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Modification of the Four-Step Motorcycle Camshaft Used in Making Salwa Cars (Go Card)

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Abstract

To meet the needs of racing, both drag bike racing and road races, vehicles or motorcycles with conditions still standing are not enough. Therefore, it is necessary to modify certain parts, including modifying the chassis, body, and engine. The three parts are very related. Of the three parts, the most priority is modifying the engine because the engine is the main factor in a vehicle or motorcycle. What is needed in modifying the engine is improving engine performance or maximizing engine performance. In this study, the author chose a four-stroke kharisma motorcycle because the modification did not require many changes from the standard conditions. Drag bike racing and road racing have similarities in modifying the engine. Only the difference is in terms of calculating engine endurance. Drag bike racing does not need long engine endurance because it only drives on straight tracks, while road races must think about engine endurance because the engine works in rough terrain conditions varies.

Keywords: Cam shaft, Four stroke motor, Salwa car

Abstrak

Untuk memenuhi kebutuhan balap, baik balap drag bike maupun road race, maka kendaraan atau sepeda motor dengan kondisi yang masih standard saja itu belum cukup. Oleh karena itu perlu adanya perubahan atau modifikasi di bagian-bagian tertentu diantarananya memodifikasi chasis, body, dan mesin. Ketiga bagian itu sangat berkaitan, dari ketiga bagian itu yang paling di utamakan adalah memodifikasi mesin kerena mesin merupakan faktor utama dalam kendaran atau sepeda motor. Adapun yang diperlukan dalam memodifikasi mesin adalah cara meningkatkan performa mesin atau memaksimalkan performa mesin. Dalam penelitian ini penulis memilih sepeda motor empat langkah kharisma karena dalam modifikasi tidak memerlukan banyak perubahan dari kondisi standardnya. Motor balap drag bike dan road race memiliki kesamaan dalam memodifikasi mesin, hanya perbedaannya dalam segi perhitungan ketahanan mesin, balap drag bike tidak perlu ketahanan mesin yang lama sebab hanya melaju pada trek lurus sedangkan road race harus memikirkan ketahanan mesin sebab mesin bekerja pada kondisi medan yang bervariasi.

Kata-kata kunci: *Poros cam, Motor empat langkah, Mobil salwa*

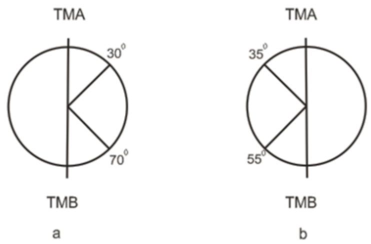
1. Introduction

Motor vehicles are one supporting means in carrying out daily activities [1]. Manufacturers produce various types and types to attract the interest of consumers. Each manufacturer wants to favor their products in demand and purchase by the public. In each product there are disadvantages and advantages, there are still many improvements in the product. Existing conditions generally design outstanding vehicles. They are easy in maintenance, repair, fuel-efficient, environmentally friendly, and easy to use because vehicles circulating in Indonesia generally meet general needs. Two-wheeled motor vehicles are made en masse.

Motor vehicles can also be used for certain needs, including racing dealers. To meet the needs of racing, both drag bike racing and road race, vehicles or motorcycles with conditions still standing are not enough. Therefore, certain parts need changes or modifications, including modifying the chassis, body, and machine. The three parts are very related. Of the three parts, the most important is modifying the engine because the engine is the main factor in the vehicle or motorcycle. What is needed in modifying the engine is improving engine performance or maximizing engine performance. Drag bike racing bikes and road races have similarities in modifying the engine, only the difference in engine endurance calculations. Drag bike racing does not need long engine endurance because it only runs on straight tracks. At the same time, road races must think about engine durability because the engine works in varying terrain conditions.

The camshaft serves as a regulator to open the valve lid on the cylinder cop. The arrangement when fuel intake and waste gas production of combustion can be arranged appropriately with the camshaft. In general, for camshaft modification, two goals will be achieved, namely the need for short distances and long distances [2]. For short distances, the duration of overlap or rinsing is enlarged. In contrast, the duration for long-distance overlaps is smaller. Still, in general, the purpose of camshaft modification is to set the lid open of both valves to get maximum fuel. The steps are: opening and closing the valve by the piston steps from the upper dead point to the dead point down. And from dead point down to upper dead point depending on the step. So each piston step means the crankshaft rotates 180° or semicircular [2]. At the actual condition, if the piston step is 180 ° crank, there will be a lack of perfection in each piston step, such as suction steps.

