The effect of gear variations on the wind turbine alternator side on the voltage and electric current generated in a 4-stroke motorcycle

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Abstract

In order to be used, hydrogen-electric vehicle fuel must go through a process of separating water molecules and verification (electrolysis) to produce hydrogen and oxygen. Previous research has shown that the voltage and electric current produced in this process tend to be small, thus requiring greater resources. By adding variations in the teeth on the generator side, the voltage and current produced can change, either for the better or for the worse. The method used in this study is the pinion experimental method which was tested at speeds of 40 km/h, 50 km/h, 60 km/h, and 70 km/h. The results of the voltage test show that at a speed of 40 km/h, a voltage of 3.1 V and a current of 0.07 A are produced. At a speed of 50 km/h, the voltage increases to 4.0 V with a current of 0.27 A. At a speed of 60 km/h, a voltage of 4.9 V and a current of 0.36 A are produced, while at a speed of 70 km/h, the voltage reaches 5.9 V with a current of 0.43 A. Based on the average values obtained, the electrolysis process can be carried out because the process requires a minimum voltage of 5.8 V.

Keywords

Gear, Alternator, Turbine, Voltage, Current

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Introduction

Motorcycles are one of the means of transportation that are often used in everyday life. Motorized vehicles move using energy generated from the combustion process, which requires fuel as its main component. However, the scarcity of fuel that causes price increases requires a solution to save fuel use in vehicles. One alternative is to utilize renewable fuels, such as hydrogen gas [1].

According to [2] the use of the Nikuba mini hydrofuel generator as a hydrogen fuel producer requires a process of separating water molecules into hydrogen and oxygen, which requires quite a lot of electricity consumption. Meanwhile, research [3][4] shows that the addition of an electrolyzer can reduce fuel consumption based on static and dynamic testing, while reducing exhaust emissions from motor vehicles. However, the weakness of this technology is the need for large energy and inefficient use of electric current.

In another study by [5], the use of additional bodies on vehicles was shown to increase the voltage and current generated by the alternator. At a speed of 60 km/h without an additional body, the voltage produced is 3.2 V with a current of 0.039 A. With the addition of a body, the voltage increases to 4.8 V and the current to 0.045 A. This study concludes that the weaknesses of water-fueled vehicles can be overcome by installing additional gears on the alternator side to increase the efficiency of generating electrical energy that will be used to charge the vehicle's battery.

This hydrogen fuel has potential because when the vehicle is operating, the air flow from the exhaust can rotate the alternator turbine which produces additional electricity [6]. However, the electric current produced is still low, so that the production of HHO gas is also less than optimal. Therefore, a method is needed to increase the electric current, one of which is by installing additional gears that accelerate the rotation of the alternator [7][8].

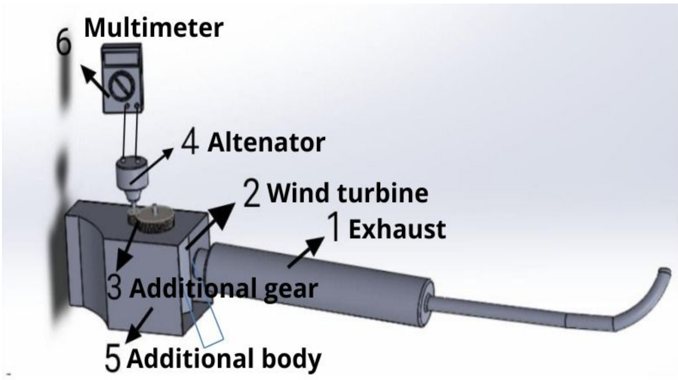

Figure 1. Tool design design

Figure 1, in this study, uses gears installed on wind turbines with different gear ratios. Large gears are combined with small gears to create rotational acceleration, which aims to increase the voltage and electric current in the alternator [9][10]. Researchers used three variations of plastic gears with different numbers of teeth to test their effects on the voltage and current produced.

Researchers hope that installing additional gears on this alternator can increase the voltage and current supplied to the battery. Testing was carried out by comparing variations in the ratio of additional gears installed on the exhaust pipe of a 4-stroke motorcycle. The results of this study are expected to contribute to the development of renewable fuel technology in the future.

