FABRICATION OF MHD POWER GENERATION USING EXHAUST OF VEHICLES

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Abstract--Magneto hydrodynamic power generation provides a way of generating electricity directly from a fast moving stream of ionized gases without the need for any moving mechanical parts no turbines and no rotary generators. MHD power generation process is basically based on the physics background of space plasma. The basic principle is the Faradays Law of electromagnetic induction. In this device plasma (Ionized gas) is the working fluid similar to the mechanism that happening in the magnetosphere of our earth's atmosphere. Except here the process is controlled and fluid density, pressure is increased to get maximum efficiency in the generating power.

High temperature gases at high velocity is passed through a powerful magnetic field and current is generated and extracted by placing electrodes at suitable position in the gas stream and hence the thermal energy of gas is directly converted in to electrical energy. A compact MHD power generator has been designed, fabricated and tested for electric power generation by utilizing the heat from the exhaust of two wheeler engine. The results obtained are promising for future power generation technology.

1 INTRODUCTION

Power generation using hydro, thermal and nuclear resources are widely used. In all the systems, the potential energy or thermal energy is first converted in to mechanical energy and then the mechanical energy is converted into electrical energy. The conversion of potential energy in to mechanical energy is considerably high (70 to 80%) but conversion of thermal energy in to mechanical energy is considerably poor (40 to 45%).In addition to this the mechanical components required for converting heat energy in to mechanical energy are large in number and considerably costly. This requires huge capital cost as well as maintenance cost also. The scientists are thinking to eliminate the mechanical system and convert thermal energy in to direct electrical energy for the last 50-years and more. Unfortunately, no system is yet developed in large capacity (MW) to compete with conventional systems. In addition to this the efficiency of such conversion remained considerably poor(less than10%). Therefore, these power generating systems are not developed on large scale. There are many ways whereby the direct energy conversion of thermal to electrical energy can be obtained. MHD generators are technically practical for fossil fuels, but have been overtaken by other, less expensive technologies, such as combined cycles in which a gas turbines or molten carbonate fuel cell's exhaust heats steam to power a steam turbine. Natural MHD dynamos are an active area of research in plasma physics and are of great interest in the geophysics and astrophysics communities, since the magnetic fields of the earth and sun are produced by these natural dynamos. In the following section the main one, magneto hydrodynamic power generation, is mentioned very briefly to give an overall background picture of the interest in direct conversion.

1.1 MHD CONCEPT

Magneto hydrodynamic (MHD) power generation process is basically based on the physics background of space plasma. The basic principle is the Faradays Law of electromagnetic induction which states that whenever a conductor is placed in a varying magnetic field an emf is induced which is called induced emf, if the conductor circuit is closed and the current which is induced is called induced current. In this device plasma (Ionized gas) is the working fluid similar to the mechanism that happening in the magnetosphere of our earth's atmosphere. Except here the process is controlled and we increase the fluid density and pressure to get maximum efficiency in the generating power. Most problems come from the low conductivity feature in the gas at high temperature. High temperature gaseous conductor at high velocity is passed through a powerful magnetic field and a current is generated and extracted by placing electrodes at suitable position in the gas stream, and hence the thermal energy of gas is directly converted in to electrical energy.

