

IMPLEMENTATION OF AN ELECTRO-PNEUMATIC SYSTEM IN A VALVE SAFETY SUPPORT DEVICE THROUGH LINEAR TO ROTATIONAL MOTION

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ABSTRACT

This research aims to develop a tool that can be used in the process of clamping valves on motorbike engine blocks using a pneumatic system as a mechanism for clamping the engine block and as a rack and pinion driver, replacing human hand movements semi-automatically through electropneumatic control. This aims to save time in the clamping process, which usually takes around 90 to 120 minutes manually. By using this valve adjustment tool, clamping time can be cut to 10 to 17.5 minutes. Research methods include design, component manufacturing, assembly, testing, and data collection. The results of the development of a valve control tool with an electro-pneumatic system can also be applied in the learning process of mechanical engineering students in the fluid control laboratory.

Keywords: Electro-pneumatic, Support device, Rotational motion

INTRODUCTION

The increase in the use of motorized vehicles as a means of transportation has resulted in an increase in the number of engine damage we encounter, especially valve leaks in the cylinder head which often occur due to the buildup of scale on the valve seat surface. This situation disrupts the compression process and reduces engine performance. Symptoms that appear include a decrease in engine performance due to suboptimal compression, instability in engine performance which causes sudden shutdown, and wasteful fuel consumption. One of the causes of scale buildup is the entry of oil into the combustion chamber. To overcome this problem, improvements are needed through the valve lapping process.

Based on research conducted by researchers in workshops around Pondok Gede and Kranggan Bekasi, there are still manual (traditional) methods used in the process. This method involves using your hand to turn the valve handle right, left, up and down. However, using both hands in this process makes measurements time consuming and inefficient. However, not all technicians in workshops are able to carry out measurements using this method.

To overcome the manual process of adjusting valves with the aim of preventing leaks and ensuring that the valve is securely attached to its seat, a valve adjustment tool is needed that uses electro-pneumatic technology. This tool converts the linear movement of the cylinder into rotational movement, so it is hoped that it can overcome the instability of hand movements in manual processes which often results in poor valve adjustment accuracy, causing uneven valve surfaces and the potential for leaks. The results of this research can produce valve adjustment tools using electro-pneumatic applications that can be applied in valve adjustment workshops. Apart from that, this tool can also be used as a practical learning tool for mechanical engineering students in understanding electro-pneumatic applications in their practical context.

METHODS

The aim of this research is to investigate problems related to the application of electro-pneumatic technology that are relevant to the field of mechanical engineering, based on theory and several available references.

Direct observations in the field were carried out to recognize and understand various problems that arise in the operation of valve adjustment workshops in Jakarta.

Testing tools is a crucial step in assessing the success of a study; without this step, the research objectives are not considered achieved. This test is essential to verify the effectiveness of the safety aids in operation. This process involves measuring three valve samples on a motorbike engine block, where the efficiency of the tool is tested by measuring the duration of the measurement time to determine the best performance for the intake and exhaust valves. The criteria for checking to be considered successful is if after the valve is installed there are no leaks, which is tested by dripping gasoline on the valve seat to ensure there are no leaks.

RESULTS AND DISCUSSION

Research Design Results

In this study, a tool was developed to operate the valve using a pneumatic cylinder which produces a back and forth rotational movement.

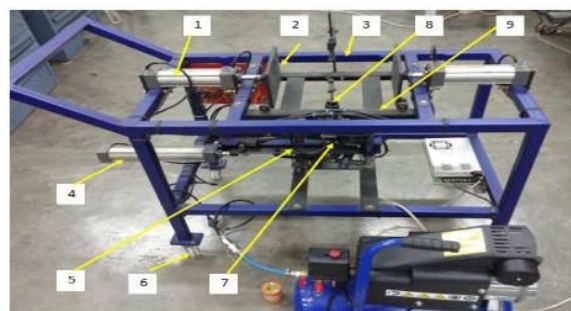


Figure 2 Valve adjustment tool

Information :

1. Double acting cylinders A and B (for gripping the cylinder head)
2. Dampening sponge
3. Framework
4. Double acting cylinder C (to move the rack and pinion)
5. Rack and pinion
6. Wheels
7. Double acting cylinder D (to raise and lower the valve)
8. Valve chuck
9. Launch pad

Work Steps Before Tool Testing

- Connect the hoses from the two double acting cylinders located at the top using a T connector, then this connection is directed to a double type 5/2 solenoid valve. Before making this connection, make sure you have installed a flow control valve. Next, the connection from the double 5/2 solenoid valve must be connected to the compressor, and the cable from the double 5/2 solenoid valve must be connected to a switch.