Method

This study uses an experimental method by designing and installing the tools to be tested. Researchers conducted tests at various speeds and time durations, not limited to just one variation [11]. The research object was installed on the rear of the exhaust, by adding additional gears to the alternator side. Measurements were made to determine the extent to which the use of additional gears affects the voltage and electric current produced. The purpose of this study was to analyze the effects of differences in the number of teeth and additional gear ratios on the alternator on the results of voltage and electric current. The research process follows the flow that has been designed and visualized in the form of a flowchart in Figure 2.

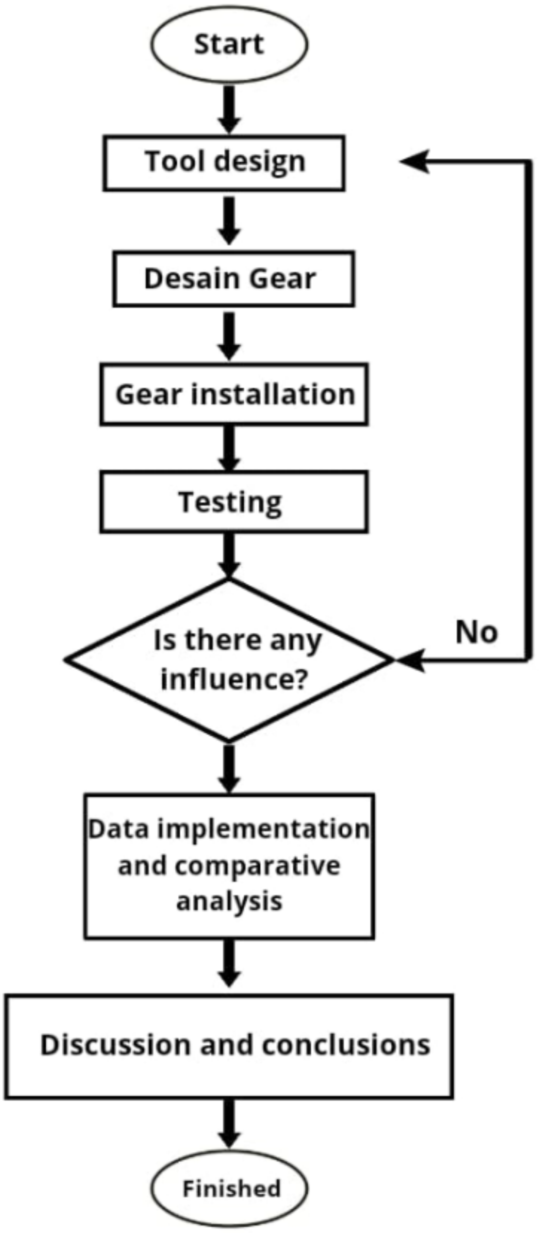

Figure 2. Research flowchart

Research patterns can be seen in Table 1.

Table 1. Combination of research patterns

Group	Treatment	Test Results	Information
R	X1	Y1	Gear 1 (76:49)
R	X2	Y2	Gear 2 (65:49)
R	X3	Y3	Gear 3 (54:49)

Description:

R: Testing and control section

X1: Treatment 1 (using gear1)

X2: Treatment 2 (using gear2)

X3: Treatment 3 (using gear3)

Y1: Effect of treatment 1

Y2: Effect of treatment 2

Y3: Effect of treatment 3

This study uses an object in the form of a four-stroke motorcycle equipped with additional wind turbine propellers, bicycle generators, and gears. Research data were obtained from the results of testing on objects using gears. Testing was carried out in dynamic conditions with speed variations including 40 km/h, 50 km/h, 60 km/h, and 70 km/h.

Results and Discussion

Gear 1 voltage and current test results

Table 2. Voltage test with gear 1

Testing	Speed (km/h)	Average Gear 1
1	30	-
2	40	3,1
3	50	4,0
4	60	5,4
5	70	5,9

Based on Table 2, the test results show that the use of gear 1 on the wind turbine alternator side produces the highest average voltage at a maximum speed of 60 km/h, which is 5.4 Volts, in accordance with previous studies. The data in the table also illustrates the average comparison between the results of this study and previous studies, and shows that differences in speed affect the results obtained. The higher the vehicle speed, the greater the voltage produced.