Suppose the suction valve is opened when the piston is in the upper dead point and closed when the piston is at the time of dead point down. In that case, the next gas entry will be very little because it gets a large obstacle there are suction channels, including the height of the valve opening. Likewise, for the exhaust step, if the exhaust valve is opened when the piston is in T dead point down and closed when the piston is on the upper dead point, there will be a complete lack in the disposal of used gas where not all exhaust gases are discharged out. Both types of perfection can be repaired by setting the current and length of the valve opening. The exhaust valve begins to open when the piston almost reaches a dead point down because the used gas pressure is higher than the outside air pressure. In this state, the exhaust gas will immediately come out easily. Then this exhaust valve is closed when the piston is after the upper dead point. It is intended so that used gas can come out of everything.



For suction steps, because at the exhaust step where the exhaust valve is still open even though the piston has passed the upper dead point, there will be a speed of exhaust gases that cause a vacuum in the combustion chamber [4] [3] It would be good and proper to start the suction step.

2. Method

An information system combines information technology and people who use that technology to support operations and management [2].

The research design of the flow chart of process planning and die design is presented in Figure 1.

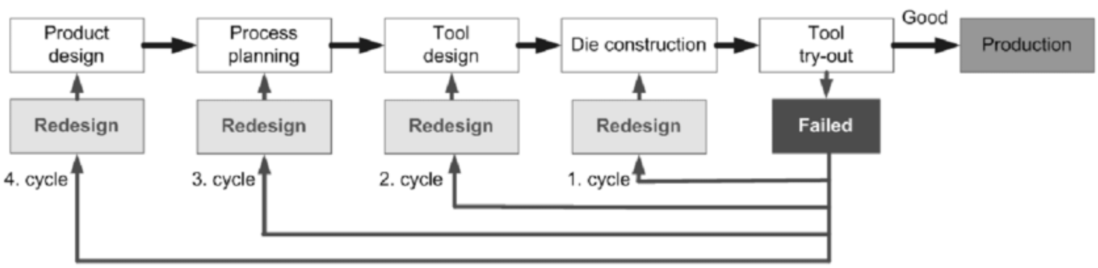


Figure 1. Design Flow Chart of Method

a. Product design

This study included a type of experimental study in determining the effect of modifications to the camshaft of a charismatic motorcycle on the torque and power of the motorcycle using a test dynamometer [4] [10].

b. Process Planning (data research)

Data obtained with a dynamometer test tool where camshaft products have been designed with careful calculations, so that torque and power reach the maximum or large.

c. Tool design or analyze data

Analyzing this camshaft design starts from observing when the piston reaches the top dead point where the velocity of the gas exits is very high, which causes the vacuum.

Analyzing this camshaft design starts from observing when the piston reaches the top dead point where the velocity of the gas exits is very high, which causes the vacuum. The intake valve has started to open so that gas cleaning occurs in the combustion chamber and clean gas intake can begin immediately. Furthermore, with the movement of the piston towards the bottom dead center, the incoming gas velocity will tend to rise again. Even though the piston has passed the bottom dead center, clean gas still flows into the cylinder. Therefore, the suction valve is closed after the piston has passed a few degrees from the bottom dead center. It is intended to increase the intake of clean gas as much as possible so that the filling efficiency can be as large as possible. When the two diagrams below are combined, a working diagram of the intake valve and exhaust valve will be seen, which is called the valve work diagram [3].

The situation in which the intake valve and exhaust valve are both opened is known as overlap, which aims to allow complete gas flushing to occur.

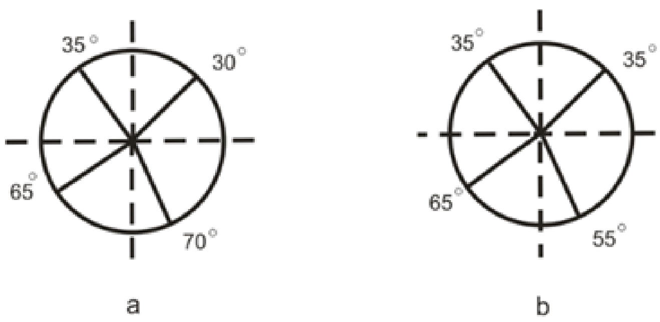


Figure 2. a. Valve diagram for low-speed engine; b. Valve diagram for high-speed engine

The degree of opening of this valve depends on the needs and engine type. For example, for low-speed engines, the degree of valve opening is made less than for high-speed engines. Likewise, when the intake valve and exhaust valve are still in the open position when the exhaust stroke goes to the intake stroke, the valves for high-speed engines are as shown in the picture below. The working life of this valve is regulated by the shape of the cam or cam, where for a short valve service life, the ridge is sharp, while for a long or long valve, the shape of the cam is blunt **[3]**.