- Attach pneumatic hoses to the two double acting cylinders at the bottom leading to the flow control valve, then connect them to the two 5/2 double solenoid valves. After that, connect the hose from the 5/2 double solenoid valve to the compressor, and the cable from the 5/2 double solenoid valve is connected to the switch.
- Connect the cable from the limit switch to the switch.
- Connect the cables to the specified locations, then use the cables to connect the relays and switches.
- Connect the (+) and (-) cables on the switch to the power supply

Test result

Trials were carried out by assessing the successful functioning of the equipment and the effectiveness of collecting excellent braking time data, with success criteria including the absence of leaks at the intake and exhaust ports.

Table 1. Valve Seats for Valve on Motorcycle Engine Block 1

Jenis Klep	Pengujian	Waktu Penyekuran	Hasil Penyekuran	Kualitas Hasil Penyekuran
Klep Intake	1	2,5 menit	Masih bocor	Belum baik
	2	5 menit	Masih bocor	Belum baik
	3	7,5 menit	Masih bocor	Belum baik
	4	10 menit	Masih Bocor	Belum baik
	5	12,5 menit	Merembes	Baik
	6	15 menit	Rapat	Baik sekali
	7	17,5 menit	Rapat	Baik sekali
	8	20 menit	Rapat	Baik sekali
Klep Exhaust	1	2,5 menit	Masih bocor	Belum baik
	2	5 menit	Masih bocor	Belum baik
	3	7,5 menit	Masih bocor	Belum baik
	4	10 menit	Masih Bocor	Belum baik
	5	12,5 menit	Masih bocor	Belum baik
	6	15 menit	Merembes	Baik
	7	17,5 menit	Rapat	Baik sekali
	8	20 menit	Rapat	Baik sekali

Table 2. Valve Seats Against Valve on Motorcycle Engine Block 2

Jenis Klep	Pengujian	Waktu Penyekuran	Hasil Penyekuran	Kualitas Hasil Penyekuran
Klep Intake	1	2,5 menit	Masih bocor	Belum baik
	2	5 menit	Masih bocor	Belum baik
	3	7,5 menit	Masih bocor	Belum baik
	4	10 menit	Masih Bocor	Belum baik
	5	12,5 menit	Merembes	Baik
	6	15 menit	Rapat	Baik sekali
	7	17,5 menit	Rapat	Baik sekali
	8	20 menit	Rapat	Baik sekali
Klep Exhaust	1	2,5 menit	Masih bocor	Belum baik
	2	5 menit	Masih bocor	Belum baik
	3	7,5 menit	Masih bocor	Belum baik
	4	10 menit	Masih Bocor	Belum baik
	5	12,5 menit	Masih bocor	Belum baik
	6	15 menit	Merembes	Baik
	7	17,5 menit	Rapat	Baik sekali
	8	20 menit	Rapat	Baik sekali

Table 3. Valve Seats Against Valve on Motorcycle Engine Block 3

Jenis Klep	Pengujian	Waktu Penyekuran	Hasil Penyekuran	Kualitas Hasil Penyekuran
Klep Intake	1	2,5 menit	Masih bocor	Belum baik
	2	5 menit	Masih bocor	Belum baik
	3	7,5 menit	Merembes	Baik
	4	10 menit	Rapat	Baik sekali
	5	12,5 menit	Rapat	Baik sekali
	6	15 menit	Rapat	Baik sekali
	7	17,5 menit	Rapat	Baik sekali
	8	20 menit	Rapat	Baik sekali
Klep Exhaust	1	2,5 menit	Masih bocor	Belum baik
	2	5 menit	Masih bocor	Belum baik
	3	7,5 menit	Masih bocor	Belum baik
	4	10 menit	Merembes	Baik
	5	12,5 menit	Rapat	Baik sekali
	6	15 menit	Rapat	Baik sekali
	7	17,5 menit	Rapat	Baik sekali
	8	20 menit	Rapat	Baik sekali

Discussion of Research Results

Based on data analysis from the sizing process between valves and valve seats in motorcycle engine blocks for samples 1, 2, and 3 (a total of three motorcycle engine block samples were examined), where each engine block has one intake valve and one exhaust valve, everything has been installed very well. This is proven through a leak test, where if the valve

and valve seat are tightly installed, this indicates very good alignment, if there is seepage, this indicates good alignment, and if there is still a leak, it indicates poor alignment.



