DESIGN OF SPRING VALVE CYLINDER HEAD OPENING TOOLS

Firmansyah Burlian, Oky Liwaldo
1 Department of Mechanical Engineering, Sriwijaya University, 30662 Indralaya, South Sumatera, Indonesia

ABSTRACT

During spring valve release process of the car cylinder head, workshops experiencing difficulties due to the released manually. The release is done by hitting the outside of the valve spring retainer which can cause damage to the valve spring retainer and also may reduce the stiffness the valve spring. It is designed tools for release spring valve on the cylinder head car. In this paper is conducted for the initial phase to design a tool, and then carried out the calculation of the force required to remove the workpiece spring valve. Tools will be made in accordance with the calculations have been done then proceed with testing tools. Once the tool has been tested, the evaluation and study of literature that will be used for the selection of materials. From the data calculation, the force required to depress the valve spring is 1942.4 N and material using the steel SC-42. Mechanism of action of the tool using a lever or a lever in order to facilitate suppression valve springs.

Keywords: Tool, Cylinder, Head, Spring, Valve, Retainer

1. INTRODUCTION

Today the situation of the business world is growing rapidly in Indonesia. With the development of business, then there are many changes that occur. Of the many changes to existing developments in the technology industry seems more rapidly. Improvement and technological innovation always happens in every activity. To meet the needs that exist today takes a relatively short time in all respects. Therefore, the man tried to raise resources to meet the various needs of the road development in all fields. In big cities the current traffic situation is very dense, by 2015 the number of users increased vehicle often with the ease of purchasing power.

Cylinder Head or more commonly called Head, positioned above the cylinder block when both are combined will make the combustion chamber. In most types of engine, the cylinder head is the home of several components including engines, injectors, valves, valve springs, camshaft, spark plugs, rocker arm (if using). Head also allow the entry of air into the engine intake manifold and then mixing it with fuel and exhaust and ended via the exhaust system. The cylinder head or cylinder head has several functions, such as the combustion chamber, for placing the valve mechanism, the installation of the spark plug, the installation of inlet and exhaust and a coat water jacket.

When the engine is experiencing overheating (excessive heat) either due to lack maximal cooling or the other, usually the cylinder head is warped, resulting in leakage between the cylinder head and cylinder block. Will usually result in water will be mixed with the oil, which would endanger the car itself. The cylinder head is attached to the cylinder block, which is fastened with bolts made of cast iron or aluminum alloy. Number of bolts contained in the cylinder head is 4 pieces (Honda Accord), in removing these bolts there is a sequence-specific and done gradually but in general to remove the bolt head bolt cylinder is from outside to inside in sequence and gradually. Then contrary to cylinder head bolts are installed from the inside to the outside. Common materials used in the manufacture of cylinder head is, cast iron (iron head) alias molten iron foundry to mold the future after passing through the cooling process and finishing cylinder head. Other materials are aluminum, cast iron using the same method, but has the advantage due to the aluminum material is much lighter than cast iron, it is used the
performance enthusiast to reduce the load on the car.

Levers facilitate efforts by doubling the style of your power and change the direction of your style. You have learned that the best mechanical advantage can be calculated by dividing the load force with a power style. The length of the power arm is the distance from the pedestal to the point of operation of the power style. The length of the load arm is the distance from the foundation up to the point of operation of the load force.

Increasing vehicle users today not only happens in big cities, but also scattered throughout the territory of Indonesia supported by the ease of the existing facilities. With the increasing number of vehicles, the lot also sprung maintenance workshop must have a complete and adequate equipment, to overcome the problems and damage. So we need tools to simplify the overall repair and regular maintenance. In the repair and maintenance of components on the vehicle, frequently encountered problems in the cylinder head. In general, problems arise at the time of the removal and installation cotter valve, how the release is done by pressing the outer surface of the valve spring retainer with a key spark plug is then hit with a hammer. While at the time of installation cotter valve when not using valve cotter tools cannot enter into the valve stem simultaneously. It required tools to facilitate opening the valve cotter, namely "Design of Spring Valve Cylinder Head Opening Tools" which is more secure, fast, and efficient in its use with the theoretical calculations.

Formulation of issues to be discussed by the authors deal with the problems spring release valve on the car with the planned release and installer tools are safe and relatively fast. In this study also discusses appropriate material to be used for the manufacture of these tools.

