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A New Technology for Power Generation Based on Kinetic Energy of the Plasma

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Abstract: *The high need of human beings to power sources has always been the main problem in their life. Due to increasing need to energy and limitations of fossil sources and nature pollution from burning these sources, caused researchers to discover new technologies, in order to use different forms of energy and to change it into power energy, with high random magneto hydro dynamics(MHD) is considered as an application plasma energy to produce power energy from kinetic energy of plasma without any turbine or generator .In this paper ,we will discuss about MHD, it's applications and conversion of energy and also about different power stations of MHD and their advantages and disadvantages.*

Keywords: MHD, Power Generation, Energy, Plasma, Magnetic Field.

1. Introduction

The high development of technology science in today's world causes to have more comfort and welfare life [1]. The development of technology science has made it easy to discover new a source is MHD [2]. It makes possible to generate power from kinetic energy of plasma .Basically, the gas in which there has been high value of ionized atoms is known as MHD converter has much lower temperature than the one used in nuclear fusion [3].

In MHD conversion with ionized gas in the electronic field, according to the phenomena known as Faraday, has been seen an induction of electronic field in the vertical direction of fluid field vector and magnetic field vector [4, 5]. In 1831, Faraday was the first one who performed such an experiment by mercury that the researchers of that time discovered that it is possible to conduct gas with ionization.

MHD generators in one circuit have been appeared as an electronic machine [6]. That is, it's possible to use plasma for production of DC energy or conversely to accelerate plasma atoms by DC power .MHD power stations have fewer costs than the stations of nuclear fusion. However, the power generation is much more expensive than in fossil power stations .It has been tried to study and analyze the performance and structure of MHD generators [7].

2. The Performance of MHD Generator

The basis of these generators is that, one electronic load of plasma gas is passed in a powerful magnetic field vertically to separate positive ions and negative electrons and is put on Electrodes. This can be achieved by the following [2]:

$$E = V . B \qquad (1)$$

In which V is the speed vector of plasma and B is the density vector of magnetic flux. This field causes to make circuit in abroad load resistance R_1. The diagram of MHD generator has been shown in Fig. 1.

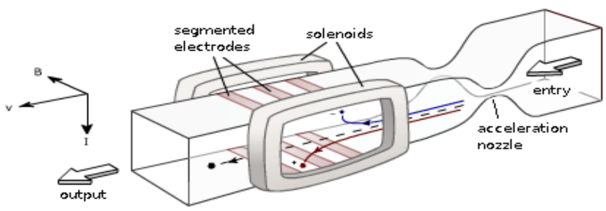

Figure 1: Diagram of MHD generator

The produced circuit of DC generator is to flow the circuit by power inverters of network. If plasma flows in the field, it causes to produce DC power and also to move plasma by DC power [8]. It shows that MHD generator works at direction of both engine and generator. The plasma flux is accelerated negatively by the passage of circuit from plasma and vertical magnetic field and its speed is reduced. The observed force of moving plasma to focus on plasma atoms equals to [9]:

$$F = J.B \tag{2}$$

where J shows the density of plasma circuit and B shows magnetic flux of density vector. This is an inappropriate phenomenon which causes to reduce the produced power [1]. Fig. 2. Shows the forces or plasma atoms in MHD generator.

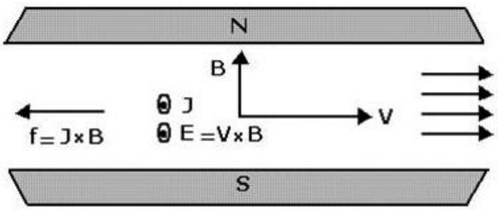

Figure 2: Forces of plasma atoms in MHD generator

3. MHD Generator Production

3.1 The Effective Parameters of MHD Generator Production Value

Fig. 3. shows the arrangement of MHD converter. The inside resistance of plasma gas in MHD generator is known as R_2 and the abroad resistance of circuit is R_1.

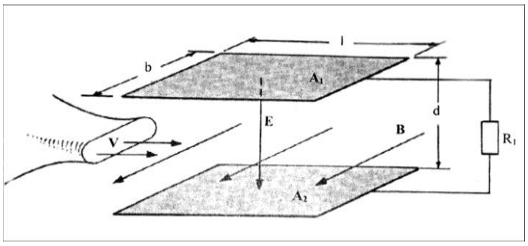

Figure 3: The arrangement of MHD generator

Although there may be potential difference between two electrodes, the generator circuit is calculated by the following formula [6]:

$$I = \frac{U}{R_1 + R_2} \tag{3}$$

Also, the potential difference is achieved by

$$U = V.B.d \tag{4}$$

where *d* is the distance between two electrodes, *V* as the average speed of plasma and B is density of magnetic flux. In the following formula the resistance R_2 depends on the plasma electronic guidance (n), electrode width (b) and electrode length (l):

$$R_2 = \frac{d}{nbl} \tag{5}$$

3.2 The Factors Affecting the Efficiency of Generator

Intensity of magnetic field: According to $\phi = B.A$ If the value of density in magnetic field increases, the value of flux will increase. Therefore, the potential difference between two electrodes has increased and effects on the flow value it is suggested to use super conductors for increasing density of magnetic field [10].

