The Effect of CVT Rollers Weight on Power and Torque of Honda Vario 125 Engine in Garuda Hybrid Car 2017

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Abstract. This study aims to find out the impact of CVT roller's weight variable to “Honda Vario” 125 engine power and its torque in “Garuda Hybrid 2017 car”. This paper is a kind of experimental research. The object of this paper is the “Honda Vario” 125 engine that has been bored down to 120cc in “Garuda Hybrid 2017 car”. There are 5 different types of calibration samples. The calibration uses a dyno test to test the engine. After calibrating the engine, the research uses descriptive analysis as the analysis data technique. The results show that: (1) the change of CVT “Honda Vario” 125 weight variable roller influence the power produced by the engine; the bigger the roller weight, the bigger the power produced by the engine. (2) The influence of its weight variable also influences the torque of the engine; the lighter the roller weight, the bigger the torque of the engine.

1. Introduction

Many research related to the CVT roller has been conducted with several variables [1], [2], [11]–[13], [3]–[10]. The 2017 International Student Car Competition (ISCC) is an international competition held in Seoul, South Korea. In this competition, there are 3 competition categories the ISCC competition, namely acceleration, maneuverability, and endurance [14]. Garuda UNY Team is one of the representative teams from Indonesia who participated in that competition. The “Garuda Hybrid 2017 car” is still quite heavy at 245 kg so that it can affect the vehicle's performance during the race. Besides that, in the 2017 ISCC race, there are committee rules that must be followed for hybrid vehicles, namely the engine capacity limitation, which is 120cc. The engine used in the “Garuda Hybrid 2017 car” is the 125cc “Honda Vario” engine. Based on the engine capacity limitation, it can be seen that engine performance could be decreased.

The “Honda Vario” transmission system used is an automatic transmission system which is often referred to as CVT [15]. This transmission system consists of a primary pulley (driver pulley) and a secondary pulley (driven pulley) connected to a V-belt [16]. In the primary pulley, there is a speed governor which plays a role in changing the size of the primary pulley diameter. In the speed governor, 6 centrifugal rollers will receive the centrifugal force due to the rotation of the shaft from the crankshaft. The roller will be thrown out pressing the inside of one side of the pulley which can be shifted (sliding sheave) towards the side of the pulley fixed (fixed sheave) causing a change in the primary pulley diameter, namely enlarging or shrinking.

This change affects the transmission ratio. The size of the roller compressive force against the sliding sheave is directly proportional to the weight of the centrifugal roller and the engine speed. The heavier
the centrifugal roller the greater the pushing force of the centrifugal roller against the sliding sheave so that the larger the diameter of the primary pulley. Whereas in the secondary pulley the movement of the pulley is caused by spring pressure, this secondary pulley only follows the reverse motion of the primary pulley, if the primary pulley is enlarged, the secondary pulley will shrink, and vice versa. Changes in the CVT pulley diameter can affect engine power [17]. In research conducted by Budiana [18] concluded that the 8gr centrifugal roller produces the best traction performance at low speeds, while for the 12gr centrifugal roller the traction performance is very good at high speeds, and the standard centrifugal roller (10.2gr) has the best traction performance. between both.

Thus, the weight of the roller affects the change in the ratio of the diameter of the primary pulley to the secondary pulley. So that variations in engine rotation will affect the centrifugal force generated and will affect the power or torque generated by the engine itself. That is the main basis for the author to improve the performance of the engine used for the 2017 ISCC competition.

2. Method
This research uses an experimental research type. Experimental research can be interpreted as a research method used to find the effect of certain treatments under controlled conditions [19]. There are several changes made to the “Garuda Hybrid 2017 car”, so it is necessary to research to determine the effect of the CVT roller weight on the power and torque of the “Honda Vario” 125 engine.

This research was conducted at the Garuda UNY Team workshop. This workshop is located in the parking area of the Faculty of Engineering Universitas Negeri Yogyakarta. Testing the effect of the weight of the CVT Roller on the Power and Torque of the “Honda Vario” 125 engine was carried out using a dyno test or dynamometer test. The duration of this research is started from January 3, 2017, until May 20, 2017. The data required are power, torque, and engine speed using different variations of roller weight.

The sample used in this study is a “Honda Vario” 125 engine that has been bored down to 120cc. The changes made were changes to the CVT roller weight. There are 5 (five) different types of test samples, namely the standard roller weight which is 16gram, 14gram, 12gram, 10gram, and 8gram which are controlled by changes in engine speed (Rpm).

The data collection technique in this study is to measure the performance of the object under study and record the required data. The test is carried out according to the procedure for using the dyno test tool by starting the engine and accelerating it repeatedly so that the maximum results are obtained. The data needed is the result data of Power (Hp) and Torque (Nm) at each engine speed (Rpm).

3. Result and Discussion
3.1. Effect of roller weight on the engine power of the “Honda Vario” 125 engine
This test was conducted to determine the effect of roller weight on the “Honda Vario” 125 engine power. From each test, there were several differences. The following graph depicts the results of the engine power test.
Based on the graph above, it can be seen the comparisons obtained from each test. The difference is seen between low rotation and high rotation. Test 1 with a standard roller weight of 16 gram obtained a maximum engine power of 9.7 HP at 9250 Rotation per Minutes (RPM). Test 2 with a roller weight of 14 grams, the maximum engine power is 9.5 HP at 9250 RPM. Testing 3 with a roller weight of 12 gram obtained a maximum engine power of 9.3 HP at a fairly high rotation of 10250 RPM. Test 4 with a roller weight of 10 grams, the maximum engine power is 9.2 HP at 9500 RPM. The last test is the fifth one, using a roller weight of 8 gram, the maximum engine power is 9.6 HP at 5750 RPM. Based on the test results, it was found that the higher the weight of the roller, the greater the power generated in proportion to changes in engine speed.