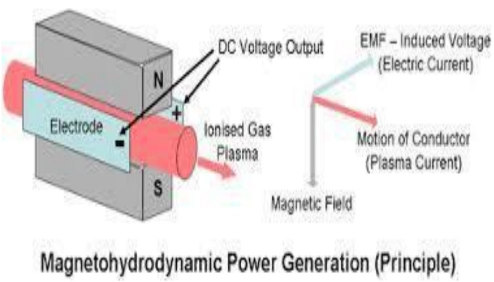

Figure 1.1 Principle of MHD Power Generation

1.2 HISTORICAL BACKGROUND

The development of commercial MHD (magnetohydrodynamic) power plants has come a long way, from the first MHD experiment by Michael Faraday at the River Thames in 1832 to
the present day efforts towards early commercialization. The concept of MHD power generation was introduced for the very first time by Michael Faraday in the year 1832 in his Bakerian lecture to the Royal Society. He in fact carried out an experiment at the Waterloo Bridge in Great Britain for measuring the current, from the flow of the river Thames in earth's magnetic field. Hannes Alfven ,a Swedish electrical engineer and plasma physicist was the first to term the name "Magneto Hydrodynamics "for which he was awarded the Noble Peace Prize in 1970.The official birth of incompressible fluid dynamics was during the years 1936 and 1937 when Hartmann and Lazarus performed theoretical and experimental MHD flow in ducts. Over these years, development of MHD technology has seen many ups and downs. The most appropriate name for the phenomena would be "Magneto Fluid Mechanics" but Magneto Hydrodynamics is generally used. Toward the end of the 1960s, interest in MHD declined because nuclear power was becoming more widely available. In the late 1970s, as interest in nuclear power declined, interest in MHD increased. In 1975, UNESCO became persuaded the MHD might be the most efficient way to utilize world coal reserves, and in 1976, sponsored the ILG-MHD. In 1976, it became clear that no nuclear reactor in the next 25 years would use MHD. The Japanese program in the late 1980s concentrated on closed-cycle MHD. The belief was that it would have higher efficiencies, and smaller equipment, especially in the clean, small, economical plant capacities near 100 megawatts (electrical) which are suited to Japanese conditions. Open-cycle coal-powered plants are generally thought to become economical above 200 megawatts. Interest in MHD power generation was originally stimulated by the observation that the interaction of a plasma with a magnetic field could occur at much higher temperatures than were possible in a rotating mechanical turbine. The limiting performance from the point of view of efficiency in heat engines was established early in the 19th century by the French engineer Sadi Carnot. The Carnot cycle, which establishes the maximum theoretical efficiency of a heat engine, is obtained from the difference between the hot source temperature and the cold sink temperature, divided by the source temperature. Allowing for the inefficiencies introduced by finite heat transfer rates and component inefficiencies in real heat engines, a system employing an MHD generator offers the potential of an ultimate efficiency in the range of 60 to 65 percent. This is much better than the 35 to 40 percent efficiency that can be achieved in a modern conventional plant. In addition, MHD generators produce fewer pollutants than conventional plants. However, the higher construction costs of MHD systems have limited their adoption.

1.3 POWER GENERATION USING MHD

Magneto hydrodynamic power generation provides a way of generating electricity directly from a fast moving stream of ionized gases without the need for any moving mechanical parts - no turbines and no rotary generators. Several MHD projects were initiated in the 1960s but overcoming the technical challenges of making a practical system proved very expensive. Interest consequently waned in favor of nuclear power which since that time has seemed a more attractive option.

MHD power generation has also been studied as a method for extracting electrical power from nuclear reactors and also from more conventional fuel combustion system. The MHD generator can be considered to be a fluid dynamo. This is similar to a mechanical dynamo in which the motion of a metal conductor through a magnetic field creates a current in the conductor except that in the MHD generator the metal conductor is replaced by conducting gas plasma.
When a conductor moves through a magnetic field it creates an electrical field perpendicular to the magnetic field and the direction of movement of the conductor. This is the principle, discovered by Michael Faraday, behind the conventional rotary electricity generator. Dutch physicist Antoon Lorentz provided the mathematical theory to quantify its effects. The flow (motion) of the conducting plasma through a magnetic field causes a voltage to be generated (and an associated current to flow) across the plasma, perpendicular to both the plasma flow and the magnetic field according to Fleming's Right Hand Rule.

Lorentz Law describing the effects of a charged particle moving in a constant magnetic field can be stated as

$F = QvB$

Where

F is the force acting on the charged particle

Q is charge of particle

v is velocity of particle

B is magnetic field

2. COMPONENTS

The components that are used in the project MHD POWER GENERATION FOR TWO WHEELER are as follows,

- Battery,
- Aluminium Oxide,

• Copper electrodes,

• Magnets,

• Circuit Board with LCD

• Engine with Frame

• Sheet Metal

2.1 BATTERIES

In isolated systems away from the grid, batteries are used for storage of excess solar energy converted into electrical energy. The only exceptions are isolated sunshine load such as irrigation pumps or drinking water supplies for storage. In fact for small units with output less than one kilowatt. Batteries seem to be the only technically and economically available storage means. Since both the photo-voltaic system and batteries are high in capital costs. It is necessary that the overall system be optimized with respect to available energy and local demand pattern. To be economically attractive the storage of solar electricity requires a battery with a particular combination of properties.

