Design and generating energy as a car alternator to be an alternative electricity

S Lubis1,* and Cholish2

1 Department Mechanical Engineering University of Muhammadiyah Sumatera Utara Jl. Kapten Mukhtar Basri, BA No. 3 Postcode: 20238, Medan, Indonesia
2 Department Electrical Engineering University of Muhammadiyah Sumatera Utara Jl. Kapten Mukhtar Basri, BA No. 3 Postcode: 20238, Medan, Indonesia

* Email: sudirmanlubis@umsu.ac.id

Abstract. The alternator is a critical component. The car alternator issued AC electric power by utilizing wind power rotation is then converted into DC electrical power supplied to the accumulator before. Therefore, it is not required of operators to operate the working of the alternator. The voltage generated cells in a standard battery is 2V / cell. However, the working voltage is higher. As is known, in order to drain current through a battery, alternator voltage should be higher than the voltage of the batteries themselves. On the other hand must be maintained so that the voltage is not too high to prevent boiling of (gas) from the batteries. As the voltage regulator safe at 200 °C should be maintained to 2.35 V / cell until 2.4 V / cell. For 12V battery it means that the working voltage of 14.1 V-14.

Keywords: Alternator, accumulator, Voltage

1. Introduction
The power plant can be Replaces like; power generation driven by solar energy, ocean wave energy and wind energy, which are still developed in limited companies. While the power plant can not be Replaces like; Hydroelectric Power Plant (HEPP), Diesel Power Plant (diesel), Gas Power Plant (power plant), Nuclear Power Plant (NPP), and so forth. In fear of this energy progressively reduced. Has done a lot of other possibilities utilization of natural resources, and everything possible could be used to generate electricity. Fulfilments of electric energy in remote areas, not reached by the grid.

Suitable electrical energy and the most efficient is the alternative power generation and solar power generation. This is supported by the location of the state of Indonesia located in the area equator enable the utilization of solar energy to be converted into electrical energy because solar rays shine all year round. From the description above, push research to try to exploit the car’s alternator instead of a generator at power plant alternatives. Through this research will reveal how to use and performance of the car’s alternator existing power plants. With the above-mentioned reasons, Researchers took the title of this research is "Design of Alternator Car for Alternative Electrical Energy Generation". Where electricity is produced from electrical energy conversion process that is commonly used is the engine AC generator, which is the main driving force can be manifold turbine engine, a diesel engine, or propeller engine. In the operation of power plants with a generator, because the reliability fluctuations, load size, then have two or more generators are operated with continuous duty, reserve, and turns to the generator.
2. Literature Review

2.1. Alternator

Car alternator (Figure 1) is a generator that functions as an electric energy supply for electric car needs such as lighting, indicator lights, ignition, fuel injection and electrical equipment other. The alternator has simple construction; the car alternator is some advantages when compared with another electric machine. The advantage is the alternator has not there are sparks between the brush and slip ring brush, as there is no commutator which is effect brushes become worn. More easy rotor and resistant to high rotation, and silicon diode.

![Figure 1. Alternator](image)

2.1.1. Rotor

Rotor (Figure 2) serves to generate a magnetic field. The rotor rotates along the shaft because the movement is called an alternator with a rotating magnetic field. The rotor consists of a core pole (pole cores), field coils, slip ring, shaft, and others. Shaped like a claw pole core and a field coil contained therein.

![Figure 2. Rotor Alternator](image)

Rotor serves to generate a magnetic field. The rotor rotates along the shaft because the movement is called an alternator with a rotating magnetic field. The rotor consists of: a core pole (pole cores), field coils, slip ring, shaft, and others. Shaped like a claw pole core and a field coil contained therein.

2.1.2. Slip ring or sliding ring

This tool from brass or copper which is mounted on the shaft by means of insulating material. This Slip ring rotates together with the shaft (as) and the rotor. Many slip ring No 2 and on each slip ring can shift borstal positive and negative, in order to strengthen Excitation Current to the winding magnet on the rotor.

2.1.3. Diodes (Rectifier)

In the alternator diode or rectifier (Figure 3), the diode has a function to convert the alternating current (AC) produced by the stator coil into direct current (Direct Current). Characteristics of a diode that can only be fed by a current in one direction. So the diode can be used as a current rectifier. In the
conventional type alternator, there are six diodes, three diodes can enter so-called positive diode, and three other diodes is negative.

