

Design and Fabrication of Engine Valve Lapping/Cleaning Machine

Shreyas V. Bhingarkar¹, Suhail S. Shaikh², Jayesh N. Mali³, Sameer I. Shaikh⁴,
Prof.A.R. Devshette⁵

¹ Student, Mechanical Engineering, RSCOE Pune, Maharashtra, India

² Student, Mechanical Engineering, RSCOE Pune, Maharashtra, India

³ Student, Mechanical Engineering, RSCOE Pune, Maharashtra, India

⁴ Student, Mechanical Engineering, RSCOE Pune, Maharashtra, India

⁵ Professor, Mechanical Engineering, RSCOE Pune, Maharashtra, India

ABSTRACT

Automobile maintenance is a major area in the industry of automobile and also a major income to the business. Present, engine maintenance can be stated as a very important section in automobile maintenance and the valve lapping process that is subjected in this thesis is done during engine maintenance. Methods used in most automobile maintenance for valve lapping process are not effective and consume a lot of working hours. Valve lapping Machine is a machine designed to overcome these problems by minimizing the human involvement in process. It consists of the background in designing the machine, results obtained by data analysis in order to optimize the design and design of the valve lapping machine. Lapping is a machining process in which two surfaces are rubbed together, by hand movement or using a power tools. This can take two forms. The first type of lapping involves rubbing of brittle material such as glass against surface such as iron with an abrasive such as aluminium oxide and jeweller's rouge. This produces microscopic conchoidal fractures as the abrasive rolls between them and removes material. The other form of lapping involves a softer material such as pitch or ceramic for the lap. The softer material, which holds it and permits it to score across and cut the material. Taken to a limit, this will produce a surface such as with a polishing cloth on an automobile, or a polishing cloth.

Keyword : - Valve lapping, Engine valves, Cylinder head, Maintenance

1. INTRODUCTION

Valve lapping or the process of creating a good seat between engine valves and the corresponding valve seat area in the IC engine head is a task which have to be done very accurately. The importance of obtaining a good seat is that the air/fuel mixture or air is prevented from flowing in to the combustion chamber, same as the exhaust gas is prevented from flowing to the exhaust manifold from the combustion chamber until the right time. And also, a good seat prevents compression leaks. The engine will lose its efficiency by huge percentages if any of the situations explained above happens. So as this is a very important task in IC engine maintenance, extra attention is given to this particular task by technicians. This process of valve lapping is typically done using a lapping stick. this process can be replaced by the ' Valve Lapping Machine for Internal Combustion Engines', specifically designed for the process of engine valve lapping. It is fully mechanical system which performs two different motions in two directions previously performed by hand when using valve lapping stick. The valve lapping machine is very effective because the human involvement is limited in the process. A valve job is an operation which is performed on internal combustion engine, the purpose of which is to resurface the mating surfaces of the poppet valves and their respective valve seats that control the intake in the earliest automotive engines, the valves needed to be removed and the sealing surfaces sanded, ground or lapped multiple times during. As the decades passed, however, engines run cleaner and the addition of tetraethyl lead in gasoline meant that such maintenance became more frequent. Today, valve jobs are done on passenger cars for the purpose of maintenance, although they are still quite

common with high-performance cars. Some reasons that may induce the need for a valve job in a modern passenger include: excessive RPM, high mileage, overheating, material failure, and foreign object damage (FOD).

2. LITERATURE REVIEW

Ayodhya Abeysekara [1]: Automobile maintenance is a major area in the industry of automobile and also a major income to the business. In present, Internal Combustion engine maintenance can be stated as a very important section in automobile maintenance and the valve lapping process that is subjected in this thesis is done during IC engine maintenance. The current methods used in most automobile maintenance businesses for valve lapping process are not effective and consume a lot of working hours. 'Valve lapping Machine for Internal Combustion Engines' is a machine designed to overcome these problems by minimizing the human involvement in the process. The thesis consists of the background in designing the machine, methodologies used, results obtained by data analysis in order to optimize the design and design of the valve lapping machine. Weiwei Liua et al [2] investigated the carbonous deposited will cut back the sturdiness and performance of diesel engines. Chemical cleansing ways area unit wide accustomed take away the deposits in remanufacturing trade however the wasted liquid is harmful to the atmosphere. During this paper the critical greenhouse unit wide accustomed take away the deposits in remanufacturing trade however the wasted liquid is harmful to the atmosphere. During this paper the critical greenhouse emission cleansing technology, associate environmentally friendly approach, has been accustomed take away these contaminants. The testing results showed that almost all organic compounds were dissolved and also the stubborn contaminants were modified to be removed simply once cleansing by critical greenhouse emission fluid. Mr. Prathmeesh Kumar [3] : Lapping is a finishing process in which the material removal takes place due to relative motion between the work material, loose abrasive grains, and the lapping plate. This process is used in achieving finer surfaces and closer fits, correction of minor imperfections, and maintaining close tolerances. Although a significant underlying science– based exists with regards to physics, mechanics, and thermal effects, lapping has been considered as an art, rather than a science. Hence exploring lapping at fundamental level will help improve its application. This study discusses the effects of the various process parameters influencing the material removal rate and surface finish. This is done by conducting a series of experiments by varying the process parameters and calculating the material removal rate.