Testing with gear 1 is carried out dynamically, allowing air to flow into the additional body to help rotate the wind turbine while the vehicle is moving. The air flow from the exhaust and vehicle movement is directed optimally, which contributes to the increase in voltage produced by the alternator.

Table 3. Current test with gear 1

Testing	Speed (km/h)	Average Gear 1
1	30	-
2	40	0,07
3	50	0,27
4	60	0,36
5	70	0,43

Based on Table 3, the highest average current from the previous study at a speed of 60 km/h is 0.43A, using gear 1 on the alternator side of the wind turbine. The data shows a comparison of the current between this study and the previous one, with a higher speed of up to 70 km/h proving that the current increases with increasing speed. Dynamic testing allows air to enter the additional body, helping to rotate the wind turbine and increase the current generated by the alternator.

Gear 2 voltage and current test results

Table 4. Voltage test with gear 2

Testing	Speed (km/h)	Average Gear 2
1	30	-
2	40	2,5
3	50	3,2
4	60	4,13
5	70	5,1

Based on Table 4, the highest average voltage from the previous study with gear 2 at a speed of 60 km/h is 4.13 Volts. The data shows a comparison of the results of this study and the previous one, and confirms that the increase in speed is directly proportional to the voltage produced. Dynamic testing allows air to enter the additional body, helping to rotate the wind turbine and increase the voltage from the alternator.

Table 5. Current test with gear 2

Testing	Speed (km/h)	Average Gear 2
1	30	-
2	40	0,05
3	50	0,17
4	60	0,26
5	70	0,40

From Table 5, the highest average current in the previous study with gear 2 at a speed of 60 km/h is 0.43A. The data shows a comparison of the results of this study and the previous one, and proves that increasing the speed to 70 km/h produces a greater current. Dynamic testing allows airflow to enter the additional body, helping the wind turbine rotate more optimally and increasing the alternator current.

Gear 3 voltage and current test results

Table 6. Voltage test with gear 3

Testing	Speed (km/h)	Average Gear 3
1	30	-
2	40	2,5
3	50	3,2
4	60	4,3
5	70	5,3

From Table 6, the highest average voltage with gear 3 at a speed of 60 km/h is 4.3 Volts. The data shows a comparison of this and previous studies, and that increasing speed increases voltage. Dynamic testing allows air to enter the additional body, helping the wind turbine rotate more optimally and increasing the alternator voltage.

Table 7. Current test with gear 3

Testing	Speed (km/h)	Average gear 3
1	30	-
2	40	0,04
3	50	0,17
4	60	0,26
5	70	0,37

From Table 7, the highest average current with gear 3 at a speed of 60 km/h is 0.26 A. The data shows a comparison of this study and the previous one, and that increasing the speed to 70 km/h increases the current. Dynamic testing allows airflow to help the wind turbine rotate more optimally, increasing the alternator current.

Average graph of current and voltage testing

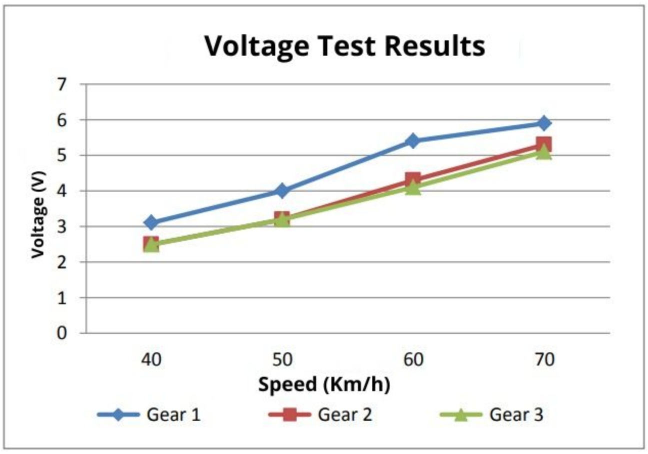

Figure 3. Average result graph of gear 1, gear 2, gear 3 voltage testing

Figure 3 shows that the voltage of gear 1 is higher than gear 2 and 3, with an increase from the previous study. At a speed of 60 km/h, the voltage of gear 1 is 5.9 V, gear 2 5.3

V, and gear 3 5.1 V. Increasing the speed to 70 km/h proves that the voltage increases with increasing speed.

