Bearings in a Camshaft Application, Considering Sensitivity to installation and Operating Parameters" 2012 SAE International.
[2] Jaffar Takaki, M.M. Khonsari, "On the dynamic performance of roller bearings operating under low rotational speeds with consideration of surface roughness" ELSEVEIR Tribology International (2015) 8662–71.
[3] Tiago R. Freitas, "Rubber sealing study applied to ball bearing Components using finite element method" SAE technical paper 2009-36-0034.
[4] Przemysław Kubiak, Krzysztof Siczek, "The analysis of friction in the bearing of rocker arms" Journal of KONES Power train and Transport, Vol. 23, No.2, 2016.
[5] Hitesh K. Trivedi, Christopher J. Klenke, James King, Nelson H. Forster, ''Rolling Contact Evaluation of Self-Lubricating Ball Bearing Retainer Materials at 482°C and 650°C,''SAE Technical Paper Series 2018-962108.
[6] Hynek Oh, Michael H. Azarian, Carlos Morillo, Michael Pecht, Edward Rhem, "Failure mechanisms of ball bearings under lightly loaded, non-accelerated usage conditions" ELSEVIER Tribology International 81(2015)291–299.
[7] Craig V. Darragh "A Method for Bearing Analysis" SAE paper series the engineering resource for advancing mobility 2018-820635.
[8] C.E. NORTON, P.J. BAKER, "The Effect of New Material and Processing Developments on Ball Bearing Fatigue Life" SAE Technical Paper 2018-779B.
[9] Sheikh, S., Thoemke, A., Mlinaric, A., Deshmukh, U. "Electric Camshaft Phasing 1. Industry Defined Project, "Analysis and Improvement in Development of Gearbox Assembly Three-Wheeler Cargo Vehicle", Atul Auto Limited, Shapar, Rajkot.
[10] R.K. Upadhyay, L.A. Kumaraswamidhas, Md. Sikandar Azam, "Rolling element bearing failure analysis: A case study," ELSEVIER, vol. Case Studies in Engineering Failure Analysis 1 (2013), no. CC BY-NC-ND license., pp. 15-17, 2013.
[11] Yi Gong, Jing-Lu Fei, Jie Tang, Zhen-Guo Yanga, Yong-Ming Han, Xiang Li, "Failure analysis on abnormal wear of roller bearings in gearbox for," ELSEVIER, vol. Engineering Failure Analysis 82 (2017) 26–38, p. 13, 2017.
[12] Sier DENG, Yujia LUc, Wenhu ZHANG, Xue SUNd, Zhenwei LU, "Cage slip characteristics of a cylindrical roller bearing with a trilobe-raceway," CSAA, Vols. Chinese Journal of Aeronautics (2017), no. (http://creativecommons.org/licenses/by-nc-nd/4.0/)., p. 12, 2017.
[13] KH. EL-Said, B.M. EL-Souhily, W.A. Crosby, H.A. EL-Gamal, "The performance and stability of three-lobe journal," ELSEVIER, no. (http://creativecommons.org/licenses/by-nc-nd/4.0/)., p. 10, 2017.
[14] B. Ramu, V. V. R. Murthy, "Contact Analysis of Cylindrical Roller Bearing," IJRMET, Vols. Vol. 3, Issue 1, no. ISSN: 2249-5762, p. 5, 2013.
[15] Jing Liu, Zhanglin Yan, Yimin Shao, "An investigation for the friction torque of a needle roller bearing with the roundness error," ELSEVIER, vol. Mechanism and Machine Theory 121 (2018), no. 259–272, 2018.

[16] Prashant M. Jundale, Prof. S. G. Kulkarni, Prof. S. A. Sonawane, "Optimization of Needle Roller Bearing System by Using Finite Element Analysis," IJERT, vol. Vol. 3 Issue 5, no. ISSN: 2278-0181, 2014.
[17] Vikas Waghole, Rajiv Tiwari, "Optimization of needle roller bearing design using novel," ELSEVIER, vol. Mechanism and Machine Theory 72, no. 0094-114X, pp. 71-85, 2014.
[18] Vladimir Rassokha, Vladimir Isaychev, "New Design of the Automobile Automatic Gearbox Providing," ELSEVIER, Vols. SPbOTSIC-2016, no. Transportation Research Procedia 20 (2017) 544 – 549, pp. 28-30, 2017.