ID 15092

Question 1

Answer:

The MHD generation or, also known as magneto hydrodynamic power generation is a direct energy conversion system which converts the heat energy directly into electrical energy, without any intermediate mechanical energy conversion, as opposed to the case in all other power generating plants. 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.

Principle of MHD Generation

The principal of MHD power generation is very simple and is based on Faraday's law of electromagnetic induction, which states that when a conductor and a magnetic field moves relative to each other, then voltage is induced in the conductor, which results in flow of current across the terminals.
As the name implies, the magneto hydro dynamics generator shown in the figure below, 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 stripswhile 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 MHD generator is approximately given by,

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

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 the fluid.
MHD Cycles and Working Fluids

The MHD cycles can be of two types, namely

1. Open Cycle MHD.
2. Closed Cycle MHD.

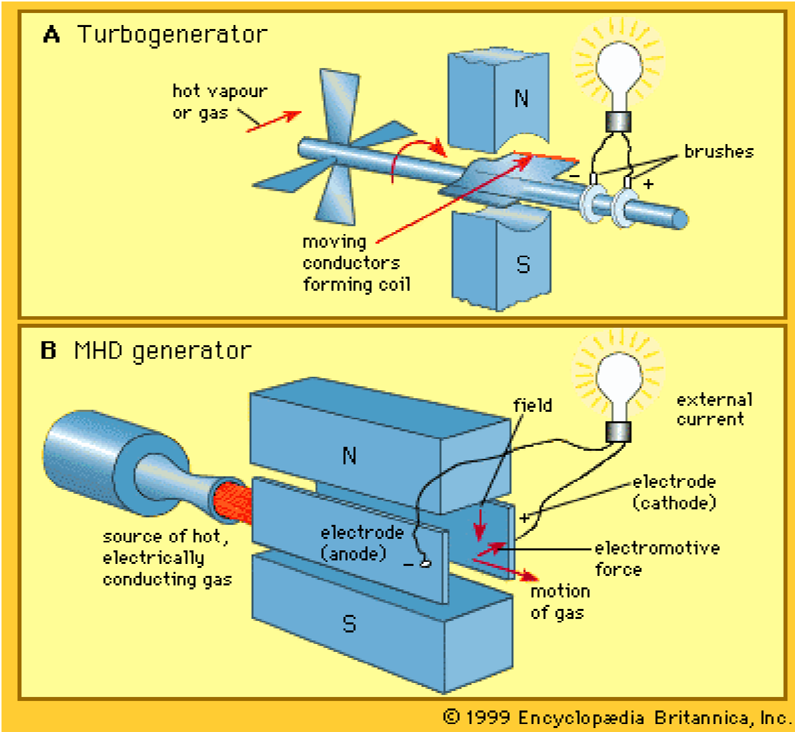
The detailed account of the types of MHD cycles and the working fluids used, are given below.

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 2700^{o}C 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

Question 2

Answer:

A thermoelectric generator (TEG), also called a See beck generator, is a solid state device that converts heat flux (temperature differences) directly into electrical energy through a phenomenon called the See beck effect (a form of thermoelectric effect). Thermoelectric generators function like heat engines, but are less bulky and have no moving parts. However, TEGs are typically more expensive and less efficient.[1]

Thermoelectric generators could be used in power plants to convert waste heat into additional electrical power and in automobiles as automotive thermoelectric generators (ATGs) to increase fuel efficiency. Radioisotope thermoelectric generators use radioisotopes to generate the required heat difference to power space probes.

Seebeck, Peltier and Thomson are the main factor which are uses in the technologies

1)SEEBECK Effect

When the junction of two different metal are maintained at different temperature the emf is produced in the circuit. This is known as Seebeck effect

The conductor ! maintained at t=delta T temperature

The Conductor 2 are maintained at T temperatursince the junction I are maintained at different the emf U flow across the circuit

2)Peltier effect

Whenever current pass through the circuit of the two disimilar conductor on the current direction ,either heat is depended or absorb or released at the junction .This is known as peltier effect.

3) Thomson Effect

Heat is absorbed or produced when the current flow in material with a certain temperature gradient . the heat is proportional to both the electric and the temperature gradiet.This is known ASthomson effect

Question 3

Answer:

A thermionic converter consists of a hot electrode which thermionically emits electrons over a potential energy barrier to a cooler electrode, producing a useful electric power output. Caesium vapor is used to optimize the electrode work functions and provide an ion supply to neutralize the electron space charge

1) vacuum closed spaced convert0r

It has under extensive research under 1957.

