INTRODUCTION

It is well known that man had always been trying to fined something new to achieve a new aims 80% of total electricity produced in the world is hydral while remaining 20% is produced from nuclear, thermal, solar, Geothermal energy and from magneto hydro dynamic power generation.

MHD power generation is a new system of electric power generation which is said to be of high efficiency and low pollution. In advanced countries MHD generator are widely used but in developing countries like India it is still under construction. This construction work is in progress at Tiruchirapalli in Tamilnadu unders joint efforts of BARC (Bhabha Atomic Research Centre), BHEL, Associated cement corporation and Russian technologists.

As its name implies, magneto-hydro-dynamic (MHD) is concerned with the flow of conducting fluid in presence of magnetic and electric field. This fluid may be gas at elevated temperature or liquid metal like sodium or potassium. A MHD generator is a device for converting heat energy of fuel directly into electric energy without a conventional electric generator. The basic difference between conventional generator and MHD generator is in the nature of conductor.

PRINCIPLE OF MHD POWER GENERATION

The principle of MHD generation is simple, discovered by faraday when an electric conductor moves across a magnetic field, a emf. Is induced in it, which produced an electric current. This is the principle of the conventional generator also, where the conductors consists of copper strips. In MHD generator the solid conductors are replaced by a gaseous conductor; i.e. an ionized gas. If such gas is passed at high velocity through a powerful magnetic field, i.e. suppose we have a charged particle (having charge q) moving at a high velocity 'V' towards right and a perpendicular magnetic field is applied. A magnetic force 'F' acts on the charged particle. Show in fig. A Positively charged particles as forced upward and negatively charged particle is forced downward.

The positive ions would be accelerated towards the upper plate P, and negative ions would be accelerated towards the plate P_2 . If the P_1 and P_2 are externally connected through a resistance, a current would flow through the resistance. Thus gas energy directly converted into electrical energy. This is the principle of MHD generator. A MHD conversion is known as direct energy conversion because it produced electricity directly from heat source without the necessity of the additional stage of steam generation as in a steam power plant.

The developed view of an MHD channel in show in fig.

MHD SYSTEM

There are two types of MHD System

1.) Open cycle System

2.) Closed cycle System

In open cycle system the working fluid after generating electrical energy is discharged to the atmosphere through a stack. In a closed cycle system the working fluid is recycled to the heat sources and thus used again and again. The operation of MHD generator directly on combustion products in an open cycle system. In open cycle system working fluid is air. In closed cycle system helium or argon is used as the working fluid.

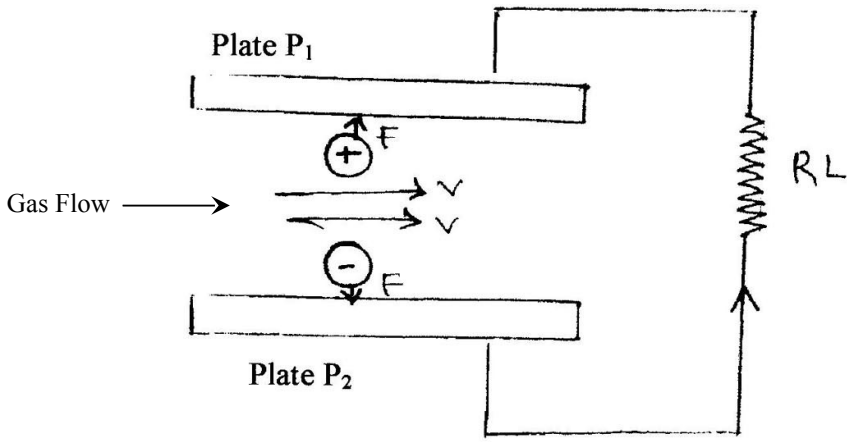
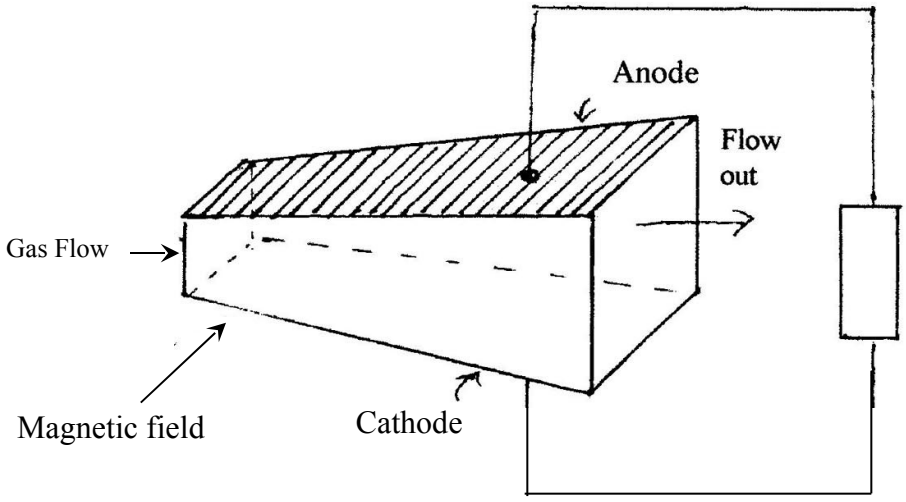