![Diagram of Diode Rectifier Alternator](image)

**Figure 3.** Diode (Rectifier) Alternator

As we can see in the Figure 3 on the diode circuit alternator, Then it appears that there are two diodes connected in series so that there are three pairs of diodes connected in series. One leg of the diode anode leg on the side of the negative diode coupled to each other and connected with the masses, while the cathode leg on the side of the positive diodes are connected together and also connected to the terminal B. The tip - stator coil is connected with the middle between the pair diode connected in series. It is the nature of the diode used for rectification. In fact function on the direction of P to N, when the voltage is less than a certain value, then the current can not flow. In silicon diodes, these prices usually range between 0.6 to 0.7 volt. When current is already flowing, it will continue to increase in size despite voltage changes almost nothing. The relationship between voltage and current vary, depending on the surrounding temperature. When the temperature rises, the current flows more easily.

2.2. **Working Principle Alternator**

At the time of the magnet (rotor) rotates in the stator coil will arise in the development of tension among both ends of the coil, will provide alternating current raise to. The relationship between the current generated in the coil with a magnet position is as shown in Figure 4. The highest flow will rise at the poles N and S reaches a distance that is closest to the coil. However every half rotation to flow in the opposite direction. Flow to shape sine wave called the "current phase frequently". Amendment 360 on the graph applies to one cycle and the number changes every second that happened called "frequency".

![Diagram of Sine Wave Generation of Alternating Current Phase One](image)

**Figure 4.** Sine Wave Generation of alternating current Phase One

Each coil A, B, and C is 120 °. At the time of the rotating magnetic among them, will rise alternating current at each coil. Figure 2.6 shows the relationship between the three alternating current with a magnet. The electricity has three alternating current is called "alternating current three-phase".
the car's alternator generate an alternating current three-phase. Typically, the components - automobile electrical components using electrical voltage 12 or 24 volt and the alternator's charging system should produce the voltage.

Electricity generated at the time played magnet inside the coil and the amount depends on the speed of rotation of the magnet. So, through a process of electro-magnetic induction, the faster the coil cutting lines of magnetic force bigger coils generate electromotive force. Furthermore, we can see that the voltage varies depending on the speed of rotation of the magnetic. To obtain a fixed voltage, the necessary rotation of the magnetic fixed, this may not be maintained because the machine will spin at speeds that are not fixed in accordance with the driving situation. To overcome this difficulty, in lieu of permanent magnet electro-magnet then used to maintain the voltage in order to remain. Electro magnet, the magnetic lines of force varies according to the alternator rotation.

3. Method
The method used in this research was started from collecting data, tool design and tool manufacture, and analyze. Measurements were made to get the output voltage and current that occurs in the equipment.

3.1. Research methods
The method to be performed in this study are:
1) The measurement results in the form of lists and charts of the gauges and that data can be stored in a computer.
2) The method used in the study with the data value of voltage and current produced equipment and the speed of the alternator.
3) From the measurement results will be seen the value of power measured mainly reactive power and power factor.
4) Analysis of the results of measurements and testing with the load.

3.2. Study Design The Forum
Draft measurement is made by measuring directly on the input and output current output instrument measuring instrument that has been prepared and measurement techniques that do are: 1) measuring voltage and current on tools Alternator; and 2) measuring at normal temperature Alternator tool.

3.3. Implementation of Research
Tests conducted on two conditions, namely cycles before and after the test load and before, housed in the Faculty of Engineering laboratory UMSU Jl. Mukhtar Basri No. 3 Medan.

4. Results and Discussion
The results of this study are the test results before (Table 1) and after the modified alternator (Table 2). From the data obtained the comparative performance of the alternator.

Table 1. Measurement unmodified Alternator

| No. | Alternator speed (RPM) | 1 Phase Voltage (Volt) |
|-----|------------------------|------------------------|
| 1   | 500                    | 2.07                   |
| 2   | 600                    | 2.49                   |
| 3   | 700                    | 2.90                   |
| 4   | 800                    | 3.32                   |
| 5   | 900                    | 3.74                   |
| 6   | 1000                   | 4.15                   |
| 7   | 1100                   | 4.57                   |
Table 1 shows that the measurement results with a wide variety of rotation speed of the alternator is followed by the results of different voltages. This indicates that the voltage is proportional to the rotational speed alternator.

