

DESIGN OF SPRING VALVE CYLINDER HEAD OPENING TOOLS

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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

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performance enthusiast to reduce the load on the car.

Lever facilitates 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.

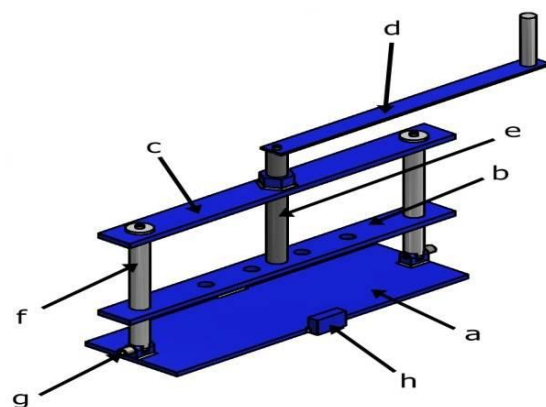
The purpose of this study was to Planning tools valve opening properly and quickly so that the efficient use of time. Analyzing the amount of force required to depress the valve spring, using the basic calculation. And analyzing the time difference between the opening valves manually by opening the valve using a valve opening that has been made.

The expected benefits of this research is to be used in the workshop. Due to the mechanics can help facilitate the release valve 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.



Notes:

- | | |
|-------------------------|-------------------|
| a: Basis Head Cylinder, | b: support Valve |
| c: support Above | d: arm Mover |
| e: Discounter shaft | f: Rod Connectors |
| g: Bolt Fastener | h: Stoper |

Figure 1. Design Tools Opener Spring Valve

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

- 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.



Figure 2. Tool Opener Spring valve and Cylinder Head

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 3. Experimenting opener valve spring

Release spring valve manually and by means of this opening is repeated 4 times in order to know the average time required, data analysis results can be seen in table 1 ,

Table 1. Data Analysis Results Release of Spring Valve

Trial	Time (minutes)	
	Manual	Opener Spring Valve
1	7	4
2	6	3.30
3	5.30	3
4	4	1

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

Time (Minutes)	Efficiency of time on each cylinder head (Unit)	
	Manual	Tool Opener Spring Valve
12	4	6
24	8	12
36	12	18
48	16	24

This study done by making tools opener spring valve for the purpose of time efficiency in the opening spring valve on the cylinder head.

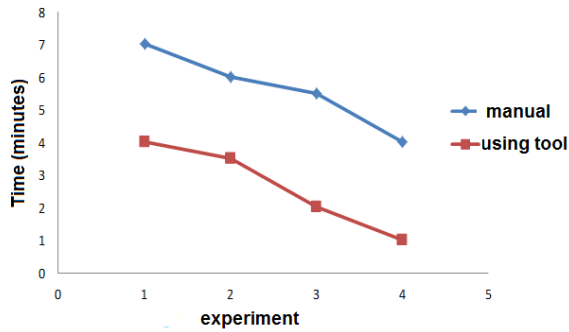


Figure 4. Graph Relationships Old Time and Release Spring Valve Manual and the Aid Opener Spring Valve

From Table 1 and Figure 4 obtained average time required to release the spring valve manually is 5.37 minutes, while for release spring valve using the tools of the opening spring valve takes the average 2:52 minutes. From the tests have been done to show the opening of the spring valve manually requires a longer time than the opening of the valve spring with the opening valve spring tools.

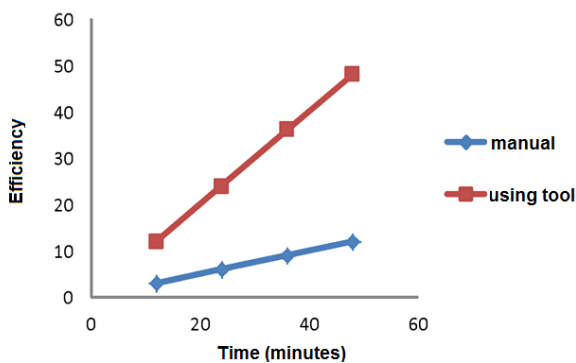


Figure 5. Graph opening time Spring Valve against time efficiency

From Table 2 and Figure 5 obtained most efficient time efficiency is opening or release valve spring using valve spring opener tools. From the longer the time variation calculation, the release spring valve manually decreased while opening or discharge valve spring with the valve spring opener tools remain stable.

The Moment and the stress that occurs in valve opening tools this spring, in order to know whether it can be used properly.

