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Electricity Generation By Thermoelectric Generator Plates

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Abstract: According to International Institute of Refrigeration, air conditioning and refrigeration consumes around 15% of the total worldwide electricity and also contributes to the emission of CFCs,HCFCs, CO_2 etc. Due to the use of such refrigerants it leads to much harmful effect to our environment i.e. the global warming. For air conditioning use of fuel also increases and all these are effect on the car efficiency.To overcome the problem of emission and fulfill the mismatch between the demand and supply of energy consumption the thermoelectric Air conditioning can be used. This system is not going to benoisy, a there will be no hazardous emission to the environment so the system is totally ecofriendly. By using this system, we can make revolution in EV's world by this process we can increaseefficiency of EV Vehicles in Upcoming World or anywhere where the hot surface is there then we cancreate electricity by using this process.

I. INTRODUCTION

A thermoelectric module is an electrical module, which produces a temperature difference with current flow. The thermoelectric module is a heat pump and has similar function as a refrigerator. It gets along however without mechanically small construction units (pump, compressor) and without cooling fluids. The heat flow can beturned by reversal of the direction of current. Thermoelectric cooling provides analternative solution to the common compressor and absorber cooler. Thermoelectric coolers are used especially if small cooling power is required up to 500 W.

Our goal is to define the new Electricity generation system. If this system comes in present automobile, then revolution will occur in the automobile. With rising population and pollution at an alarming rate this system has come to rescue as these areenvironment friendly and compact. Conventional compressor run cooling equipment have more limitations related to energy efficiency and Chloro-fluro Carbon (CFC) refrigerants use. Both these factors indirectly point to the impending scenario of global warming. As most of the electricity generation relies on the coal power plants, which add greenhouse gases to the atmosphere is the more cause of global warming. Althoughresearches are going on, best alternatives for the CFC refrigerants is still on the hunt. So instead of using conventional air conditioning systems, other products which can efficiently cool a person are to be planned. By using other efficient cooling device, we can save the electricity bills as well as control the greenhouse gases that are currently released into the surrounding atmosphere.

Although thermoelectric property was discovered about two centuries ago thermoelectric device save only been commercialized during current years. The applications of thermoelectric vary from small refrigerator. In this System we implement Thermoelectric Generator plates on Refrigeration cycles Evaporator and sucks its heat and generate electricity and that electricity we can use for battery charging of car and any other purpose.

II. LITERATURE SURVEY

Ramesh Chandra Arora [1], In vapor compression system there are four majorcomponents: evaporator, compressor, condenser and expansion device. Power is supplied to the compressor and heat is added to the system in the evaporator, whereas in the condenser heat rejection occurs. Study of condenser and evaporator design as per the book 'refrigeration and air conditioning' by Ramesh Chandra Arora andprovides area calculations of condensers including bare tube area, fin area, minimum flow area, total heat transfer area, inside heat transfer area. Various correlations like Zecchin's correlation, Dean ackers, crosser's correlation and Shah's correlation are used for calculating condensation heat transfer coefficient. Procedure for calculating air side heat transfer coefficient and overall heat transfer coefficient is given and we can calculate face area or number of rows for the air cooled condensers.

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Y. S. Lee et al.[2], have studied the performance of VCRS with isobutene and compare the results with R12 and R22. They used R600a about 150 g and set the refrigeration temperature about 4 °C and -10 °C to maintain the situation of cold storage and freezing applications. They used 0.7 mm internal diameter and 4 to 4.5 m length of capillary tube for cold storage applications and 0.6 mm internal diameter and 4.5 to 5 m length of capillary tube for freezing applications.

Eric Granryd [3], has enlisted the different hydrocarbons as working medium in refrigeration system. He studied the different safety standards related to these refrigerants. He showed the properties of hydrocarbons (i.e. no ODP and negligible GWP) that make them interesting refrigerating alternatives for energy efficient and environmentally friendly. But safety precautions due to flammability must be seriously taken into account.

Manish Baweja, et al. [4], the primary focus of this study is to evaluate the performance of Air-cooled condenser under various conditions. The performances of air-cooled condenser decrease with increase in ambient temperatures and high wind conditions. Hybrid (dry/wet) dephlegmator achieves measurable enhancement in cooling performance when ambient temperatures are high. Wind-walls are used to reduce the effect of wind. fan speed can also be increased. Changing the Shading the ACC of air-conditioned unit helps to reduce the high ambient temperature due to solar radiation. Shape of finned tubes from circular to flat and adjusting their inclination also helps in increasing heat transfer rate. Various techniques are also used to clean thetubes to increase heat transfer rate.