The purpose of this study was to Planning tools valve opening properly and quickly so that the efficient use of time. (State the objectives of the work and provide an adequate background, avoiding a detailed literature survey or a summary of the results).

2. METHODOLOGY/ EXPERIMENTAL

Manufacture valve spring opener at cylinder head is specifically designed for cars Honda Accord. To be able to make this valve spring opening tools we need the data length, width and height of the cylinder head. Plate used as the basis of the cylinder head is a steel plate measuring 45 cm x 20 cm with a thickness of 2 cm plate. Steel used for connecting rods with a length of 20 cm and a diameter of 2 cm by 2 pieces, for joining used M 14 bolt, while connecting on welding. At the fulcrum of valves we have to measure in accordance with the retainer valve spring in the cylinder head. The hole support valve in drilling or milling then mounted magnet so that the cotter valve can stick to the magnet for easy retrieval of the valve cotter. Recently connecting rod used for steel plate with a thickness of 2 cm which is used to drive the bolt suppressant.

![Figure 1. Design Tools Opener Spring Valve](image)

Notes:
- a: Basis Head Cylinder
- b: Support Valve
- c: Support Above
- d: Arm Mover
- e: Discounter Shaft
- f: Rod Connectors
- g: Bolt Fastener
- h: Stopper

Research on spring opener for head cylinder valve is done in order to get a more efficient and facilitate the release of its valve cotter. The procedure of the research include:
1. setting up head cylinder to be removed

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valve is
2. Preparing opener spring valve that has been created
3. Putting head cylinder on the anvil opener spring valve
4. Ensuring head cylinder is properly installed in accordance with the holes on the fulcrum valve
5. Moving the connecting rod so that the bolt suppressant and fulcrum pressing down the valve spring valve
6. After fulcrum valve cotter pressing the valve spring will come loose and stick to that are in the hole - holefulcrum valve
7. then roll back the connecting rod to the opposite direction in order to avoid pressure again so that the valve spring can be taken by hand.

3. RESULTS AND DISCUSSION

The design of opener valve spring in the workmanship using a lathe, flat surface grinding machines, drilling machines and electric welding. The sizes of the workpiece to be done has been determined and at the time of drilling on the fulcrum valve, should be more careful in the measurement of the distance between the valve spring in the cylinder head in order to minimize errors that occur at the time of drilling.

After completing the design of opener valve spring is testing tool before starting the experiment. This test is intended to ensure that the opener spring valve of this can function properly. Testing tool is done by ensuring return fulcrum hole in the valve according to the size of the cylinder head and then turning the connecting rod over and over - again to be certainly there is no problem when conducting the experiment. After testing the tool, and then do the performance test by calculating the time it takes to release the valve cotter use tools opener valve spring. This study was conducted to determine the effect of opener the valve spring against time efficiency in release valve spring and then compared to open it manually.

![Figure 2. Tool Opener Spring valve and Cylinder Head](image)

![Figure 3. Experimenting opener valve spring](image)

Table 1. Data Analysis Results Release of Spring Valve

<table>
<thead>
<tr>
<th>Trial</th>
<th>Time (minutes)</th>
<th>Manual</th>
<th>Opener Spring Valve</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>7</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>6</td>
<td>3.30</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>5.30</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>4</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

Time efficiency is a comparison between the consumption of time utilized for release spring valve on each cylinder head. In this study, time efficiency is calculated by the direct method by using stopwatch.

Table 2. Calculation Results Time Efficiency

<table>
<thead>
<tr>
<th>Time (Minutes)</th>
<th>Efficiency of time on each cylinder head (Unit)</th>
<th>Manual</th>
<th>Tool Opener Spring Valve</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>4</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>8</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>36</td>
<td>12</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>48</td>
<td>16</td>
<td>24</td>
<td></td>
</tr>
</tbody>
</table>

This study done by making tools opener spring valve for the purpose of time efficiency in the opening spring valve on the cylinder head.
Calculation of the force on the spring valve having known diameter, \( D = 30 \text{ mm} \)

\[
F = 0.07 \text{ kgf/mm}^2 \times 3.14 \times 30^2 \text{ mm}^2 \\
F = 49.5 \text{ kgf} 	imes 9.81 = 485.6 \text{ N}
\]