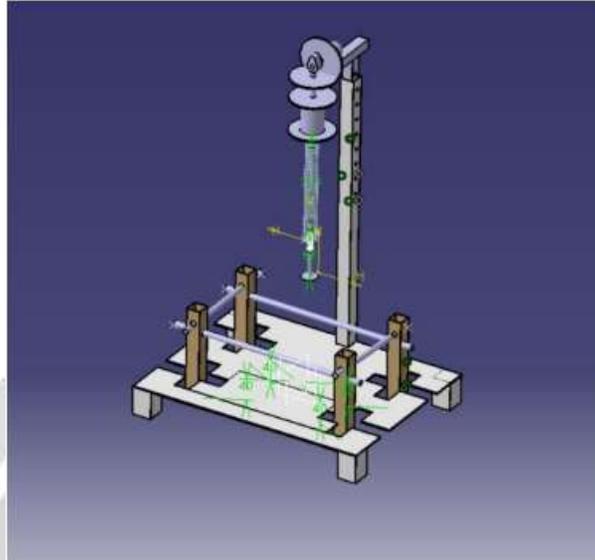
2.1 NEED OF LAPPING MACHINE FOR VALVE COMPONENT:

Lapping process is characterized by its low speed, low pressure, and low material removal rate. This process is used in achieving finer surfaces and closer fits, correction of minor imperfections, and maintaining close tolerances. During the process of lapping, the mechanisms of surface formation and removal rate is decisively influenced by the movement type of the individual grains within the lapping abrasive. A gate valve is used to start and stop the flow of fluid. So, the wedge and seat ring of a valve are in continuous pressure of fluid flow and due to opening and closing of valve these components get wear and they need lapping during reconditioning. This paper will share the need, requirement and application of lapping during the reconditioning of valve.

2.2 EFFECT OF EGR ON THE EXHAUST GAS TEMPERATURE AND EXHAUST OPACITY IN COMPRESSION IGNITION ENGINES:

In diesel engines, NO_x formation is a highly temperature-dependent phenomenon and takes place when the temperature in the combustion chamber exceeds 2000 K. Therefore, in order to reduce NO_x emissions in the exhaust, it is necessary to keep peak combustion temperatures under control. One simple way of reducing the NO_x emission of a diesel engine is by late injection of fuel into the combustion chamber. This technique is effective but increases fuel consumption by 10–15%, which necessitates the use of more effective NO_x reduction techniques like exhaust gas recirculation (EGR). Re-circulating part of the exhaust gas helps in reducing NO_x, but appreciable particulate emissions are observed at high loads, hence there is a trade-off between NO_x and smoke emission. To get maximum benefit from this trade-off, a particulate trap may be used to reduce the number of unburnt particulates in EGR, which in turn reduce the particulate emission also.

2.3 DESIGN OF MACHINE:



MACHINE BED: Machine bed is the base of the valve lapping machine. The cylinder head can be initially kept on the machine bed for measuring or observing purposes and the bed is designed to accommodate a cylinder head without any problem.

MACHINE STAND: Machine stand is assembled to the machine bed in one end. Another end of the machine stand is the mounting for the valve lapping mechanism and also the holding bracket for motor, mounted near the same end. Therefore, allowing the access to any valve position of a cylinder head placed on machine bed. The load generated while the valve lapping process is transmitted to machine bed through the machine stand and the integrity of the structure is a very important factor to consider when designing. Lower end of machine stand which is assembled to machine bed is one of the areas of the machine with highest stress concentration.