James M. Calm [5], has studied the emission and environmental impacts of R11, R123 and R134a due to leakage from centrifugal chiller system. He also investigated the total impact in form of TEWI and change in system efficiency or performance due to charge loss. He also summarized the methods to reduce the refrigerant losses by the system like design modifications, improvement in preventive maintenance techniques, use of purge system for refrigerant vapour recovery, servicing and lubricantchanging in system.

B.O. Bolaji [6] discussed the process of selecting environmental-friendly refrigerants that have zero ozone depletion potential and low global warming potential. R23 and R32 from methane derivatives and R152a, R143a, R134a and R125 from ethane derivatives are the emerging refrigerants that are non-toxic, have low flammability and environmental-friendly. These refrigerants need theoretical and experimental analysis to investigate their performance in the system.

M.L. Mathur, F.S. Mehta [7], has different types of refrigerant and air properties at different temperatures and pressures like specific heat, entropy at fluid and gaseous state, enthalpy at fluid and gaseous state beneficial while designing stage as well as beneficial when doing experimental calculations.

III. METHODOLOGY

3.1 Vapour Compression Refrigeration System

Vapor-compression refrigeration or Vapor-compression refrigeration system (VCRS), in which the refrigerant undergoes phase changes, is one of the many refrigeration cycles and is the most widely used method for air-conditioning of buildings and automobiles. It is also used in domestic and commercial refrigerators, large-scale warehouses for chilled or frozen storage of foods and meats, refrigerated trucks and railroad cars, and a host of other commercial and industrial services. The vapor-compression uses a circulating liquid refrigerant as the medium which absorbs and removes heat from the space to be cooled and subsequently rejects that heatelsewhere. Figure 1 depicts a typical, single-stage vapor-compression system. All such systems have four components: a compressor, a condenser, a thermal expansion valve (also called a throttle valve or metering device), and an evaporator. Circulating refrigerant enters the compressor in the thermodynamic state known as a saturated vapour and is compressed to a higher pressure, resulting in a higher temperature as well. The hot, compressed vapor is then in the thermodynamic state known as a superheated vapor and it is at a temperature and pressure at which it canbe condensed with either cooling water or cooling air. That hot vapor is routed through a condenser where it is cooled and condensed into a liquid by flowing through a coil or tubes with cool water or cool air flowing across the coil or tubes. This is where the circulating refrigerant rejects heat from the system and the rejected heat is carried awayby either the water or the air (whichever may be the cas4e).