Plate P_1
F
Gas Flow
V
V
F
Plate P_2
RL

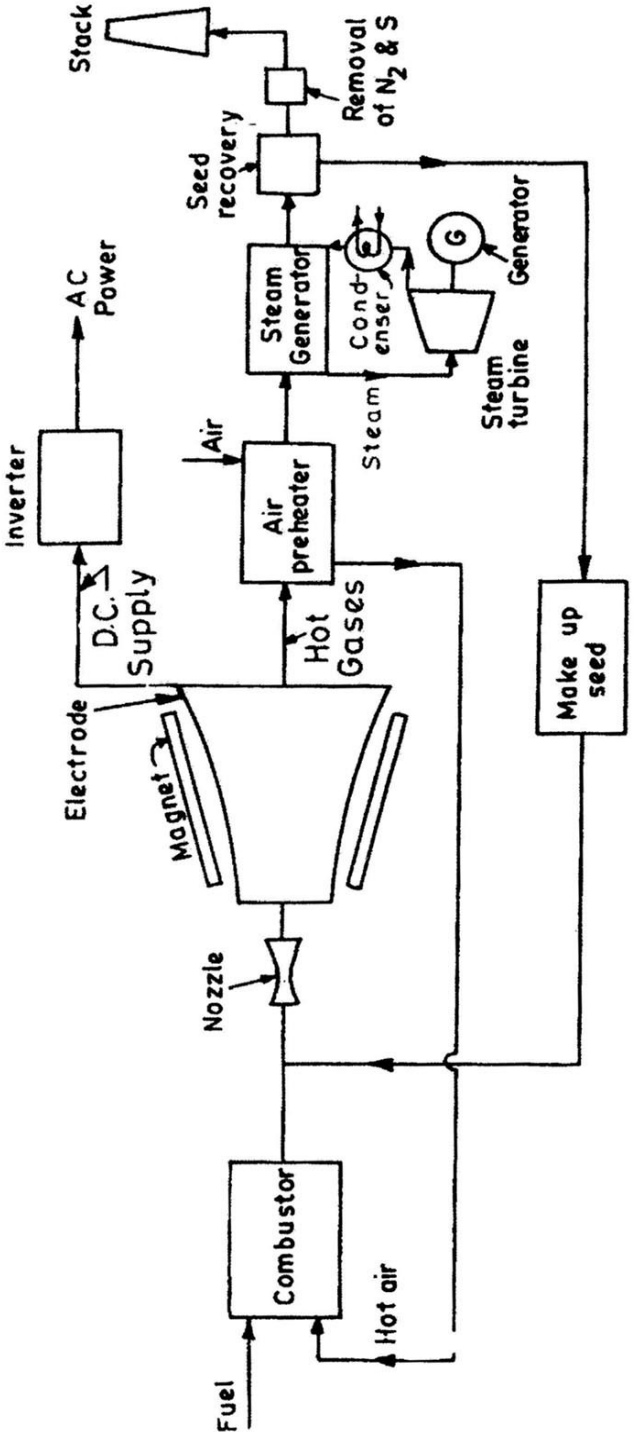

Anode
Flow
out
Gas Flow
Magnetic field
Cathode

OPEN CYCLE MHD SYSTEM

An elementary open cycle MHD system, is shown in fig. The MHD generator resembles a rocket engine surrounded by a magnet the coal is burnt to produced hot gas. The hot gas is then seeded with a small amount of an ionized alkali metal (cesium or potassium) to increase the electrical conductivities of gas. The gas expand through the generator surrounded by powerful magnet. During the motion of gas the positive and negative ions move to the electrodes and constitute an electric current. The rejected gas passes through an air heater for preheating the inlet air. The seed material is recovered for successive use. The nitrogen and sulphur are remove for pollution controlled and then gasses are discharged to the atmosphere.