Physical spacing 0f 0.005inch 0r less maintained between anode and cathode.

Will have engineering difficulty and its life time is 40 hours.

2) Cesium gas filled

Cesium gas filled between anode and cathode .

Working efficiency is higher than former one.

Lifetime is nearly 600 hours.

Main problem is efficient selling and corrosive nature of cesium.

Advantages

1) rotating equipment is not employed

2)liquid vapour phase problem do not exist.

3) Separate for fluid are not required

4)frictional losses due to bearing nnot present.

Disadvantages

1)individual convertor are low voltage high current devices

2)a large number of of convertor must be sequentialy arrangedto obtaianed voltage.

3)power losses in convertors in can seriously cut useful power.

Question 4

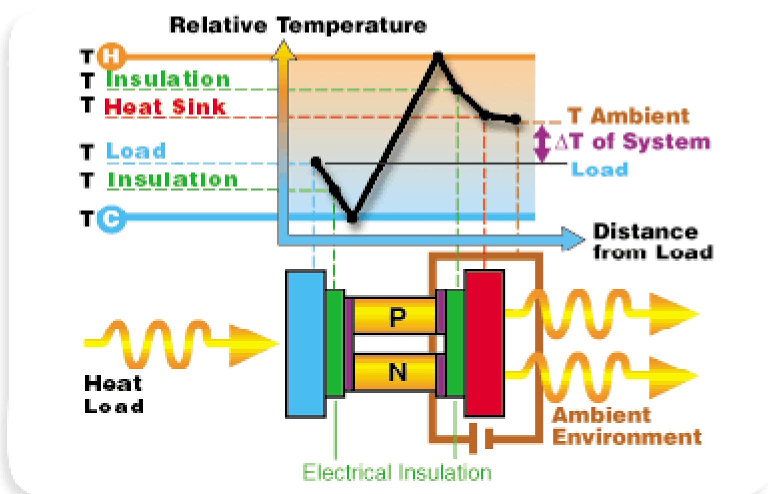
Answer: **Thermo electric basic principle**

Thermoelectricity means the direct conversion of heat into electric energy, or vice versa. The term is generally restricted to the irreversible conversion of electricity into heat described by the English physicist James P. Joule and to three reversible effects named for Seebeck, Peltier, and Thomson, their respective discoverers.

According to Joule's law, a conductor carrying a current generates heat at a rate proportional to the product of the resistance (R) of the conductor and the square of the current (I). The German physicist Thomas J. Seebeck discovered in the 1820s that if a closed loop is formed by joining the ends of two strips of dissimilar metals and the two junctions of the metals are at different temperatures, an electromotive force, or voltage, arises that is proportional to the temperature difference between the junctions. A circuit of this type is called a thermocouple; a number of thermocouples connected in series is called a thermopile.

In 1834 the French physicist Jean C. A. Peltier discovered an effect inverse to the Seebeck effect: If a current passes through a thermocouple, the temperature of one junction increases and the temperature of the other decreases, so that heat is transferred from one junction to the other. The rate of heat transfer is proportional to the current and the direction of transfer is reversed if the current is reversed.

Thermoelectric materials are of interest for applications as *heat pumps and power generators*. The performance of thermoelectric devices is quantified by a figure of merit, ZT, where Z is a measure of a material's thermoelectric properties and T is the absolute temperature. A material with a figure of merit of around unity was first reported over four decades ago, but until recently, there has been only modest progress in finding materials with enhanced ZT values at room temperature.



Principle of Thermionic Converter:

A thermionic generator (converter) converts heat energy directly to electrical energy by utilizing thermionic emission effect. All metals and some oxides have free electrons which are released on heating. In a thermionic converter, electrons act as the working fluid in place of a vapour or gas. In this device electrons are emitted from the surface of heated metal. The energy required to extract an electron from the metal is known as work function and expressed in electron volts (eV). The work function depends upon the nature of metal and its surface condition.

The principle of thermionic converters is illustrated in Fig. 7.12. In a thermionic converter two electrodes are placed in a container containing an ionised gas or cesium vapour to reduce the space charge. The cathode is heated by concentrating the rays on it. On heating of cathode the electrons are emitted from it and travel to anode. The cathode and anode are connected externally through the load circuit.