Figure 3. The relationship between staking time and the quality of engine block 1's staking results

Information:

- Pensekuran 1 has not very good quality.
- Pensekuran 2 has good quality.
- Surveying 1 shows very good quality.
- Series 1 is a suction valve.
- Series 2 is an exhaust valve. Based on table 1 and figure 3 from a study of the adjustment of the valve seat and the valve itself in the engine block of motorbike 1, it was found that to obtain very good quality on the intake valve, a adjustment time of 15 minutes was required, whereas to achieve the same quality on the exhaust valve , a survey time of 17.5 minutes is required.



Figure 4. Relationship between mixing time and the quality of engine block 2 skirting results

Details:

- The quality of the first survey was deemed unsatisfactory.
- The quality of the second survey was considered good.
- The quality of the first survey was considered very good.
- The first series is categorized as suction valves.
- The second series is categorized as an exhaust valve.

Based on information from table 2 and figure 4 in research on the seaming process of the valve seat and the valve itself in the engine block of motorbike 1, it was revealed that the suction valve required a seaming time of around 15 minutes to achieve very good quality. Meanwhile, for the exhaust valve to achieve similar quality, it required a tuning time of 17.5 minutes, which coincidentally is the same result as previous research on motorbike engine block 1.

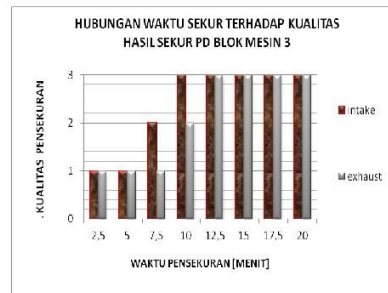


Figure 5. Relationship between staking time and the quality of engine block 3's securing results

Details:

The performance of the first survey did not meet standards.

The performance of the second survey was considered satisfactory.

The performance of the first survey turned out to be very satisfactory.

Series 1 is identified as a suction valve.

Series 2 is identified as an exhaust valve.

Analysis of the data in table 3 and figure 5 in the study of the sequestering process in the seat area and the valve itself on the motorbike engine block 1 shows that to achieve very satisfactory performance on the suction valve, a sequestering time of 10 minutes is required. Likewise, to achieve very satisfactory performance on the exhaust valve, 12.5 minutes of sizing time is required, indicating that this result is different from previous sizing studies on motorcycle engine blocks 1 or 2.

Based on analysis of three test samples of motorbike engine blocks number 1, 2, and 3, it was found that drilling for the suction valve takes a minimum of 10 minutes. Meanwhile, for the exhaust valve, a searing time of 12.5 minutes is required, especially in the test carried out on motorbike engine block number 3. In the case of motorbike engine blocks number 1 and 2, to achieve excellent seaming quality, it is necessary 15 minutes for checking the suction valve seat and 17.5 minutes for checking the exhaust valve seat. Variations in the adjustment time required for each test sample can be explained by differences in the initial condition of the valve seat and valve, which may be influenced by factors such as the year the engine was manufactured, maintenance methods, motorbike use, and the type of fuel used. In particular, exhaust valves require a longer cleaning time compared to intake valves because the presence of exhaust gases from the combustion process tends to accelerate the buildup of dirt.

CONCLUSIONS

The results of this research produce an auxiliary device for securing valves that operates with a linear pneumatic mechanism that is converted to rotational movement. Based on the tests carried out, conclusions can be drawn as follows:

1. The test results show that very good seaming quality is achieved on the valve seat and the valve itself in the number 3 motorbike engine block, requiring a seaming time of 10 minutes for the intake valve and 12.5 minutes for the exhaust valve.
2. Among the three samples tested, only test samples number 1 and 2 gave similar results, namely that a probe time of 15 minutes was required for the suction valve and 17.5 minutes for the exhaust valve.
3. The closing time for the intake valve is shorter than for the exhaust valve because there is a flow of exhaust gas which results in a faster buildup of combustion residue.
4. The difference in closing time between each test sample is caused by the initial condition of the sample which is not identified, including the varying age of use of the motorbike engine.

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