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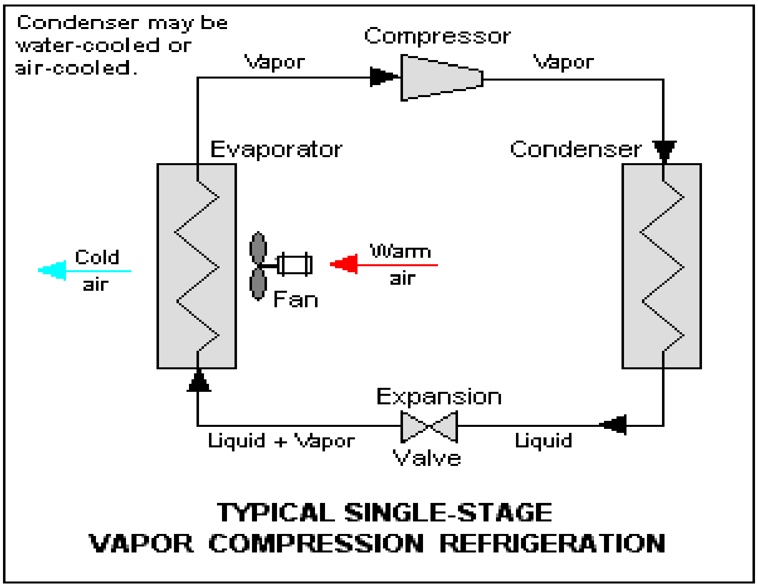
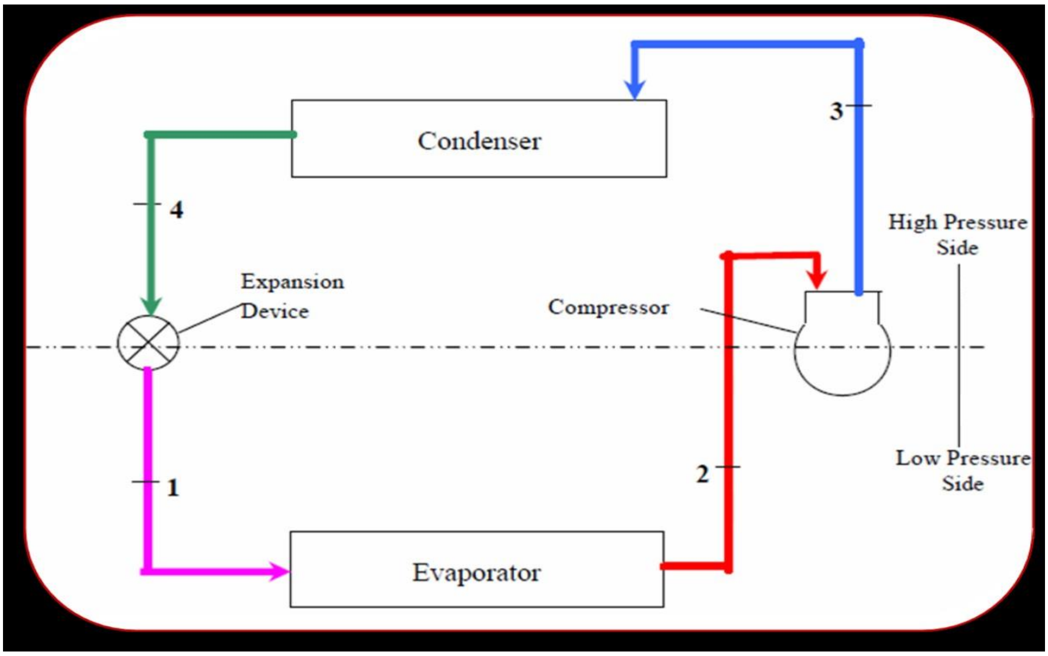


The condensed liquid refrigerant, in the thermodynamic state known asa saturated liquid, is next routed through an expansion valve where it undergoes an abrupt reduction in pressure. That pressure reduction results in the adiabatic flash evaporation of a part of the liquid refrigerant. The auto-refrigeration effect of the adiabatic flash evaporation lowers the temperature of the liquid and vapor refrigerant mixture to where it is colder than the temperature of the enclosed space to be refrigerated. The cold mixture is then routed through the coil or tubes in the evaporator.A fan circulates the warm air in the enclosed space across the coil or tubes carrying the cold refrigerant liquid and vapor mixture. That warm air evaporates the liquid part of the cold refrigerant mixture. At the same time, the circulating air is cooled and thus lowers the temperature of the enclosed space to the desired temperature. The evaporatoris where the circulating refrigerant absorbs and removes heat which is subsequently rejected in the condenser and transferred elsewhere by the water or air used in the condenser. To complete the refrigeration cycle, the refrigerant vapor from evaporator isagain a saturated vapor and is routed back into the compressor.

3.2 WORKING OF REFRIGERATION SYSTEM

A refrigeration system is an improved type of air refrigeration system in which a suitable working substance, termed as refrigerant is used. It condensed and evaporatesat temperatures and pressures close to the atmospheric conditions. The refrigerants usually used for this purpose are ammonia, carbon dioxide and sulphur dioxide.

