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Design and Development of tool for R550 series diesel engine

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ABSTRACT

In this paper we are going to represent our work to eliminate human errors in installation of main bearing in crank case and piston rings in piston by designing a tool for the same. Using Poka Yoke concept, we designed these tools for "mistake proofing". The designed tool for insertion of main bearing is used to insert all the main bearings simultaneously into the crank case. Extended portions are provided on both the sides of the shaft for proper placement and alignment of the tool in the crank case. By such arrangement, time requirement reduced and productivity is increased. The tool is used to place four main bearings in three cylinder engine if number of cylinder is increased by number then by doing certain changes in tool, we can also use same tool for more number of cylinder engine. The designed tool for piston ring insertion is used to insert piston rings nonchalantly into the piston. Highly smooth surface is provided to the tool. By using this type of tool, the damage done to the piston ring inner surface while insertion is avoided, hence the life of the rings is increased.

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I. INTRODUCTION

The diesel engine is an internal combustion engine in which burning of air- fuel mixture in the combustion chamber produces high amount of heat energy which is converted into mechanical energy.

A bearing is a device supporting a crank shaft and providing its movement relatively to crank case with a minimum power loss. The bearings hold the crankshaft in place and prevent the forces created by the piston and transmitted to the crankshaft by the connecting rods from dislodging the crankshaft, instead forcing the crank to convert the reciprocating movement into rotation.

The piston rings are the rings which fits into the groove provided on the outer surface of the piston. Piston rings are used for identifying if an engine is two stroke or four stroke. The two types of piston rings are used, compression rings and oil rings.

Sometimes, failure occurs due to simple installation human errors. For example, if a main bearing is improperly installed this may lead to major damage to the crank shaft assembly, also the improper placing of piston rings on the piston may lead to leakage in the combustion chamber. Other types of assembly errors may also be seen. If a bearing or piston rings isn't set into place securely, it may cause failure. So, for that, careful installation procedure should be followed. The objective is to design a tool to avoid the above mentioned errors or problems.

II. PROBLEM STATEMENT

Manual labour takes time and is not much effective. Even if the manual insertion is easy, there might be some unavoidable errors like positioning, accuracy, material wear, etc. To avoid these errors, a proper tool designing is done. Even to increase the life of component and its productivity.

A. OBJECTIVES

- To secure locate (position in a specific location or orientation) and support the work.
- To improve the economy of production and reduce the requirement of skilled labour.
- To reduce time for assembly.
- Easy installation of piston rings and bearings.
- To improve the productivity and life of both main bearing and piston rings.
- To avoid material wear of both.
- To avoid any type of mechanical damage to the both while placing.

III. CONSTRUCTION AND WORKING

A. MAIN BEARING INSERTION TOOL

CONSTRUCTION

The main bearing insertion tool consists of following components,

- Tool shaft
- Extended parts
- Notch
- Dummy parts

The test rig consist of cross-sectional tool shaft with 1mm extended part on both side of curved surface of the shaft and dummy supported at both end of the shaft which is used in the mechanism of placement of upper bearing into the crank case. The experimental setup consists crank case, upper bearing and oil for positioning of upper bearing on the tool shaft. A handle joined at one end of the dummy supporter is used to rotate tool shaft in order to insert upper bearing into the crank case.

WORKING

The experimental procedure is divided into two steps:

- The first step aims to adjust the level of oil on the tool shaft which is important for proper positioning of upper bearing on the outer face of the tool shaft. It also avoids the slipping of upper bearing. The thin layer of oil maintains contact between upper bearing and outer face of the tool shaft. Oiling is done on the crank case for proper lubrication.
- The upper bearing should be placed in such a way that there is 5mm distance between extended part and upper bearing i.e. it should be placed before 5mm extended part which is important for proper alignment.
- Then pick up the tool shaft parallel to crank case and make proper alignment of dummy end and the face of crank case. In this way entry of upper bearing into the crank case is carried out.
- In second step rotate the tool shaft with help of handle which inserts the upper bearing into the crank case. But in this process one thing should be considered that the notch of the upper bearing should get matched with the inner face of the crank case, after that remove the tool shaft.

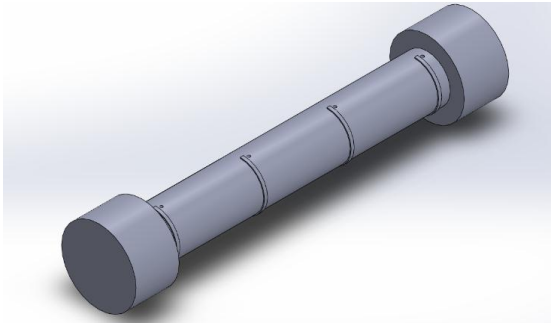

Fig: CAD model of main bearing insertion tool

B. PISTON RING INSERTION TOOL

CONSTRUCTION

The test rig consist of hollow cylindrical cross- sectional tool with outer diameter 173mm and inner stepped diameter of 170mm, 140mm and 70mm. The height of the tool is 125mm, with a straight part of 32mm and an angular part of 93mm with angle of 7.4°. The thickness of the operational part of the tool is sufficiently provided for the extension of the piston rings to fit into the grooves present on the piston. The inner diameter of the operational part of the tool is equal to the outer diameter of the piston. The operating surface of the tool is highly finished to avoid any friction between the tool and the piston rings. The whole tool is designed hollow just to reduce the weight.

WORKING

The experimental procedure is as follows:

- The tool is located properly on the piston such that the outer diameter of piston exactly fits into the inner diameter of the operational part of the tool.
- The entire outer surface of the tool is highly finished and smooth with no resisting or functional force during the insertion.
- The piston is inserted from the top of the tool. Initially there is no extension in the ring. Before insertion the tool is oiled properly for lubrication and smooth operation.
- The angle of 7.4° is provided for the extension of the ring.
- These extended rings are easily inserted into the piston grooves. By following similar procedure, all the rings are inserted into the piston grooves by using the same tool.

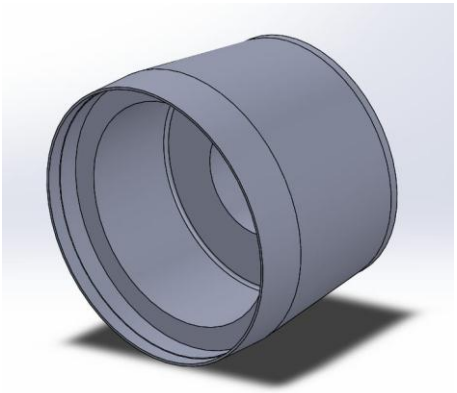

Fig: CAD model of piston ring insertion tool

IV. CONCLUSION

- Engine bearings are sliding bearings operating mostly in hydrodynamic regime of lubrication in which the bearing and journal surfaces are separated by an oil film. And for the proper installation of multiple bearings simultaneously in the crank case a tool is designed for the reduction of human errors and proper positioning, also the time required for the insertion is reduced.
- Piston rings of reciprocating engines have several functions apart from sealing the gas pressure which affect the performance of engine. In order to easy

and safe installation of piston rings into the piston grooves, a tool is designed with highly finished outer surface of entire tool and inner surface of the operational portion of the tool.

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