A Design of a Tool of Car Brake Piston Caliper Remover with Pneumatic Power

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Abstract: The development of automotive technology makes all aspects of life easier. Various work aids have been designed and created, making it easier for workers to do their jobs. One of the jobs are often done in automotive service is the brake system. In performing brake service, the work most often done is replacement of the brake canvass. The second most common job after replacing brake linings is replacing the caliper seals due to leaks and jammed caliper pistons. Removing the caliper piston is currently done by using an air-gun or gouging. Releasing using an air-gun often fails due to insufficient compressor pressure. Base on observation in the workshop, now day we designed a brake caliper piston removing tool using pneumatic power obtained from the pressure of the hermetic compressor. The tool pressure is set at 300 psi. The test results show that the process of removing the caliper piston takes 7.6 seconds.

1 INTRODUCTION

Technological developments make all aspects of life easier, more comfortable and safer. It is the same in the automotive world. One of the most important components in vehicles in the automotive world is the brake system (Toyota, 2007; Daryanto, 2009). The brake system functions to stop or reduce vehicle speed to prevent vehicle movement when a fixed position is required. All brake systems use friction for their operation. At this time the most widely used is the hydraulic brake system. The components of the brake system consist of: brake pedal, brake booster and caliper. The current research is focused on the brake caliper component because this component is the part of the brake system that is most often damaged after the brake lining. Figure 1 shows a picture of the working of brake caliper.

In figure 1, it can be seen that the pressure in the floating calipers will move the piston to the left and cause the brake pad to touch the brake disc rotor. If the pressure is continued again, the floating caliper will shift to the right against the steering knuckle, so that the brake disc rotor clamping process occurs by the pad. So that the braking process occurs (Adhi, 2021; Setiawan, 2014)

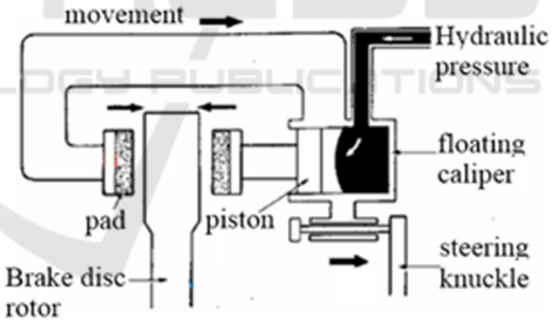

Figure 1: The brake caliper work.

At this time the method used to remove the brake caliper piston is to use an air-gun or gouging. Using an air-gun to remove the brake caliper pistons is often difficult. It even had to be knocked and the remaining brake fluid in the caliper housing was often scattered and spurted everywhere. This is very dangerous considering that brake fluid is damaging to the vehicle body paint. Using an air-gun can be dangerous for the tool itself and the workers, because

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it can damage the piston if it bounces far and hits the worker. Until now there is, no special tool used to remove the brake caliper piston apart from the air-gun and the help of a screwdriver to remove it. That is why it is necessary to think about special tools for work in automotive vehicle repair activities in the workshop.

(Setia. 2014) designed the Toyota Fortuner brake caliper piston remover tool. Using the SST tool he designed it took 106 minuts to remove the brake caliper pistons. The design model of the tool he made is shown in Figure 2.

Figure 2: The caliper piston remover tool designed by Setia A.

Based on this background, we thought that it was necessary to make a device that can remove the piston of the car's disc brake calipers. We conducted research by designing a car brake caliper piston release device with pneumatic power. By doing the design and testing of this tool, it is expected to facilitate the work in the car repair shop, especially in removing the pistons of the car brake calipers. Based on the description on the background, the formulation of the problem in testing the design of this tool is how much the car brake caliper piston release tool can simplify, speed up the work.

Design is planning and engineering calculation of materials and components, simulation test and modeling of a tool. The design of a tool must be based on a careful planning so that the designed tool can function optimally. Design in a tool or machine includes everything related to system planning, machine properties, machine elements, structures, and instruments so that it involves all mechanical engineering disciplines. In planning are marked with technical drawings as a communication tool and pay attention to design criteria that refer to function, safety, reliability, cost, manufacturability, marketability (Achmad, 2006; Juhana, 2000; Nur, 2007; Buchari, 2015; Sumbodo, 2017).

2 MATERIALS AND METHOD

Based on observations made in the workshop that the flow process of removing the caliper pistons is currently shown in Figure 3 as follow.

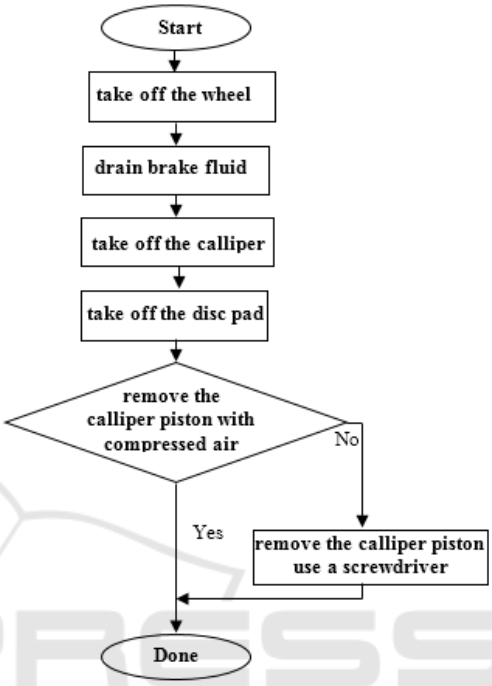

Figure 3: Flow process before improvement.