3.2.1 Simple Refrigeration System



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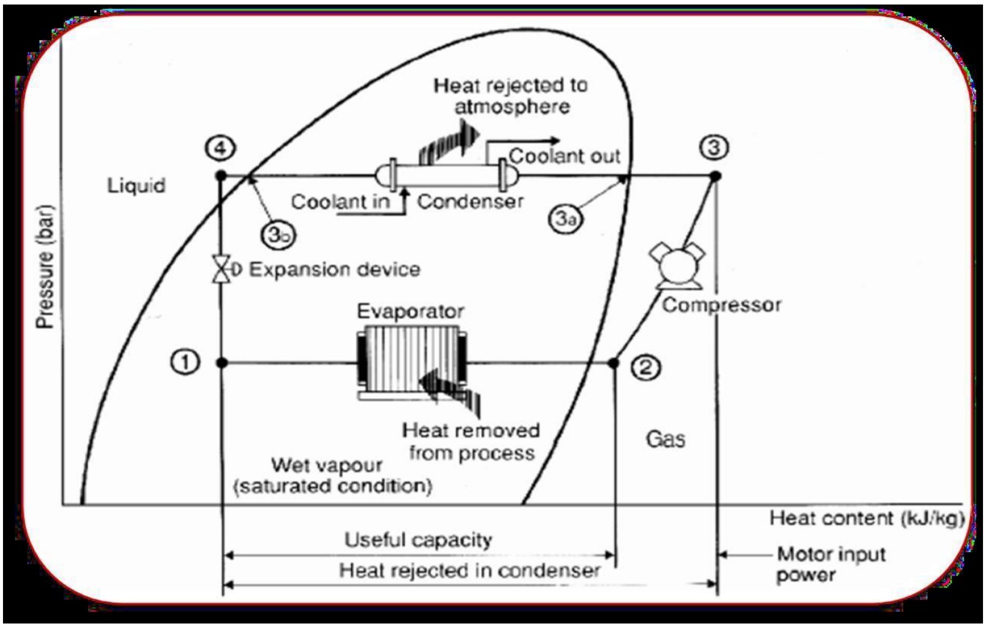
3.3 Comparison between Gas Cycles and Vapour Cycles

Thermodynamic cycles can be categorized into gas cycles and vapour cycles. In atypical gas cycle, the working fluid (a gas) does not undergo phase change; consequently, the operating cycle will be away from the vapour dome. In gas cycles, heat rejection and refrigeration take place as the gas undergoes sensible cooling and heating. In a vapour cycle the working fluid undergoes phase change and refrigeration effect is due to the vaporization of refrigerant liquid. If the refrigerant is a puresubstance, then its temperature remains constant during the phase change processes. Hence, the required mass flow rates for a given refrigeration capacity will be much smaller compared to a gas cycle. Vapour cycles can be subdivided into vapour compression systems, vapour absorption systems, vapour jet systems etc. Among these the vapour compression refrigeration systems are predominant.



3.4 Mechanism of Simple Refrigeration System:

Compression refrigeration cycles take advantage of the fact that highly compressed fluids at a certain temperature tend to get colder when they are allowed to expand. If the pressure change is high enough, then the compressed gas will be hotter than our source of cooling (outside air, for instance) and the expanded gas will be cooler than our desired cold temperature. In this case, fluid is used to cool a low temperature environment and reject the heat to a high temperature environment. Vapour compression refrigeration cycles have two advantages. First, a largeamount of thermal energy is required to change a liquid to a vapor, and therefore a lotof heat can be removed from the air-conditioned space. Second, the isothermal natureof the vaporization allows extraction of heat without raising the temperature of the working fluid to the temperature of whatever is being cooled. This means that the heat transfer rate remains high, because the closer the working fluid temperature approachesthat of the surroundings, the lower the rate of heat transfer. The refrigeration cycle is shown in Figure below and can be broken down into the following stages:

1– 2 Low-pressure liquid refrigerant

In the evaporator absorbs heat from its surroundings, usually air, water or some other process liquid. During this process it changes its state from a liquid to a gas, and at the evaporator exit is slightly superheated.

2– 3The superheated vapour

Enters the compressor where its pressure is raised. The temperature will also increase, because a proportion of the energy put into the compression process is transferred to the refrigerant.

3– 4The high pressure superheated gas

Passes from compressor into the condenser. The initial part of the cooling process (3- 3a) superheats the gas before it is then turned back into liquid (3a-3b). The cooling for this process is usually achieved by using air or water. A further reduction in temperature happens in the pipe work and liquid receiver (3b - 4), so that the *refrigerantliquid* is sub-cooled as it enters the expansion device.