Total force on the valve spring is

\[
P = 49.5 \text{ kgf/mm}^2 \times 4 \\
P = 198 \text{ kgf/mm}^2 \times 9.81 = 1942.4 \text{ N}
\]

**on arm activator**

Knowing Moment Twist on arm movers

\[
MP = F \times L \\
MP = 1196 \times 2 \text{ N} \times 440 \text{ mm} \\
MP = 86328 \text{ N mm}
\]

**on shaft suppressors**

diameter inside of the shaft is \( D_1 = 19 \text{ mm} \) and the outer diameter of the shaft is \( D_2 = 22 \text{ mm} \).

shaft stress

\[
\sigma = \frac{F}{A} \\
\sigma = \frac{1942}{\frac{\pi}{4} \times D_1^2} \\
\sigma = \frac{1942}{3.14 \times 19^2 / 4 \text{ mm}^2} \\
\sigma = 6.9 \text{ N/mm}^2
\]

Allowable stress is

\[
\sigma_{\text{allowable}} = \frac{\sigma_0}{V} \\
\sigma_{\text{allowable}} = \frac{42 \text{ kgf/mm}^2}{6} \\
\sigma_{\text{allowable}} = 68.67 \text{ N/mm}^2
\]

Allowable Stress > working Stress

\[68.67 \text{ N/mm}^2 > 6.9 \text{ N/mm}^2 \text{ (safe)}\]

**on top support**

Bending Moment On Top support

\[
M_t = \frac{L}{2} \times F \\
M_t = \frac{480 \text{ mm \times 1942.4 N}}{2} \\
M_t = 466176 \text{ N mm}
\]
the bending stress at the upper support
\[ \sigma_L = \frac{M_L}{W_L} = \frac{466176 N \cdot mm}{480 mm \times 395 N} \times \frac{2}{2} \]
\[ = \frac{466176 N \cdot mm}{86328 N \cdot mm} = 5.4 \text{ N/mm}^2 \]

Allowable stress on upper support
\[ \sigma_{\text{allowable}} = \frac{\sigma_b}{V} \]
\[ \sigma_{\text{allowable}} = \frac{42 \text{ kg/mm}^2}{3} = 14 \text{ kg/mm}^2 \times 9.81 = 137.3 \text{ N/mm}^2 \]

Allowable Stress > working Stress
137.3 N/mm\(^2\) > 5.4 N/mm\(^2\) (safe)

at the support valves
Bending moment the support valves 1
\[ M_L = \frac{L}{2} \times F \]
\[ M_L = 44 mm \times 1942.4 N \]
\[ M_L = 22 mm \times 1942.4 N \]
\[ M_L = 42732 N \cdot mm \]

for the force (\(F_1\)) on the support valve to be able to know the stress that occur in areas prone to cracking point
\[ M_0 = 44 mm \times F_i \]
\[ 86328 N \cdot mm = 44 mm \times F_i \]
\[ F_i = \frac{86328 N \cdot mm}{44 mm} = 1962 N \]

the stress at point area prone to cracks
\[ \sigma = \frac{F_i}{(18 \times 12) \times 2} = (1962 N \times 1.26) \times \frac{2}{(18 \times 12) \times 2} \]
\[ = 2472.1 N \]
\[ 432 mm^2 \]
\[ = 5.7 \text{ N/mm}^2 \]

allowable stress on the valve support 1
\[ \sigma_{\text{allowable}} = \frac{\sigma_b}{V} \]
\[ \sigma_{\text{allowable}} = \frac{37 \text{ kg/mm}^2}{3} \]
\[ = 120 \text{ N/mm}^2 \]

Allowable Stress > working Stress
120 N/mm\(^2\) > 2.3 N/mm\(^2\) (safe)

4. CONCLUSION
The results of research and discussion that has been described, it can be concluded as follows:

1. Opening spring valve using the tools that have been made easier and safer for the working mechanism of the tool using a lever or lever, thus simplifying the process presses the valve spring in the release spring valve in the cylinder head.
2. From the data calculation, the force required to depress the valve spring is 1942.4 N.

3. Obtained average time to open the valve spring manually required time is 5.37 minutes while opening the valve spring using the tools that have been made is 2:52 minutes.

REFERENCES