Car brake caliper piston removal process previously using an air-gun and duster to spray compressed air from the compressor to push the piston out from the caliper housing. The use of an air-gun and a rag can be used if the brake caliper piston is easy to remove, or the brake caliper piston is not stuck or does not rust. The use of the tip of air-gun and a rag to remove the caliper piston cannot be fully used because the air pressure is not all compressed, as a result of the tip of air-gun being less precise with the brake caliper holes. Also the duster cannot function as a good seal. Besides the leakage when putting the air into the caliper housing, it is also due to the compressor pressure in the workshop which is usually only 120 psi so it is not enough to push the piston out of the piston housing. This method of removing the brake caliper pistons is also less safe, because the remaining brake fluid can splatter, the caliper pistons can also bounce. The method of removing the caliper piston using an air-gun can be seen in Figure 4.

Figure 4: Releasing the brake caliper piston with an air-gun.

If the brake caliper piston cannot be removed using an air-gun, the brake caliper piston must be removed by other means such as pulling with pliers or gauging with a screwdriver. The process of removing the caliper piston using pliers or a screwdriver often results in damage to the brake caliper piston. Figure 5 shows the process of removing the brake caliper piston using a screwdriver.

Figure 5: Removing the brake caliper piston using the screwdriver.

The design of this car brake caliper piston remover tool utilizes the pneumatic power of a hermatic compressor. In designing a tool that is needed for a mature stage to produce a tool that can work well. The flow chart for making this car brake caliper piston removing tool can be seen in Figure 6.

The design of this car brake caliper piston remover tool is designed to be used easily and safely with fairly affordable manufacturing costs (Achmad, 2006; Nur, 2017; Buchari, 2015; Roslin, 2018; Azmi, 2018; Setia, 2014). This car brake caliper piston remover tool can assist mechanics in speeding up their job on repairs and replacement of car brake caliper pistons. And most important thing is to make the workers and the components safe. The figure of the caliper piston remover tool using pneumatic power can be seen in Figure 7.

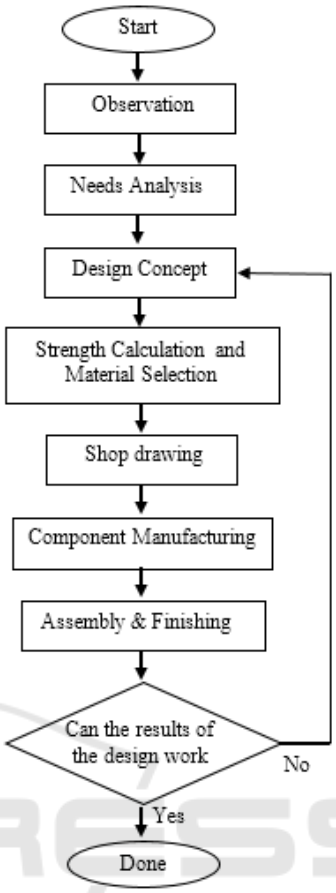

Figure 6: Flowchart of making caliper piston removal tool.

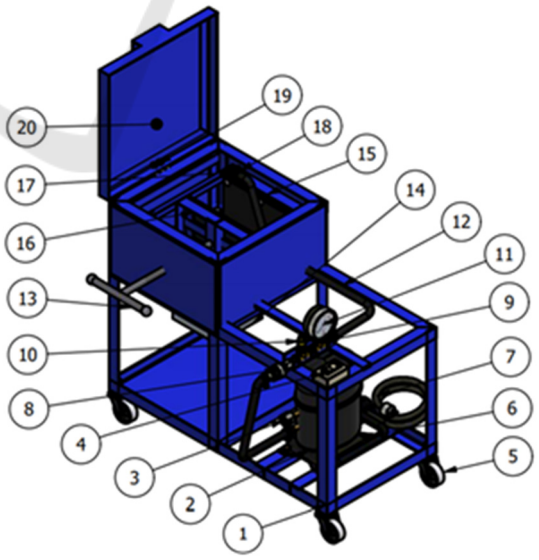

Figure 7: The caliper piston release tool uses pneumatic power.