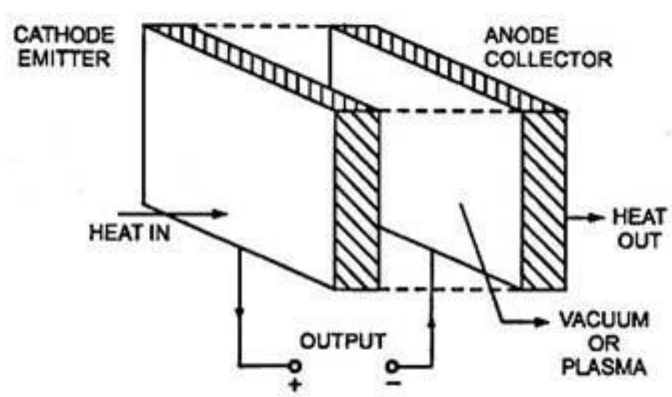


Fig. 7.12. ***Principle of Thermionic Converter***

Question 5

Answer:

Thermonuclear fusion is a way to achieve nuclear fusion by using extremely high temperatures. There are two forms of thermonuclear fusion: *uncontrolled*, in which the resulting energy is released in an uncontrolled manner, as it is in thermonuclear weapons ("hydrogen bombs") and in most stars; and *controlled*, where the fusion reactions take place in an environment allowing some or all of the energy released to be harnessed for constructive purposes. Fusion is the process by which the sun and other stars generate light and heat. It's most easily achieved on Earth by combining two isotopes of hydrogen: deuterium and tritium. Hydrogen is the lightest of all the elements, being made up of a single proton and a electron The current status of the nuclear problems of the thermonuclear fusion research program and, in particular, tritium, is discussed. It is noted that thermonuclear power generation without a uranium or thorium blanket is problematic; the key nuclear problems of the fusion–fission hybrid system remain unsolved. It is proposed that an integrated strategic analysis be made of the thermonuclear research program and the realistic possibilities of its application in nuclear power-engineering. the physical problems involved in the design of a thermonuclear reactor with a rotating plasma. Detailed consideration is given to a version of the reactor in which the plasma is stabilized mainly by radial variation of the rate of rotation of the plasma (electric shear). Such aspects as the heating, longitudinal confinement, stability and equilibrium of the plasma as well as the problem of impurities are considered and a calculation of the reactor's efficiency is made. The authors discuss the engineering problems of the creation of a high-intensity radial electric field in the plasma and describe a modification of this type of reactor – a system without magnetic mirrors (a 'centrifugal trap'). Thermonuclear fusion is the process that occurs when two atoms combine to make a larger atom, creating a whole lot of energy. Fusion already happens naturally in stars — including the sun — when intense pressure and heat fuse hydrogen atoms together, generating helium and energy

.

One of the biggest reasons why we haven't been able to harness power from fusion is that its energy requirements are unbelievably, terribly high. In order for fusion to occur, you need a temperature of at least 100,000,000 degrees Celsius. That's slightly more than 6 times the temperature of the Sun's core

But fusion reactors have other serious problems that also afflict today's fission reactors, including neutron radiation damage and radioactive waste, potential tritium release, the burden on coolant resources, outsize operating costs, and increased risks of nuclear weapons proliferation

On Earth it is very difficult to start nuclear fusion reactions that release more energy than is needed to start the reaction. The reason is that fusion reactions only happen at high temperature and pressure, like in the Sun, because both nuclei have a positive charge, and positive repels positive

One of the biggest reasons why we haven't been able to harness power from fusion is that its energy requirements are unbelievably, terribly high. In order for fusion to occur, you need a temperature of at least 100,000,000 degrees Celsius. That's slightly more than 6 times the temperature of the Sun's core

The steps are:

- Two protons within the Sun fuse. Most of the time the pair breaks apart again, but sometimes one of the protons transforms into a neutron via the weak nuclear force. ...
- A third proton collides with the formed deuterium. ...
- Two helium-3 nuclei collide, creating a helium-4 nucleus plus two extra neutrons

What are the effects of fusion on the environment? ... There are no CO_2 or other harmful atmospheric emissions from the fusion process, which means that fusion does not contribute to greenhouse gas emissions or global warming. Its two sources of fuel, hydrogen and lithium, are widely available in many parts of the Earth.