Area and Distance of Electrodes: According to the relation (5), the value of inside resistance in plasma gas can be decreased by distance between two electrodes and increasing their area. The external value of Circuit will be increased by decreasing the resistance R_2 [11].

Speed of Ionized gas: According to the equation (4), if the average speed increases, the voltage and flow value in an outside circuit will be increased. The initial energy of MHD generators is a thermal type which can be produce by the process of burning or nuclear reactions of nuclear reactors [3].

The first step In this generator is to change the thermal movement energy into the direct movement energy. This action is done by the way revealed inside the atoms her. The plasma speed will be calculated by the following formula in case that the temperature of combustion chamber T_1 equals to the decreased temperature in the revealed outlet T_2:,

$$V = \sqrt{2C_t(T_1 - T_2)} \tag{6}$$

where C_t shows the special heat of plasma J/K. T_1 and T_2 are based on K^o According to the relation (6), it is possible to achieve higher speed in combustion chamber by creation of higher thermal temperature [4].

The Effect of Electrical conductivity: If the plasma is ionized more, the value of conductivity will increase .We must perform two actions for ionization:

1) If we don’t have any scientific limitations, we can increase the store temperature that the degree of ionized plasma increases.

2) Adding impure amount with low potential ionization like alkali metals causes conductivity [7].

4. The Types of MHD Generators from the Aspect of Building

We can categorize into different groups according to the manner of electrodes connection with abroad load:

4.1 The Faraday Generator with Continuous Electrodes

The Fig.3 shows this generator. This is the simplest type connected to an abroad load. An electrode with same potential causes the fluid circuit to be vertical on plasma flow. The central component to circuit follows more long direction that causes large losses and also decreases the transverse component of circuit [9]. The diagram of Faraday generator with continuous electrode has been shown in Fig. 4.

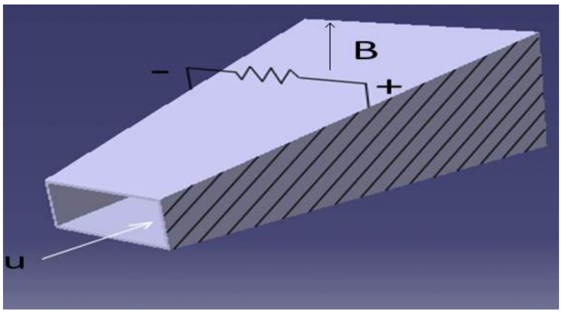

Figure 4: FARADAY generator with continuous electrode

4.2 The Faraday Generator with Discontinuous Electrodes

In this type of generator, we can stop large losses by connecting each of the blade electrodes to an external load. Each of the circuit has different potential difference separately. The Fig. 5 shows this type of generator [8]. The diagram of Faraday generator with continuous electrode has been shown in Fig. 5.

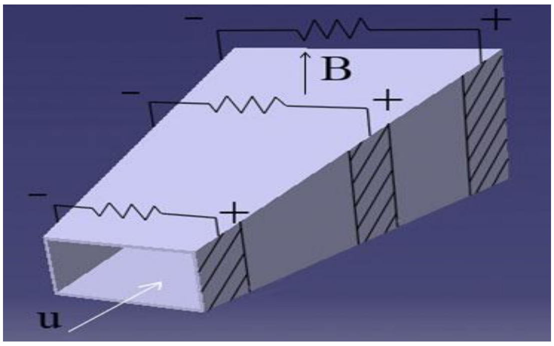

Figure 5: FARADAY generator with discontinuous electrode

4.3 Hull Generator

In this generator, the blade electrodes are shortly connected together and broad load is connected into the initial and last electrodes .The figure (5) shows this kind of generator that the production power is central by electrical circuit and field [11]. The diagram of Hull generator has been shown in Fig. 6.

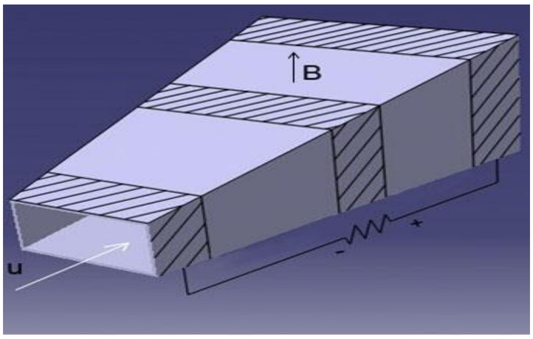

Figure 6: Hull generator

4.1 Series Connections Generator with Discontinuous Electrode

In this generator electrodes have connected to gather diagonally and then load is connected to the initial and last net .It is possible to connect much more loads that may cause some difficulties, but we can control this problem by making some limitations. This problem is possible because the components of X and Y make the resultant that have angle with electrical field. Therefore, it is necessary to insulate the net walls in direction of electrical field [9].The diagram of Series connection of generator with discontinuous electrode has been shown in Fig. 7.