(1) Low cost
(2) Long life
(3) High reliability
(4) High overall efficiency
(5) Low discharge
(6) Minimum maintenance
(A) Ampere hour efficiency
(B) Watt hour efficiency

We use lead acid battery for storing the electrical energy from the solar panel for lighting the street and so about the lead acid cells are explained below.

2.2ALUMINIUM OXIDE

Aluminium oxide is a chemical compound of aluminium and oxygen with the chemical formula Al2O3. It is the most commonly occurring of several aluminium oxides, and specifically identified as aluminium (III) oxide. It is commonly called alumina and may also be called aloxide, aloxite, or alundum depending on particular forms or applications. It occurs naturally in its crystalline polymorphic phase α-Al2O3 as the mineral corundum, varieties of which form the precious gemstones ruby and sapphire. Al2O3 is significant in its use to produce aluminium metal, as an abrasive owing to its hardness, and as a refractory material owing to its high melting point.

2.3 COPPER ELECTRODES

• The copper–copper(II) sulfate electrode is a reference electrode of the first kind, based on the redox reaction with participation of the metal (copper) and its salt, copper(II) sulfate. It is used for measuring electrode potential and is the most commonly used reference electrode for testing cathode protection corrosion control systems. The corresponding equation can be presented as follow:

• $Cu^{2+} + 2e^- \rightarrow Cu^0$(metal)

• This reaction characterized by reversible and fast electrode kinetics, meaning that a sufficiently high current can be passed through the electrode with the 100% efficiency of the redox reaction (dissolution of the metal or cathodicde position of the copper-ions).The Nernst equation below shows the dependence of the potential of the copper-
copper (II) sulfate electrode on the activity or concentration copper-ions.

• Commercial reference electrodes consist of a plastic tube holding the copper rod and saturated solution of copper sulfate. A porous plug on one end allows contact with the copper sulfate electrolyte. The copper rod protrudes out of the tube.

• A voltmeter negative lead is connected to the copper rod. The potential of a copper sulfate electrode is +0.314 volt with respect to the standard hydrogen electrode. Copper–copper (II) sulfate electrode is also used as a one of the half cells in the Daniel-Jakobi galvanic cell.

2.4 MAGNETS

• A magnet is a material or object that produces a magnetic field. This magnetic field is invisible but is responsible for the most notable property of a magnet a force that pulls on other ferromagnetic materials, such as iron, and attracts or repels other magnets.

•A permanent magnet is an object made from a material that is magnetized and creates its own persistent magnetic field. An everyday example is a refrigerator magnet used to hold notes on a refrigerator door. Materials that can be magnetized are also the ones that are strongly attracted to a
magnet, are called ferromagnetic (or ferrimagnetic).

•These include iron, nickel, cobalt, some alloys of rare earth metals, and some naturally occurring minerals such as lodestone. Although ferromagnetic materials are the only ones attracted to a magnet strongly enough to be commonly considered magnetic, all other substances respond weakly to a magnetic field, by one of several other types of magnetism.

•Ferromagnetic materials can be divided into magnetically "soft" materials like annealed iron, which can be magnetized but do not tend to stay magnetized, and magnetically "hard" materials, which do. Permanent magnets are made from "hard" ferromagnetic materials such as alnico and ferrite that are subjected to special processing in a powerful magnetic field during manufacture, to align their internal microcrystalline structure, making them very hard to demagnetize.

•An electromagnet is made from a coil of wire that acts as a magnet when an electric current passes through it but stops being a magnet when the current stops. Often, the coil is wrapped around a core of "soft" ferromagnetic material such as steel, which greatly enhances the magnetic field produced by the coil .The overall strength of a magnet is measured by its magnetic moment or, alternatively, the total magnetic flux it produces. The local strength of magnetism in a material is measured by its magnetization.