**Table 2. Measurement After Alternator modified**

| No. | Alternator speed (RPM) | 1 Phase Voltage (Volt) |
|-----|------------------------|------------------------|
| 1   | 500                    | 8.15                   |
| 2   | 600                    | 9.03                   |
| 3   | 700                    | 10.48                  |
| 4   | 800                    | 11.36                  |
| 5   | 900                    | 12.23                  |
| 6   | 1000                   | 13.69                  |
| 7   | 1100                   | 14.56                  |

Based on the measurement results 1 phase output voltage of the alternator (Table 2), there are a wide variety followed by increasing the output voltage. On lap 500 rpm is the lowest voltage at the time before the modified, amounting to 2.07 V. The highest were at the time after modified, amounting to 8.11 V. The results of the measurement of the wind turbine and alternator after modifications in the field can be seen in Table 3.

**Table 3. Measurement of the wind turbine and alternator field**

| Hour  | Wind Speed (m / s) | DC voltage (Volt) |
|-------|--------------------|-------------------|
| 07:00 | 1.9                | 2.07              |
| 08:00 | 2.6                | 3.32              |
| 09:00 | 3.5                | 3.74              |
| 10:00 | 3.5                | 3.74              |
| 11:00 | 4.0                | 8.15              |
| 12:00 | 5.8                | 10.15             |
| 13:00 | 6.2                | 12.23             |
| 14:00 | 5.9                | 10.48             |
| 15:00 | 4.3                | 11.36             |
| 16:00 | 4.1                | 8.25              |
| 17:00 | 2.9                | 3.50              |
| 18:00 | 3.8                | 4.55              |

Based on the results of field measurements of the alternator output voltage depending on the speed of the wind that blows in the area Alue Naga wide variety followed by increasing the output voltage of the alternator. At 07:00 the wind speed of 1.9 m / s alternator voltage of 3.59 V. And high output voltage ranging from 11.00 in the amount of 14.11 V. The output voltage alternator achieved the highest time at 12.00 to 15.00 in the amount of 21, 20 V. this indicates that the speed increases as 11.00 till 16.00, so between 11.00 till 16.00 alternator power plants work efficiently. The alternator output voltage is still shaped AC voltage (AC) and should be rectified by the rectifier.

**5. Conclusions**

Horizontal type multiblade wind turbine is suitable for areas that have average wind speed is low. The diameter of the copper wire in the stator with a smaller size will get a larger number of windings than before the alternator is modified, ie from 36 to 108 coil windings on the stator coil. Wind power generation by using horizontal type multiblade windmills that are placed on the shore Alue Naga
works efficiently at 11.00 till 16.00. For further research can be measured by using wind energy. Also recommended for further research to analyze alternative methods of generating wind energy.

References
[1] Ilhamd Fabillo, 2012, “Perancangan Pembangkit Listrik Tenaga Angin Skala Kecil (100va)” Proyek Akhir, Universitas Pendidikan Indonesia.
[2] Adityo Putranto. 2011, “Rancang Bangun Turbin Angin Vertikal Untuk Penerangan Rumah Tangga” Universitas Diponegoro.
[3] Situngkir, P. Putra S, 2011, “Rancang Bangun dan Uji Eksperimental Pengaruh Profil Dan Jumlah Sudu Pada Variasi Kecepatan Angin Terhadap Daya Dan Putaran Turbin Angin Savonius Menggunakan Sudut Pengarah Dengan Luas Sapuan Rotor 0,9 m2”, Universitas Sumatra utara.
[4] Setiono,puji, 2006, “Pemanfaatan Alternator Mobil Sebagai Pembangkit Listrik Tenaga Angin”, Universitas Negeri Malang.
[5] Habibie Ilham, 2012, “Perancangan Ulang Alternator Mobil Menjadi Generator Sinkron Kecepatan Rendah”, Fakultas Teknik Universitas Syiah Kuala Darussalam, Banda.