d. Die Construction

Modification of the camshaft for racing is designed so that the length of the valve opening is the intake stroke and exhaust stroke times, often referred to as duration, are made greater than the duration of the standard camshaft shaft. The lift or maximum distance of the valve opening on the hood is also greater than the standard because, with this, the engine performance at lower and upper rpm is achieved **[8]**. To make the power greater than the standard, the step that must be taken is to apply or add an overlap between 4˚ - 8˚ nok (8˚ - 16˚ crank). If the increase in stroke exceeds 4˚ - 8˚ will cause excessive pressure on the carburetor, which is detrimental to the power generated **[3]**.

3. Results and Discussion

The engine in a motor vehicle is a generator of power or motion (1). In this machine, power is generated, which then causes an alternating motion into rotary motion. Machine parts can be separated into moving parts and immovable machine parts. Motors or machines can be distinguished based on the working process: a four-stroke 4-stroke motor and a two-stroke 2-stroke motor. **[6]**

a. Below are some terms that exist on the motor or machine, namely:
b. Top Dead Point, where the position of the piston is at the maximum distance from the axis of the crankshaft.
c. Bottom dead center is the position of the piston when it reaches the minimum distance from the axis of the crankshaft.
d. Piston stroke is the distance between the piston at the top dead center position to the bottom dead center in the cylinder chamber.
e. Stroke volume is the volume created by the motion of the piston from the top dead center and bottom dead center.

If cylinder diameter = D and piston stroke length = L, then the formula for the volume of steps is [9] :

$$VL = \frac{\pi}{4} D^2 \times L : \ldots\ldots (cm^3)$$

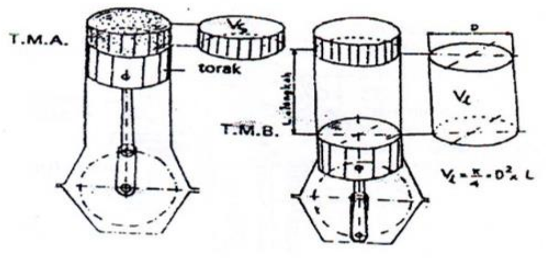


Figure 3. Dead point designation, stroke length, step volume (6)

a) Total Volume (Vt) is the content of the space between the piston when it is at the bottom dead center to the cylinder cover or, in other words: the largest volume between the piston and the cylinder cover.

b) Residual volume (Vs) is the volume between the piston at the top dead center of the cylinder cap. From the above statement, the total volume is the sum of the step volumes with the residual volume, or:
Vt = VL + Vs

c) The compression ratio is the quotient between the total volume and the residual volume, so

$$C = \frac{Vl + Vs}{Vs} = 1 + \frac{Vl}{Vs}$$

a. Results

Make a modified camshaft, and careful calculations are needed to maximize the results. In essence, modifying the camshaft is to adjust the valve opening time and valve closing time, which will affect the amount of fuel and air mixture that will enter the combustion chamber, as well as in modifying the camshaft the length of time the intake valve opens and the exhaust hole closes quickly [5].

To make the power greater than the standard, the steps that must be taken are to increase the duration between 8° - 10° and add overlap between 4° - 8° on the camshaft. If the addition of steps exceeds 4° - 8° will cause excessive pressure on the carburetor to the detriment of the power generated [3].

In this section, making the camshaft which requires very high accuracy due to the slightest error, must be replaced with a new cam for grinding.

Tables 1. Valve Degree Size and Noc Lift Height

Motor	Valve Degree				Camshaft Lift Height
	IN		EX		
	Open	Close	Open	Close	
Standard	30°	70°	55°	35°	5,53 mm
Modification	35°	65°	65°	35°	8,8 mm

The table above measures the modification of the four-stroke motor camshaft.

b. Test

After the design and manufacture process has been completed, the next step is the trial process to determine the extent to which the modified camshaft can be successful by planned goals.[7] Two types of motors were carried out in the trial process, namely standard motors and motors with modified camshafts. The purpose of doing a standard motor test is as a comparison. To what extent is the difference or increase in Horse Power and Motorcycle torque with modified camshaft.[9]

The test method with Dynotest begins with raising the motor on the Sportdyno V3.2 tool. The front motor wheel is tied to the mount. The black cable from Dynotest is connected to the coil cable (+). The yellow cable from Dynotest is connected to the motor body. The big black cable from Dynotest is connected to the spark plug wire or high voltage cable. Next, the motor is turned on while on the gas at 6000 rpm; the gas is held and then opened to full while looking at the graph on the monitor. After the data is obtained, the machine is turned off, and the Dynotest data is printed.