2.5 CIRCUIT BOARD WITH LCD

The PIC microcontroller PIC16f877a is one of the most renowned microcontrollers in the industry. This controller is very convenient to use, the coding or programming of this controller is also easier. One of the main advantages is that it can be write-erase as many times as possible because it use FLASH memory technology. It has a total number of 40 pins and there are 33 pins for input and output. PIC16F877A is used in many PIC16F877A also have many application in digital circuits. As it has been mentioned before, there are 40 pins of this microcontroller IC. It consists of two 8 bit and one 16 bit timer. Capture and compare modules, serial ports, parallel ports and five input/output ports are also present in it.

The present chapter introduces the operation of power supply circuits built using filters, rectifiers, and then voltage regulators. Starting with an ac voltage, a steady dc voltage is obtained by rectifying the ac voltage, then filtering to a dc level, and finally, regulating to obtain a desired fixed dc voltage. The regulation is usually obtained from an IC voltage regulator unit, which takes a dc voltage and provides a somewhat lower dc voltage, which remains the same even if the input dc voltage varies, or the output load connected to the dc voltage changes.

A block diagram containing the parts of a typical power supply and the voltage at various points in the unit. The ac voltage, typically 120 V rms, is connected to a transformer, which steps that ac voltage down to the level for the desired dc output.
A diode rectifier then provides a full-wave rectified voltage that is initially filtered by a simple capacitor filter to produce a dc voltage. This resulting dc voltage usually has some ripple or ac voltage variation. A regulator circuit can use this dc input to provide a dc voltage that not only has much less ripple voltage but also remains the same dc value even if the input dc voltage varies somewhat, or the load connected to the output dc voltage changes.

This voltage regulation is usually obtained using one of a number of popular voltage regulator IC units.

2.6 ENGINE WITH FRAME

The engine is a 4 stroke Hero Honda 100 cc engine. Fuel economy is better in four-strokes due to more complete combustion of the intake charge in four-stroke engines. It is an air cooled engine with 97.2 cc displacement. The maximum power produced by it is 6.15 kW at 8000 rpm and the maximum torque developed is 8.05 Nm at 5000 rpm. The bore is 50 mm in diameter and the stroke is 49.5 mm long. Compression ratio is 9.9:1 and it is started by kick.

Fuel is injected using carburetor from the fuel tank kept on the frame. The frame is made by steel with 1 inch width. It is cut, welded to form the appropriate structure in which the engine rests.

2.7 SHEET METAL

Sheet metal is metal formed by an industrial process into thin, flat pieces. Sheet metal is one of the fundamental forms used in metalworking and it can be cut and bent into a variety of shapes. Countless everyday objects are fabricated from sheet metal. Thicknesses can vary significantly; extremely thin sheets are considered foil or leaf, and pieces thicker than 6 mm (0.25 in) are considered plate steel or "structural steel."

Sheet metal used is Grade 3003-H14 which is formable and is economical. It is corrosion resistant and weldable. It is cut into 4 trapeziums of same dimensions and is welded together to form a tapered structure exhaust which increases the velocity of exhaust gases.

Sheet metal manufacture is mostly performed on a press and parts are formed between two die. The top die is called a punch. Sometimes sheet metal parts are referenced to as stampings. Parts are usually economical and easy to mass produce. Sheet metal is usually formed cold, however warm or hot working of parts, (particularly plate), is possible. Generally for sheet metal applications there is essentially no change, or negligible change, in sheet thickness. For some processes like deep drawing, there is a slight and expected change in thickness, but this may also be neglected in most cases. Sheet metal manufacturing produces parts that typically have high strength, good surface and accurate tolerances.

3. METHODOLOGY

Manufacturing processes are the steps through which raw materials are transformed into a final product. The manufacturing process begins with the creation of the materials from which the design is made. These materials are then modified through manufacturing processes to become the required part. Manufacturing processes can include treating (such as heat treating or coating), machining, or reshaping the material. The manufacturing process also includes tests and checks for quality assurance during or after the manufacturing, and planning the production process prior to manufacturing.