CAM AND CAM FOLLOWER: Cam is the main part responsible for the vertical movement of the valve lapping mechanism. Actually, a cam works as a system that consist with a follower, a cam drive and a follower system. The vertical motion is gained by the valve lapping mechanism when the cam is rotated by the rotary motion. DC motor which is the cam drive and the rotary motion is then converted in to linear motion using the shape of cam and it is transmitted to the valve mechanism through the cam follower. The vertical motion of the valve lapping mechanism helps to break the contact between valve seat and the corresponding surface of a cylinder head. The importance of this action is the rotary motion is converted into linear motion. Cam follower is tensioned using a spring in the valve lapping mechanism and as the cam rotates, follower gain space to move upwards and when the cam nose area returns follower move downwards creating a linear motion.

SPRING CONSTRAINT: The contact between follower and cam profile is maintained by spring. The valve lapping machine for internal combustion engines are mainly consisting of three main units. The base, the machine stands and the valve lapping mechanism.

ARDUINO: The program for the rotation of the lower motor is done in such a way that the motor rotates clockwise for 8 secs and anticlockwise for 8 secs for the uniform cleaning of the valve. This program is stored in the Arduino where the programming language is C++. The Arduino is connected with wires of the low rpm motor which gives commands for the rotatory motion.

3. PROBLEM STATEMENT

The main purpose of the project is to minimize the human effort with excellent machines with precision although the time required for the process is the same for manual as well as the given by employee will be reduced machine but, if we use a machine instead of the person the person can do another job by this time.

4. OBJECTIVE

The objective of this project is to design a machine both efficient and effective than previously used machine/methods for valve lapping and to reduce the labor cost by reducing the human involvement in the process. The objectives that had to be achieved in order to achieve the main goal were designing the basic prototype of the machine, designing the valve lapping mechanism, assembly of the whole machine by designing the parts needed, calculating and designing the cam needed, analysing data and categorizing, analysing data to obtain the specifications of the machine, obtaining two high torque dc motors that have specific RPM values and deciding what materials must be used in order for the design to be durable and economical.

5. SCOPE

The objective of this work is to develop a New Automatic operated Machine of Valve Lapping. This concept allows us to achieve our goal as well as better space management. The new model takes into account all the real time conveying system and provide solution over their short coming. The New model will get good efficiency compare to old method.

6. CONCLUSIONS

The difficulty of holding the internal combustion engine was solved by designing a component. The newly designed machine replaces the manual labour. The vertical movement of the machine was used to lift the cylinder to accommodate different heights of engine. During the process of the internal combustion engine the valve wear gets induced due to the pressure developed in the combustion chamber. The valve wear pattern may vary different type of valves. This may result in leakage in combustion chamber which decreases the performance of the engine and the loss in the economy. During the lapping process the material removal rate would differ from material to material. At the beginning of the lapping process the material removal rate would be high and lower during the end of the process.

7. REFERENCES

- [1] Ayodhya Abeysekara “Valve Lapping Machine for Internal Combustion Engines,” 2015.
- [2] M. R. Pratheesh Kumaret all: “Optimization of Process Parameters In Lapping of Stainless Steel”, International Journal of Engineering Research & Technology (IJERT),2013.
- [3] Weiwei Liua, Xiaochuan Qinga, Mingzheng Lia, Lihong Liua, Hongchao Zhanga, Supercritical CO2 cleaning of carbonaceous deposits on diesel engine valve, The 22nd CIRP conference on Life Cycle Engineering, USA, (2015).
- [4] S. M. Fulmali all: “Need of Lapping Machine for Valve Component: A Case Study”, International Journal of Modern Engineering Research
- [5] Owat Sunanta : “flat surface lapping: process modeling in an intelligent, Environment”, University of Pittsburgh, 2002.
- [6] Arpreet Singhet.all : “A comparative study of precision finishing of rebuild engine valve faces using microgrinding and ECH”, Singh and Jain Journal of Remanufacturing,2015.

[7]Avinash Kumar Agrawal¹, Shrawan Kumar Singh², Shailendra Sinha, Mritunjay Kumar Shukla, “Effect Of EGR On The Exhaust Gas Temperature And Exhaust Opacity In Compression Ignition Engines”, (2003).

[8] Evans C. J., Paul E., Dornfeld, David, Lucca, D. A., Byrne, G.,” Material removal mechanism in lapping and polishing”, Laboratory for Manufacturing and Sustainability, (2003)