The second part is testing using a timer. Standard motorbikes and modified motorbikes are tested for how long it takes to cover a distance of 201m at maximum speed. This trial was carried out several times to obtain more accurate results to calculate the comparison between the modified motor and the standard motor.

Testing with this timer was carried out in Sleman, Yogyakarta, with a distance of 201 meters and assisted by two observers to record the start and finish times. One person guards the starting line, and one person guards the finish line, holding a stopwatch. This test was carried out three times to obtain accurate results.

The motor testing results using the Dyno Test are as follows: Standard Motor Test Results.

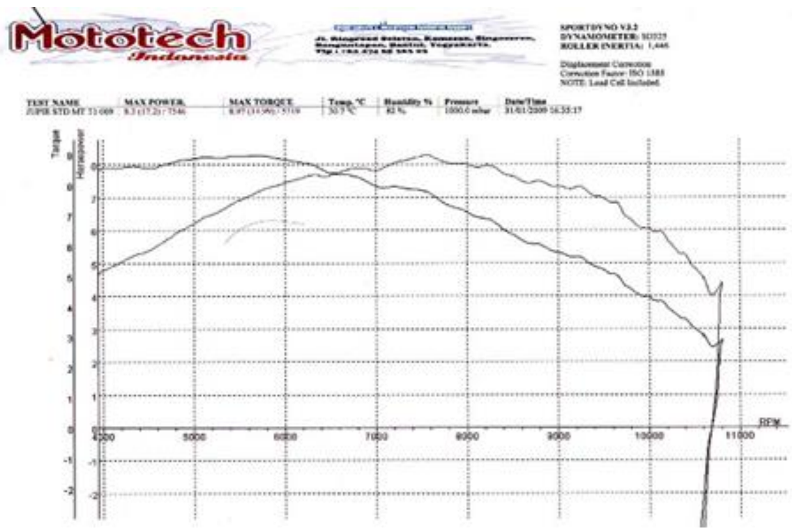


Figure 4. Graph of Dynotest Motor Honda Kharisma Standard

Numerical data that can retrieve are as follows:

DATA FOR TEST:

Comments
BASE

RPM	HP (HP)	TQ (N*M)	EXHAUST 1
3500	4.7	8.53	1000
3750	4.8	8.55	1000
4000	4.8	8.55	1000
4250	5.2	8.60	1000
4500	5.4	8.54	1000
4750	5.9	8.75	1000
5000	6.3	8.88	1000
5250	6.6	8.88	1000
5500	6.9	8.95	1000
5719	7.2	8.97	1000
5750	7.3	8.95	1000
6000	7.5	8.81	1000
6250	7.7	8.70	1000
6500	7.7	8.38	1000
6750	7.9	8.29	1000
7000	7.8	7.94	1000
7250	8.1	7.92	1000
7500	8.3	7.81	1000
7546	8.3	7.78	1000
7750	8.1	7.38	1000
8000	8.0	7.06	1000
8250	8.0	6.84	1000
8500	7.6	6.34	1000
8750	7.5	6.05	1000
9000	7.3	5.76	1000
9250	7.3	5.59	1000
9500	6.9	5.12	1000
9750	6.4	4.63	1000
10000	6.0	4.24	1000
10250	5.5	3.82	1000
10500	4.8	3.23	1000
10750	4.2	2.75	1000

LOSSES:	-8.9 HP	-6.0N*M
TOTAL ENGINE:	17.2HP	14.99N*M

Figure 5. Data Dynotest Results in Honda Kharisma Standard

Test Results with Modified Camshaft

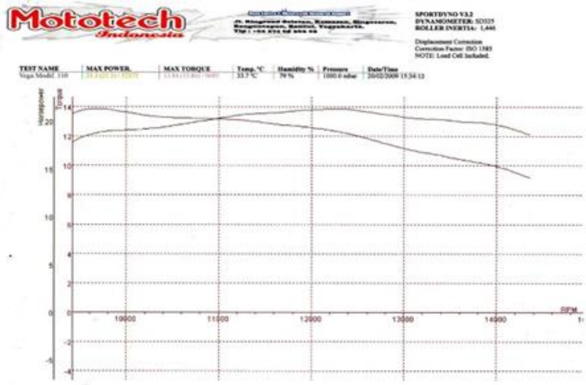


Figure 6. Graph of Modified Kharisma Motor Dyno test

Numerical data are taken from the dyno test :