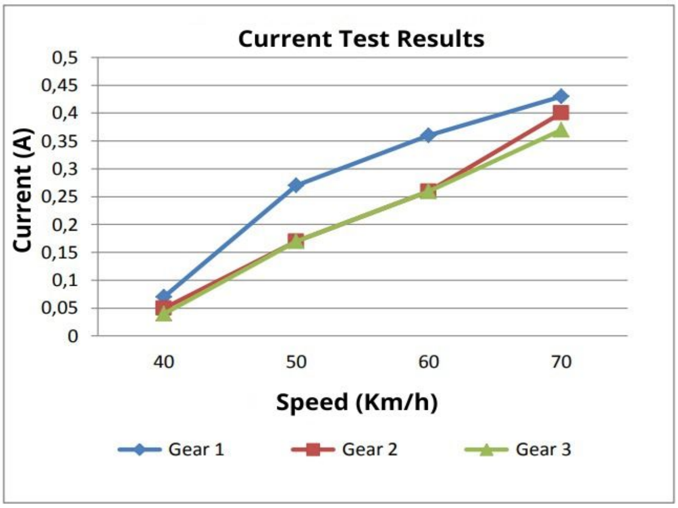

Figure 4. Average result graph of gear 1, gear 2, gear 3 current testing

Based on the combined current Figure 4 on gear 1, gear 2, and gear 3, it can be concluded that the current on gear 1 has a higher value compared to gear 2 and gear 3. In addition, the voltage generated from this treatment shows an increase compared to the results of previous studies. The researchers also compared the voltage results at high or maximum speed, namely at 60 km/h, with the current generated respectively: gear 1 of 0.43 A, gear 2 of 0.40 A, and gear 3 of 0.37 A. In this study, the speed was increased to 70 km/h to prove that the higher the speed, the greater the current generated.

Discussion

From the test results, it can be concluded that the variation of gears on the alternator side of the wind turbine affects the voltage and electric current produced. Compared with the average results of previous studies, there was an increase in voltage and current in the treatment using gears on the alternator side of the wind turbine.

The test was carried out by installing gears alternately. In the first test, gear 1 was installed, and the voltage and current produced on the alternator were measured using a multimeter. Similar steps were taken in the second test with gear 2 and the third test with gear 3, where each measurement was made to determine the voltage and current on the alternator.

The speeds used in the test were 30, 40, 50, and 60 km/h, higher than previous studies which averaged only 60 km/h. In this study, researchers increased the speed to 70 km/h to prove that the higher the speed, the greater the voltage and electric current produced.

In the first test with gear 1, the average measurement results at a maximum speed of 60 km/h were a voltage of 5.4 V and a current of 0.36 A, showing an increase compared to previous studies. The second test with gear 2 showed an average voltage of 4.3 V and a current of 0.26 A, while the third test with gear 3 produced an average voltage of 4.1 V and a current of 0.26 A. From these results, gear 1 proved to be the best gear variation for use at maximum speed, producing a voltage of 5.4 V and a current of 0.36 A at a speed of 60 km/h.

This increase in current and voltage was caused by the installation of gears on the side of the wind turbine alternator, which utilizes the air flow from the exhaust and the speed of the vehicle. The air is directed to rotate the wind turbine faster, so that the alternator can produce higher voltage and current than previous studies. Gear 1 proved to be the most efficient choice in producing electricity at maximum speed.

Conclusion

Research on gear installation shows significant results in increasing voltage and electric current on the alternator side of the wind turbine. Of the three types of gears tested, gear 1 with a gear ratio of 76:49 proved to be the most effective in increasing voltage and current. This is because gear 1 has more teeth, so it is able to produce more optimal rotational acceleration to transfer power. The installation of this gear requires a fairly strong air flow in order to increase rotational acceleration, resulting in greater voltage and current than previous research.

According to the researcher, to prove the increase in voltage and electric current, additional testing was carried out by increasing the vehicle speed to the maximum. In the process of installing the gear combination, proper adjustments are needed so that the measurement results using a multimeter can be optimal. If this research is continued, it is recommended to use gears with a larger size than the gears in the current treatment, so that the voltage and electric current produced by the alternator can be further increased. During the research process, it is highly recommended to involve the help of friends, both to document the testing process via video and to help when the test is carried out while the vehicle is moving.

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