3.2. Effect of CVT roller weight on “Honda Vario” 125 engine torque
This test is conducted to determine the effect of roller weight on the engine torque of the “Honda Vario” 125 engine. From each test, there are several differences. The following graph illustrates the results of engine torque testing.
Figure 2. The Effect of Roller Weight on the Engine Torque.

Based on the graph above, we can see the comparison obtained from each test. Test 1 with a standard roller weight of 16 gram obtained a maximum engine torque of 12.5 Nm at 3500 RPM. Test 2 with a roller weight of 14 grams, the maximum engine torque is 13.9 Nm at 4000 RPM. Test 3 with a roller weight of 12 grams, the maximum engine torque is 13.67 Nm at 4000 RPM. Test 4 with a roller weight of 10 grams, the maximum engine torque is 14.56 Nm at 4000 RPM. The last test is the fifth one, using a roller weight of 8 gram, the maximum engine torque is 14.96 Nm at 4000 RPM engine speed. The difference is seen between low rotation and high rotation. Based on these test results, it was found that the lighter the roller weight the greater the torque produced by the engine.

4. Conclusion
Based on the results, research on the effect of the variable weight of CVT rollers on the “Garuda Hybrid 2017 car” on engine performance can be concluded that (1) changes in the variable weight of the CVT roller “Honda Vario” 125 affect the power generated in the engine. The results of the study with the highest power were in using a 16-gram roller weight and (2) the influence of the variable weight of the CVT roller “Honda Vario” 125 affects engine torque. The results of the study with the highest torque were in using a roller weight of 8gr.

5. References
[1] Teknik P S P and Murdianto I 2016 Jurusan teknik mesin fakultas teknik universitas negeri semarang J. Ilm. Tek. Mesin
[2] Salam R 2016 Pengaruh Penggunaan Variasi Berat Roller Pada Sistem Cvt (Continuously Variable Transmission) Terhadap Performa Sepeda Motor Honda Beat 110cc Tahun 2009 J. Ilm. Tek. Mesin
[3] Gradu M 2000 Tapered roller bearings with improved efficiency and high power density for automotive transmissions SAE Technical Papers
[4] Shibukawa Y, Yamamoto T and Mori H 2004 Improvement of the high rigidity power-roller
support structure in a half-toroidal CVT SAE Technical Papers

[5] Tanaka H and Toyoda N 2004 Development of a 6 Power Roller Half-Toroidal CVT Proc. Symp. Motion Power Transm.

[6] Hutabarat H, Darlius and Zulherman 2018 Pengaruh variasi berat roller cvt dan rpm terhadap daya pada yamaha soul gt 115cc J. Pendidik. Tek. Mesin

[7] Prasojo A B and Kaelani Y 2016 Analisa Beban Kerja Dan Gaya Dinamis Pada Round Roller Dan Sliding Roller Untuk Sistem CVT (Continuously Variable Transmission) Sepeda Motor Matic J. Tek. ITS

[8] Susena A T, Wigraha A and Dantes R 2017 ROLLER TERHADAP TORQUE DAN RPM PADA MOTOR GANESHA ELECTRIC VEHICLES 1.0 BASE CONTINOUS VARIABLE TRANSMISION (CVT) Singaraja, Indonesia J. Jur. Tek. Mesin

[9] Susena I G T A, Wigraha N A and Dantes K R 2017 PENGARUH SUDUT PRIMARY PULLEY DAN VARIASI BERAT ROLLER TERHADAP TORQUE DAN RPM PADA MOTOR GANESHA ELECTRIC VEHICLES 1.0 BASE CONTINOUS VARIABLE TRANSMISION (CVT) J. Pendidik. Tek. Mesin Undiksha

[10] Oshidari T, Watanabe J, Kobayashi K and Nakano M 2008 A study of power roller synchronization in a toroidal CVT SAE Technical Papers

[11] NARITA Y, YAMANAKA M and INOUE K 2004 Effect of Backup Roller on Efficiency of Shaft Drive CVT Proc. Symp. Motion Power Transm.

[12] Narita Y, Yamanaka M and Inoue K 2009 Improvement to power to weight ratio of shaft drive CVT using zero-spin disk Nihon Kikai Gakkai Ronbunshu, C Hen/Transactions Japan Soc. Mech. Eng. Part C

[13] Narita Y, Yamanaka M and Inoue K 2007 Improvement of power to weight ratio of Shaft Drive CVT using zero-spin disk (1st report, proposal of shape and optimum design) Nihon Kikai Gakkai Ronbunshu, C Hen/Transactions Japan Soc. Mech. Eng. Part C

[14] Anonim 2017 Rule 2017 Internasional Student Car Competition (Korea Selatan: KASA KATRI)

[15] AHM 2015 Service Manual Vario 125, 2015 (Jakarta: AHM)

[16] Jama J et al 2008 Teknik Sepeda Motor (Jakarta: Depdiknas)

[17] Wibowo R P B 2012 Pengaruh Diameter Roller CVT (Continously Variable Transmission) dan Variasi Putaran Mesin Terhadap Daya Pada Yamaha Mio Sporty Tahun 2007 Skripsi (Surakarta : Universitas Sebelas Maret)

[18] Budiana M 2008 Variasi Berat Roller Sentrifugal Pada Continuously Variable Transmission (CTV) Terhadap Kinerja Traksi Sepeda Motor Skripsi (Bali: Universitas Udayana)

[19] Sugiyono 2010 Metode Penelitian Kuantitatif Kualitatif dan R&D (Bandung: Alfabeta)