DATA FOR TEST:

Comments
MAPPING

RPM	HP (HP)	TQ (N•M)	EXHAUST 1
8500	18.2	13.70	0
8750	18.4	13.79	0
9000	18.6	13.83	0
9250	18.8	13.84	0
9685	18.8	13.84	0
9500	18.9	13.82	0
9750	19.0	13.78	0
10000	19.1	13.59	0
10250	19.2	13.35	0
10500	19.6	13.25	0
10750	20.0	13.20	0
11000	20.4	13.14	0
11250	20.7	13.06	0
11500	20.8	12.85	0
11750	21.0	12.70	0
12000	21.2	12.53	0
12250	21.3	12.33	0
12273	21.3	12.33	0
12500	21.1	11.93	0
12750	20.8	11.55	0
13000	20.4	11.12	0
13250	20.2	10.81	0
13500	20.0	10.51	0
13750	19.9	10.24	0
14000	19.6	9.93	0
14250	18.9	9.38	0

LOSSES: 0.0 HP 0.0N•M
TOTAL ENGINE: 21.3HP 13.84N•M

Figure 7. Numerical data

1. Testing using a timer:

   a. Test results with standard motors

Table 2. Test results with standard motors

Test	Distance	Time (s)
1	201 m	11
2	201 m	11,3
3	201 m	10,9
Mean	201 m	11

b. Test Results with modified motors

Table 3. Test Results with modified motors

Test	Distance	Time
1	201 m	9,173
2	201 m	9,201
3	201 m	9,182
Mean	201 m	9,185

c. Discussion

From observations obtained from manual testing or the Dyno Test tool, interrelated data were obtained, which showed an increase in acceleration and power on the motor.

1. Testing using the Dyno Test tool

The maximum value of a motor with standard torque conditions is 8.97 HP when the motor rotates at 5719 RPM. Maximum power appears after the motor rotates at a value of 7546 RPM of 8.3 HP. 8.3 HP is motor power at standard position.

From the graph, the power starts to rise at 4000 RPM, and the condition of the motor has been able to turn the wheels. Because the motor is stationary condition is 1500 RPM. With maximum power produced at 7546 RPM position. Although the RPM is increased, the power produced decreases, and it can conclude that the maximum power is only at 7546 RPM. Even so, this standard motor is sufficient for use in motorcycle racing. Still, to get more power, it is necessary to modify it so that it is made so that before 4000 RPM, the power has appeared so that it can outperform another player at the start of the start. Modifications are needed if the standard motor has not yet reached the power required in motor racing. As well as the time it takes to increase the power that must make faster.

Torque data reaches the peak point before the Horse Power reaches the peak point; this happens because the motor load has been overcome after the torque has passed the peak point. Then the power of the motor starts to look up. Increasing the gearshift can make the motor's torque slower because the motor's RPM is already high. The following is a calculation of the increase in Horse Power motor after modification based on data taken from Dynoster.

Table 4. Percentage of Increase in Horse Power

Horse Power Max. Motor (dk)		Difference	Percentage Increase
Standart	Modification		%
8,3	21,3	13	156,626506

From the calculation, it can conclude that the motor has an increase in Horse Power of 156.6% after being modified, a significant improvement.

The calculation of the percentage increase in torque on the modified motor is as follows:

Table 5. Percentage of Torque Peningkatan Increase

Torque Max. Motor (N.M)		Difference	Percentage Increase
Standart	Modification		%
8,97	13,84	4,87	54,2920847

From the calculation, it can be concluded that the torque of the modified motor increases by 54.3%. Discussion of test results manually:

Table 6. Comparison of Maximum Acceleration

Test	Motor		Difference	Percentage Increase
	Standart	Modification		
1	11	9,173	1,83	16,609091
2	11,3	9,201	2,1	18,575221
3	10,9	9,182	1,72	15,761468
Mean	11,06	9,18	1,88	16,981927

4. Conclusion

Based on observations and research on experimental results that have been carried out by looking at the data obtained, the following conclusions can be drawn:

To modify the camshaft is to grind the outside of the camshaft until it reaches the specified size as depicted in the valve diagram. After the size is determined, the measurement is measured using a protractor. The dial indicator of this measurement is very accurate, so if there is an excessive grinding process, the camshaft cannot be used.

The performance of the modified camshaft motor experienced a significant increase, including Horsepower increasing by 156.6%, the torque also increasing by 53.3%, and increasing acceleration reaching 16.98%. This improvement can be measured using the Dyno Tester and the timer system. With this increase, the acceleration and power have increased on the motor modified the camshaft.es that are connected.

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