The above cycle is not suitable for commercial use. The exhaust gases of MHD unit are still at a sufficiently hot temperature it is possible to use for additional power generation in a steam turbine alternator unit. This is increase the efficiency of process. Such cycle is known as hybrid MHD-steam plant cycle.

Figure shows hybrid MHD steam cycle, coal is processed and burnt in the combustor at high temperature (2750 to 3000 °K) and pressure (7 to 15 at atmosphere). With preheated air to form the plasma. The plasma is then seeded with small fraction (1%) of an alkali metal (potassium) introduced usually as a carbonate powder or solution.



Schematic of an open cycle MHD Generators.

HYBRID MHD STEAM PART OPEN CYCLE

The resulting mixture having an electrically conductivity of about 10 ohm/m is expanded through a nozzle to increase its velocity and then

passed through the high magnetic field (5 to 7 teslas) of the MHD generator. Electrodes channel provided electric contact between flow and external load. The power o/p is dc and it is necessary to use to change it to ac before the power can be fed to an electric grid.

The gas coming out of MHD generator is still sufficiently hot and is used to raise steam, which generates additional energy in a steam in a steam turbine alternator unit. A part of this steam is also used in a steam turbine which driver a compressor for compressing air for the MHD cycle. The seed material is recovered from the gas the harmful emissions (sulphur) are also removed from gas before it is discharged to atmosphere through a stack. For efficient practical realization a MHD system must have following features:

1) Air superheating arrangement to heat the gas to around 2500 °C so that the electrical conductivity gas is increased.
2) The combustion chamber must have low heat losses
3) A management to add a low ionization potential seed material to the gas to increase, its conductivity.
4) A water cooled but electrically insulating expanding dust with long life electrodes.
5) A magnet capable of producing high magnetic flux density.
6) Seed recovery apparatus necessary for both environmental and economics reasons.

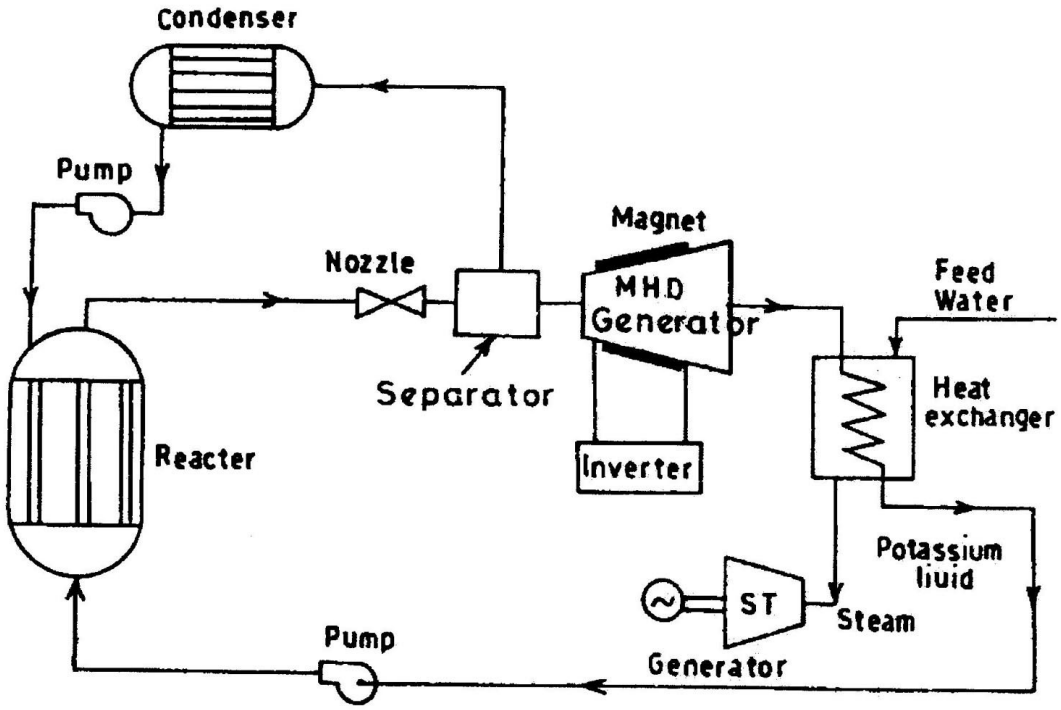
CLOSED CYCLE MHD SYSTEM

The closed cycle inert gas MHD system was conceived 1965. The main disadvantages of the open cycle system is very high