3.1 METAL CUTTING

Metal cutting or machining is the process of by removing unwanted material from a block of metal in the form of chips.

Cutting processes work by causing fracture of the material that is processed. Usually, the portion that is fractured away is in small sized pieces, called chips. Common cutting processes include sawing, shaping (or planning), broaching, drilling, grinding, turning and milling. Although the actual machines, tools and processes for cutting look very different from each other, the basic mechanism for causing the fracture can be understood by just a simple model called for orthogonal cutting.

In all machining processes, the work piece is a shape that can entirely cover the final part shape. The objective is to cut away the excess material and obtain the final part. This cutting usually requires to be completed in several steps – in each step, the part is held in a fixture, and the exposed portion can be accessed by the tool to machine in that portion. Common fixtures include vice, clamps, 3-jaw or 4-jaw chucks, etc. Each position of holding the part is called a setup. One or more cutting operation may be performed, using one or more cutting tools, in each setup. To switch from one setup to the next, we must release the part from the previous fixture, change the fixture on the machine, clamp the part in the new position on the new fixture, set the coordinates of the machine tool with respect to the new location of the part, and finally start the machining operations for this setup.

Therefore, setup changes are time-consuming and expensive, and so we should try to do the entire cutting process in a minimum number of setups; the task of determining the sequence of the individual operations, grouping them into (a minimum number of) setups, and determination of the fixture used for each setup, is called process planning.

These notes will be organized in three sections:

(i)Introduction to the processes,

(ii)The orthogonal cutting model and tool life optimization and
(iii) Process planning and machining planning for milling.

3.2 SAWING

Cold saws are saws that make use of a circular saw blade to cut through various types of metal, including sheet metal. The name of the saw has to do with the action that takes place during the cutting process, which manages to keep both the metal and the blade from becoming too hot. A cold saw is powered with electricity and is usually a stationary type of saw machine rather than a portable type of saw.

The circular saw blades used with a cold saw are often constructed high speed steel. Steel blades of this type are resistant to wear even under daily usage. The end result is that it is possible to complete a number of cutting projects before there is a need to replace the blade. High speed steel blades are especially useful when the saws are used for cutting through thicker sections of metal.

Along with the high speed steel blades, a cold saw may also be equipped with a blade that is tipped with tungsten carbide. This type of blade construction also helps to resist wear and tear. One major difference is that tungsten tipped blades can be re-sharpened from time to time, extending the life of the blade. This type of blade is a good fit for use with sheet metal and other metallic components that are relatively thin in design.

3.3 WELDING

Welding is a process for joining similar metals. Welding joins metals by melting and fusing, the base metals being joined and, the filler metal applied. Welding employs pinpointed, localized heat input. Most welding involves ferrous-based metals such as steel and stainless steel. Weld joints are usually stronger than or as strong as the base metals being joined.

Welding is used for making permanent joints. It is used in the manufacture of automobile bodies, aircraft frames, railway wagons, machine frames, structural works, tanks, furniture, boilers, general repair work and ship building.

OPERATION

Several welding processes are based on heating with an electric arc, only a few are considered here, starting with the oldest, simple arc welding, also known as shielded metal arc welding (SMAW) or stick welding. In this process an electrical machine (which may be DC or AC, but nowadays is usually AC) supplies current to an electrode holder which carries an electrode which is normally coated with a mixture of chemicals or flux. An earth cable connects the work piece to the welding machine to provide a return path for the current. The weld is initiated by tapping ('striking') the tip of the electrode against the work piece which initiates an electric arc. The high temperature generated (about 6000oC) almost instantly produces a molten pool and the end of the electrode continuously melts into this pool and forms the joint.

The operator needs to control the gap between the electrode tip and the work piece while moving the electrode along the joint.

In the shielded metal arc welding process (SMAW) the 'stick' electrode is covered with an extruded coating of flux. The heat of the arc melts the flux which generates a gaseous shield to keep air away from the molten pool and also flux ingredients react with unwanted impurities such as surface oxides, creating a slag which floats to the surface of the weld pool. This forms a crust which protects the weld while it is cooling. When the weld is cold the slag is chipped off.