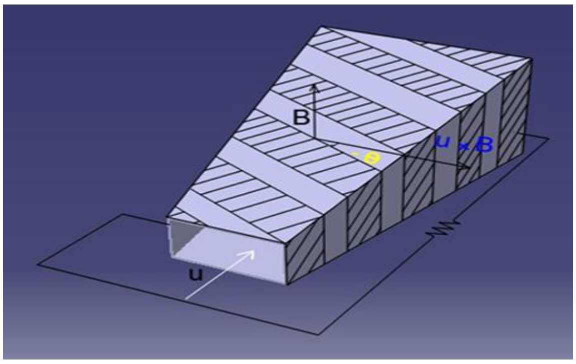

Figure 7: Series Connection of Generator with Discontinuous Electrode

5. The Type of Fluid Cycle in MHD Generator

5.1 Open Cycle

This system includes on MHD generator with a compressor of high temperature. The thermal random has been about 30 percent. The fluid makes the hot clean air by MHD external gas at industrial unit. Such cycle do not need any cooling water for steam distillation and returning heat. The gas leaves the channel actor with the temperature about 1900 C. Continuously, the heat can be pre-given for combustion air and steam is provided in a generator to produce steam in turbine unit. So, system is changed into a compound cycle and the total round is about *60 percent* [10].

5.2 Closed Cycle

In this kind of cycle, two generators are used with the capacity of conductivity resulted of ionization of seed material and fluid metal. The compressed gas expanded by an external source in a thermal converter and MHD generator. Besides the dropping of pressure and temperature, the gas heat is cached by a cooler and then compressed. The MHD generator allows choosing more due to lower temperature but system with open circle has higher thermal round.

6. Comparison of MHD Power Station with Others

MHD generator controllers have simple and cheap mechanisms. The existence of voltage converter causes to increase meant in costs of controlling. Also, there invertors by modern electrical power, as the costs has been rather low. MHD power stations have low effects on the environment due to low levels of contaminants. Distribution of pollution in MHD powerhouse is just from distribution of oxidized gases in MHD cycle into the air that can be removed by recycling and filtration. Flue consumption for these generators can be achieved in every place and it is accessible and also it is possible to use unclear energy for fuel .Besides that, we can produce electrical power about 10000 MW and more in thermal station. In this generator, we time limitation on application due to high temperature and fear of danger from thermal, mechanical and corrosion tensions and also destruction of material properties [1,2] .

7. Conclusion

In this paper, we tried to study the performance of MHD generators and to identify and classify the effective factors on the level of efficiency, with respect to their structure. By comparing MHD power stations with other, we hope to see such industrial generators in our world.

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References

[1] R. Hushmand, *Power generation in stations*, publications of Kerman University, 2010.

[2] S.M. Moghadas, *The sources of power generation in the 21st centure*, publication of Toosi University, 2006.

[3] M.R. Alizade, “The study of generation structure of electrical energy with respect to MHD and its opportunities and difficulties,” *the fourth conference of power stations*, 2008.

[4] N. Kayukawa, “Comparisons of MHD topping combined power generation systems,” *Energy Conversion & Management*, 41, 1953-1974, 2000.

[5] N. Kayukawa, Y. Aoki, K. Ohtake, “MHD/gas turbine/steam turbine triple combined cycle with thermo chemical heat recovery,” *In: The 28th Plasma dynamics and Laser Conference, Atlanta*, AIAA Paper No. 97. p.2370, 1997.

[6] I.O. Marrero, A.M. Lefsaker, A. Razani, K.J. Kim , “ Second law analysis and optimization of a combined triple power cycle,” *Energy Conversion & Management*, 43, 557-573, 2002.

[7] A.L. Polyzakis, C. Koroneos, G. Xydis, “ Optimum gas turbine cycle for combined cycle power plant, *Energy Conversion & Management*,” 49, 551-563, 2008.

[8] A.M. Bassily, “Modeling, numerical optimization, and irreversibility reduction of a dual-pressure reheat combined cycle,” *Applied Energy*, 81, 127-151, 2005.

[9] A.M. Bassily, “Modeling, numerical optimization, and irreversibility reduction of a triple-pressure reheat combined cycle,”, *Energy*, 32, 778-794, 2007.

[10] M.E. Nimvari, A. Hadidi, “Analysis of Triple Combined Cycle with MHD Generator as a Topping Cycle,” *conference on thermal power plants, 2008.*

[11] V.V. Daniela. , “Closed cycle MHD generator with no uniform gas-plasma flow driving recombinated plasma clots formed by high-energy electron beams,” Krasnoyarsk State Univ., Russia ,*ieee international conference .2006 ,*

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