temperature requirement and a very chemically active flow could be removed, by closed cycle MHD system. As the name suggests the working fluid in closed cycle, is circulated in a closed loop. The working fluid is helium or argon with cesium seeding. Figure show a closed cycle MHD system. The complete system has three distinct but interlocking loops. On the left is the external heating loop, coal is gasified and the gas having a high heat value of about 5.35 MJ/kg and temperature of about 530°C is burnt in a combustor to produce heat. In the heat exchanger HX, this heat is transferred to argon the working fluid of MHD cycle. The combustion products after passing through the airpreheater (to recover a part of the heat of combustion product) and purifiers (To remove harmful emissions) and discharged to atmosphere.

The loop in the centre is the MHD loop. The hot argon gas is seeded with cesium and passed through MHD generator. The dc power output of MHD generator is converted to A.C. by the inverter and is then feed into the grid.

The loop shown on the right hand side in fig is the steam loop for further recovering the heat of the working fluid and converting this heat into electrical energy. The fluid passes through the heat exchanges HX_2 where it imparts its heat to water which gets converted to steam. This steam is used partly for during a turbine which runs the compressor partly for turbine



Closed cycle MHD generator using liquid metal as working fluid coupled with steam genarator.

driver an alternator. The output of the alternator is also to the grid. The working fluid goes back to the heat exchanges HX) after passing through compressor and intercooler. A closed system can provide more useful power

conversion at lower temperatures (around 1900° K as compared to 2500° K for open cycle system).

NEED FOR FURTHER RESEARCH

The commercial use of MHD concept has not been possible

because numerous technological advancements are needed prior to commercialization of MHD systems. Most of these are related to material problem created by the simultaneous presence of high temperature and a highly corrosive and abrasive environment. The MHD channel operates extreme conditions of temperature, magnetic and electric fields. Search is on for better insulator and electrode materials which can with stand the electrical, thermal, mechanical and thermo-chemical stresses and corrosion.

ADVANTAGES OF MHD GENERATION

MHD generation offers several advantages as compared to other methods of electric generation.

1) The conversion efficiency of a MHD system can be 50% as compared to

less than 40 percent for the most efficient steam plants.

2) Large amount of power is generated.
3) It has no moving parts, so more reliable.
4) It has ability to reach the full power level as soon as started.
5) Because of higher efficiency, the overall generation cost of an MHD plant will be less.
6) The more efficient heat utilization would efficient heat utilization would decreases the amount of heat discharged to environment and the cooling water requirements would also be lower.
7) The higher efficiency means better fuel utilization. The reduce fuel consumption would offer additional economic and social benefits.
8) The Closed cycle system produces power free of pollution.

Following table show the pollutant emission of an MUD plant and a conventional steam plant.

Pollutant emission m tons per day based on use of coal having-3 percent sulphur contents.

	1000 MWC Conventional steam plant.	1000MWC MHD Plant using coal as a fuel.
Particulate matter	33	3
Sulphur oxides	450	3
Nitrogen oxides	80	4

Applications

1.) Power generation in space craft.

2.) Hypersonic wind tunnel experiments.

3.) Defense application.

CONCLUSIONS

With the increased industrial and agricultural activities, power demand is also highly increased. In the country is sure to fall short of the energy demand by the first decade of next century. This means an additional capacity of power is required next 10 year. The answer to this is in non conventional energy.

The MHD power generation is in advanced stage today and closer to commercial utilization significant progress has been made in development of all critical component and sub system technologies coal burning MHD combined steam power plant promise significant economic and environmental advantages compared to other coal burning power generate technologies. It will not be long before the technological problem of MHD generate are overcome and MHD power generation transform itself from non-conventional to conventional energy sources.

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