The SMAW process cannot be used on steel thinner than about 3mm and being a discontinuous process it is only suitable for manual operation. It is very widely used in jobbing shops and for onsite steel construction work. A wide range of electrode materials and coatings are available enabling the process to be applied to most steels, heat resisting alloys and many types of cast iron.

3.4 DRILLNG

Drilling is a cutting process that uses a drill bit to cut or enlarge a hole of circular cross-section in solid materials. The drill bit is a rotary cutting tool, often multipoint. The bit is pressed against the work piece and rotated at rates from hundreds to thousands of revolutions per minute. This forces the cutting edge against the work piece, cutting off chips (swarf) from the hole as it is drilled.

OPERATION

The geometry of the common twist drill tool (called drill bit) is complex; it has straight cutting teeth at the bottom – these teeth do most of the metal cutting, and it has curved cutting teeth along its cylindrical surface. The grooves created by the helical teeth are called flutes, and are useful in pushing the chips out from the hole as it is being machined. Clearly, the velocity of the tip of the drill is zero, and so this region of the tool cannot do much cutting. Therefore it is common to machine a small hole in the material, called a center-hole, before utilizing the drill. Center-holes are made by special drills called center-drills; they also provide a good way for the drill bit to get aligned with the location of the center of the hole. There are hundreds of different types of drill shapes and sizes; here, we will only restrict ourselves to some general facts about drills.

Common drill bit materials include hardened steel (High Speed Steel, Titanium Nitride coated steel); for cutting harder materials, drills with hard inserts, e.g. carbide or CBN inserts, are used.

In general, drills for cutting softer materials have smaller point angle, while those for cutting hard and brittle materials have larger point angle.

If the Length/Diameter ratio of the hole to be machined is large, then we need a special guiding support for the drill, which itself has to be very long; such operations are called gun-drilling. This process is used for holes with diameter of few mm or more, and L/D ratio up to 300. These are used for making barrels of guns.

Drilling is not useful for very small diameter holes (e.g. < 0.5 mm), since the tool may break and get stuck in the work piece; - Usually, the size of the hole made by a drill is slightly larger than the measured diameter of the drill – this is mainly because of vibration of the tool spindle as it rotates, possible misalignment of the drill with the spindle axis, and some other factors.

For tight dimension control on hole diameter, we first drill a hole that is slightly smaller than required size (e.g. 0.25 mm smaller), and then use a special type of drill called a reamer. Reaming has very low material removal rate, low depth of cut, but gives good dimension accuracy.

3.5 INSPECTION

Critical appraisal involving examination, measurement, testing, gauging, and comparison of materials or items. An inspection determines if the material or item is in proper quantity and condition, and if it conforms to the applicable or specified requirements. Inspection is generally divided into three categories: (1) Receiving inspection, (2) In-process inspection, and (3) Final inspection. In quality control (which is guided by the principle that "Quality cannot be inspected into a product") the role of inspection is to verify and validate the variance data; it does not involve separating the good from the bad.

3.6 ASSEMBLY

An assembly line is a manufacturing process (most of the time called a progressive assembly) in which parts (usually interchangeable parts) are added as the semi-finished assembly moves from work station to work station where the parts are added in sequence until the final assembly is produced. By mechanically moving the parts to the assembly work and moving the semi-finished assembly from work station to work station, a finished product can be assembled much faster and with much less labor than by having workers carry parts to a stationary piece for assembly.

4 CONCEPTS AND THEORIES

The MHD generator can be considered to be a fluid dynamo. This is similar to a mechanical dynamo in which the motion of a metal conductor through a magnetic field creates a current in the conductor except that in the MHD generator the metal conductor is replaced by conducting gas plasma.

When a conductor moves through a magnetic field it creates an electrical field perpendicular to the magnetic field and the direction of movement of the conductor. This is the principle, discovered by Michael Faraday, behind the conventional rotary electricity generator. Dutch physicist Antoon Lorentz provided the mathematical theory to quantify its effects.