Given the force on the valve spring Honda Accord is:

$P = 690 \text{ KPA}$ (Honda Accord 1994-1997 Service Manual)

$P = 0.07 \text{ kgf / mm}^2$

Calculation of the force on the spring valve having known diameter, $D = 30\text{mm}$

$$F = 0.07 \text{ kgf / mm}^2 \times 3.14 / 4 \times 30^2 \text{ mm}$$

$$F = 49.5 \text{ kgf} \times 9.81 = 485.6 \text{ N}$$

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

$$MP = \text{force} \times \text{Distance} \quad (1)$$

$$MP = F \times L$$

$$MP = 1196.2 \text{ N} \times 440 \text{ mm}$$

$$MP = 86328 \text{ N} \cdot \text{mm}$$

on shaft suppressors

diameter inside of the shaft is $D1 = 19 \text{ mm}$ and the outer diameter of the shaft is $D2 = 22 \text{ mm}$.

shaft stress

$$\sigma = \frac{F}{A} \quad (2)$$

$$\sigma = \frac{1942.4 \text{ N}}{\frac{\pi}{4} D_1^2}$$

$$\sigma = \frac{1942.4 \text{ N}}{3.14 \times 19^2 / 4 \text{ mm}^2}$$

$$\sigma = 6.9 \text{ N/mm}^2$$

Allowable stress is

$$\sigma_{\text{allowable}} = \frac{\sigma_B}{V} \quad (3)$$

$$\sigma_{\text{allowable}} = \frac{42 \text{ kg / mm}^2}{6}$$

$$\sigma_{\text{allowable}} = 68.67 \text{ N/mm}^2$$

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

$$M_L = \frac{L}{2} \times F \quad (4)$$

$$= \frac{480 \text{ mm}}{2} \times 1942.4 \text{ N}$$

$$= 466176 \text{ N} \cdot \text{mm}$$

the bending stress at the upper support

$$\sigma_L = \frac{M_L}{W_L} = \frac{466176 N.mm}{\frac{480 mm}{2} \times 395 N} \quad (5)$$

$$= \frac{466176 N.mm}{86328 N.mm} = 5.4 N/mm^2$$

Allowable stress on upper support

$$\sigma_{allowable} = \frac{\sigma_B}{V} \quad (6)$$

$$\sigma_{allowable} = \frac{42 kg / mm^2}{3}$$

$$\sigma_{allowable} = 14 kg/mm^2 \times 9.81 = 137.3 N/mm^2$$

Allowable Stress > working Stress
137.3 N/mm² > 5.4 N/mm² (safe)

at the support valves

Bending moment the support valves 1

$$M_L = \frac{L}{2} \times F \quad (7)$$

$$M_L = \frac{44 mm}{2} \times 1942.4 N$$

$$M_L = 22 mm \times 1942.4 N$$

$$M_L = 42732 N.mm$$

for the force (F₁) on the support valve to be able to know the stress that occur in areas prone to cracking point

$$M_p = 44 mm \times F_1$$

$$86328 N.mm = 44 mm \times F_1$$

$$F_1 = \frac{86328 N.mm}{44 mm} = 1962 N$$

the stress at point area prone to cracks

$$\sigma = \frac{F_1}{(18 \times 12) \times 2} = \frac{(1962 N \times 1.26)}{(18 \times 12) \times 2}$$

$$= \frac{2472.1 N}{432 mm^2} = 5.7 N/mm^2$$

allowable stress on the valve support 1

$$\sigma_{ijin} = \frac{\sigma_B}{V} \quad (8)$$

$$\sigma_{allowable} = \frac{42 kg / mm^2}{3}$$

$$\sigma_{allowable} = 137.3 N/mm^2$$

Allowable Stress > working Stress
137.3 N/mm² > 5.7 N/mm² (safe)

For valve 2 is calculated with the same steps.

in trunk bolt connectors

P on the bolts in order to seek a stress that occurs at the bolt with a ratio of the bending moment and half the length of the fulcrum on. The bolts using cast carbon steel material 37.

$$F = \frac{M_p}{L / 2} \quad (9)$$

$$F = \frac{86328 N.mm}{240 mm}$$

$$F = 259.7 N$$

The calculation of the stress on the bolt is

$$\sigma = \frac{F}{2 \times \left(\frac{\pi}{4} \times D^2\right)}$$

$$\sigma = \frac{259.7 N}{2 \times \left(\frac{3.14}{4} \times 10 mm\right)}$$

$$\sigma = \frac{259.7 N}{157 mm^2}$$

$$\sigma = 2.3 N / mm^2$$

allowable stress on the bolt

$$\sigma_{allowable} = \frac{37 kg / mm^2}{3}$$

$$\sigma_{allowable} = 120 N/mm^2$$

Allowable Stress > working Stress
120 N/mm² > 2.3 N/mm² (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.

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