Caption:

1. frame
2. Compressor
3. Compressor filter
4. compressor switch
5. Support wheel
6. Compressor bolt
7. Power cable
8. Quick Qulper
9. Nepple
10. Savety valve
11. Manometer
12. Caliper hose
13. Vise drive screw
14. Drain
15. Permanent vise
16. Moving vise
17. Ring
18. clamp
19. Hinge, bolt, nut
20. Close up

3 RESULTS AND DISCUSSION

In the brake caliper component, the most common disturbance is the leakage of brake fluid on the caliper piston, so the seal must be replaced. Replacement of the caliper piston seal is done by removing the caliper piston from its housing. When removing the caliper piston from the housing, the mechanics often have difficulty, based on observations in the workshop, we designed a tool that can assist the mechanics in completing their work. Figure 8 show the brake caliper.

Figure 8: Brake caliper.

From the test results, opening the caliper piston using an air-gun and using pneumatic power obtained the required time and pressure data. Compressor working pressure in maintenance and repair workshops is generally 120 psi. So the working pressure when opening the caliper piston using an air-gun is 120 psi. Table 1 presents the test data against time and pressure using an air-gun.

The working pressure of the hermetic compressor used for pneumatic power is 500 psi. In table 2 are test data using pneumatic power with a working pressure setting of up to 350 psi.

Table 1: Air-gun test.

Caliper Piston No.	Release pressure (psi)	Time (seconds)	explanation
1	50	25	released
2	-	-	not released
3	-	-	not released
4	75	30	released
5	-	-	not released

Table 2: Pneumatic power test.

Caliper Piston No.	Release pressure (psi)	Time (seconds)	explanation
1	50	5	released
2	200	10	released
3	180	8	released
4	75	5	released
5	200	10	released

To make it easier to read, from the table results, a graph of the comparison of the time and pressure needed to release the caliper piston can be made. Figure 9 shows the comparison of the time required to release the caliper piston using an air-gun and using pneumatic power. Figure 10 shows the ratio of the pressure required to release the caliper piston.

Figure 9 shows 5 tests using different brake calipers. Each caliper piston is released using the air-gun method and pneumatic power. In the first test, it takes 25 seconds to use an air-gun and 5 seconds to use pneumatic power to release the same brake caliper piston. In the 2nd, 3rd and 5th tests the brake caliper piston could not be released using the air-gun method. By using pneumatic power the 2nd, 3rd and 5th tests were release at 10, 8 and 10 seconds. It takes longer to release the same brake caliper pistons that can be released using an air-gun than using pneumatic force. The longer time it takes to release the caliper piston using the air-gun is due to the length of time it takes to reach the same pressure using pneumatic power. This is due to a leak during the intake of air into the caliper housing.

Figure 10 shows the pressure required to release 5 different caliper pistons. In the first test both with the air-gun and with pneumatic power the brake caliper pistons were released at 50 psi. In tests 2, 3 and 5 the piston could not be released using an air-gun. By using pneumatic power the piston can be released at a pressure of 200, 180 and 200 psi. This means that in tests 2,3 and 5 the piston is released at a pressure above the operating pressure of the compressor usually in the maintenance workshop,

which is 120 psi. In the 4th test the piston can be released using either an air-gun or pneumatic power. Piston releases at 75 psi.

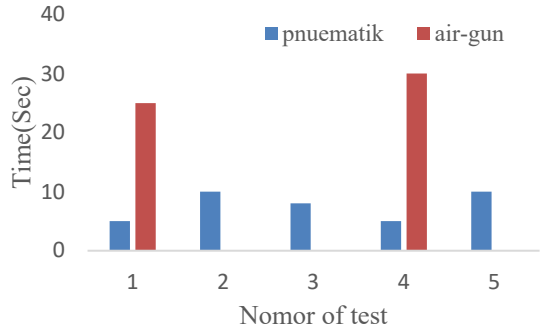

Figure 9: Comparison graph of the time required to remove the calipers piston.

The use of the tip of air-gun and a rag to release the caliper piston cannot be fully used because the air pressure is not all compressed, as a result of the tip of air-gun being less precise with the brake caliper holes. Also the duster cannot function as a good seal. Besides the leakage when putting the air into the caliper housing, it is also due to the compressor pressure in the workshop which is usually only 120 psi so it is not enough to push the piston out of the piston housing

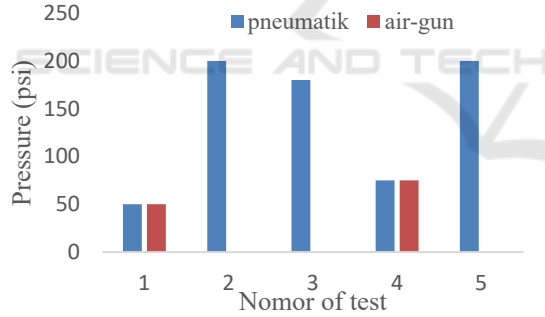

Figure 10: Graph of the pressure ratio required to release the calipers piston.

4 CONCLUSIONS

In terms of workability, based on the design test results that have been made, the brake caliper piston remover device using pneumatic power is able to remove all brake calipers in an average of 7.6 seconds. Compared to removing the brake piston using an air-gun from 5 times of testing, it only released twice in an average of 27.5 seconds and could not be released three times.

In terms of safety, release the caliper piston using pneumatic power is safer because there is no risk of tool damage.

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