The flow (motion) of the conducting plasma through a magnetic field causes a voltage to be generated (and an associated current to flow) across the plasma, perpendicular to both the plasma flow and the magnetic field according to Fleming's Right Hand Rule. Therefore, in this process, substantial fuel economy can be achieved due to the elimination of the link process of producing mechanical energy and then again converting it to electrical energy.

As the name implies, the magneto hydro dynamics generator is concerned with the flow of a conducting fluid in the presence of magnetic and electric fields. In conventional generator or alternator, the conductor consists of copper windings or strips while in an MHD generator the hot ionized gas or conducting fluid replaces the solid conductor.

A pressurized, electrically conducting fluid flows through a transverse magnetic field in a channel or duct. Pair of electrodes are located on the channel walls at right angle to the magnetic field and connected through an external circuit to deliver power to a load connected to it. Electrodes in the MHD generator perform the same function as brushes in a conventional DC generator. The MHD generator develops DC power and the conversion to AC is done using an inverter.

The power generated per unit length by magneto hydro dynamic power generation is approximately given by the following formula

$$P = \frac{\sigma u B^2}{P}$$

Where, u is the fluid velocity, B is the magnetic flux density, σ is the electrical conductivity of conducting fluid and P is the density of fluid.

It is evident from the equation above that for the higher power density of an MHD generator there must be a strong magnetic field of 4-5 tesla and high flow velocity of conducting fluid besides adequate conductivity.

MHD Cycles and Working Fluids

The MHD cycles can be of two types, namely

1. Open Cycle MHD.

2. Closed Cycle MHD.

The detailed account of the types of MHD cycles and the working fluids used, are given below.

Open Cycle MHD System

In open cycle MHD system, atmospheric air at very high temperature and pressure is passed through the strong magnetic field. Coal is first processed and burnet in the combustor at a high temperature of about 2700oC and pressure about 12 ATP with pre-heated air from the plasma. Then a seeding material such as potassium carbonate is injected to the plasma to increase the electrical conductivity. The resulting mixture having an electrical conductivity of about 10 Siemens/m is expanded through a nozzle, so as to have a high velocity and then passed through the magnetic field of MHD generator. During the expansion of the gas at high temperature, the positive and negative ions move to the electrodes and thus constitute an electric current. The gas is then made to exhaust through the generator. Since the same air cannot be reused again hence it forms an open cycle and thus is named as open cycle MHD.

Closed Cycle MHD System

As the name suggests the working fluid in a closed cycle MHD is circulated in a closed loop. Hence, in this case inert gas or liquid metal is used as the working fluid to transfer the heat. The liquid metal has typically the advantage of high electrical conductivity, hence the heat provided by the combustion material need not be too high. Contrary to the open loop system there is no inlet and outlet for the atmospheric air. Hence, the process is simplified to a great extent, as the same fluid is circulated time and again for effective heat transfer.

Advantages of MHD Generation

The advantages of MHD generation over the other conventional methods of generation are given below.

1. Here only working fluid is circulated, and there are no moving mechanical parts. This reduces the mechanical losses to nil and makes the operation more dependable.

2. The temperature of working fluid is maintained by the walls of MHD.

3. It has the ability to reach full power level almost directly.

4. The price of MHD generators is much lower than conventional generators.

5. MHD has very high efficiency, which is higher than most of the other conventional or non-conventional method of generation.

5 CONCLUSION

MHD power generation is elegantly simple technique. Magneto Hydro Dynamics (magneto-fluid dynamics) is the academic discipline which studies the dynamics of electrically conducting fluids. Since there are no moving parts in this type of power generation the energy losses associated with the working is very low when compared to the working in large scale thermal power plants. The cost associated with implementing this type of technology depends only on modifying the exhaust of the two wheeler vehicles so as to accommodate efficient electrical power generation while also not affecting the driving capabilities of the two wheeler vehicles. This can be implanted in the day to day life of life of those who own two wheeler vehicles and also in heavy vehicles and other transporting machineries.

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