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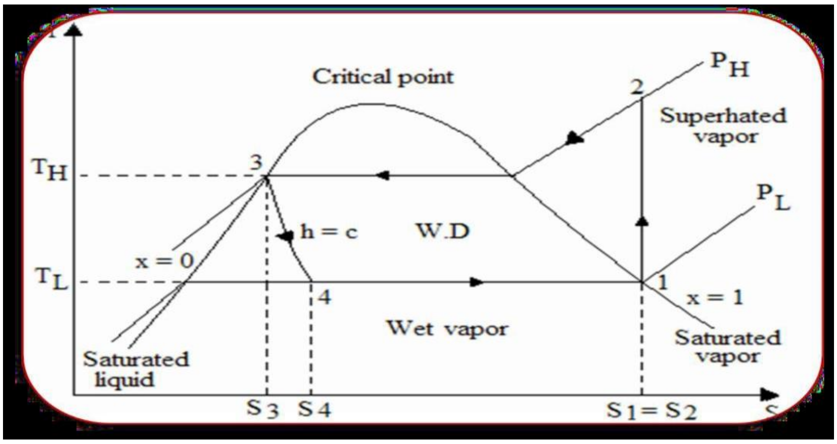

Figure. T-S diagram of simple refrigeration cycle

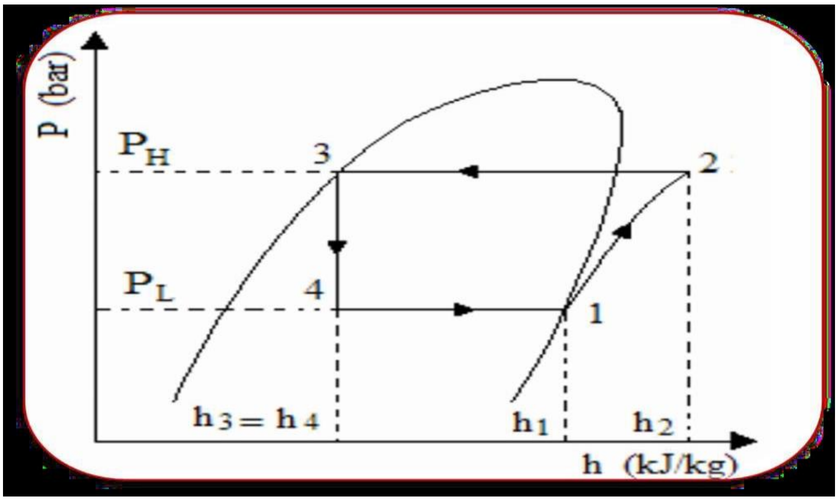

Figure. P-H diagram for simple refrigeration cycle

3.5 COMPONANTS OF REFRIGERATION SYSTEM

3.5.1 Condenser

As already mentioned, condenser is an important component of any refrigeration system. In a typical refrigerant condenser, the refrigerant enters the condenser in a superheated state. It is first de-superheated and then condensed by rejecting heat to an external medium. The refrigerant may leave the condenser as a saturated or a sub- cooled liquid, depending upon the temperature of the external medium and design ofthe condenser.

Figure. Actual air cooled fin tube condenser

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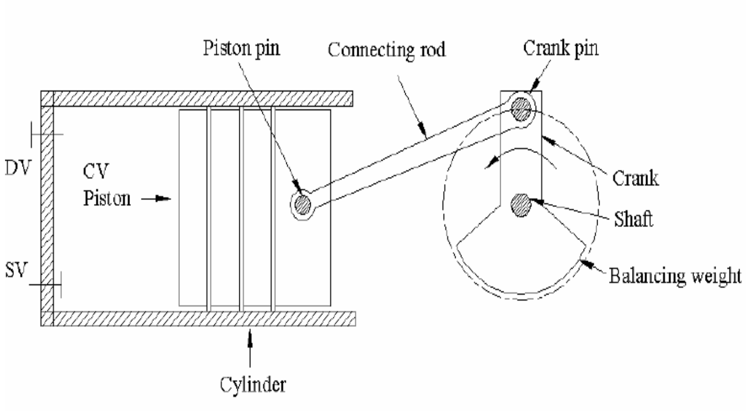

Figure. Schematic diagram of condenser

3.5.2 Compressor

A compressor is the most import ant and often the costliest component (typically 30 to 40 percent of total cost) of any vapour compression refrigeration system (VCRS). The function of a compressor in a VCRS is to continuously draw the refrigerant vapour from the evaporator, so that a low pressure and low temperature can be maintained in the evaporator at which the refrigerant can boil extracting heat from the refrigerated space. The compressor then has to raise the pressure of the refrigerant to a level at which it can condense by rejecting heat to the cooling medium in the condenser.

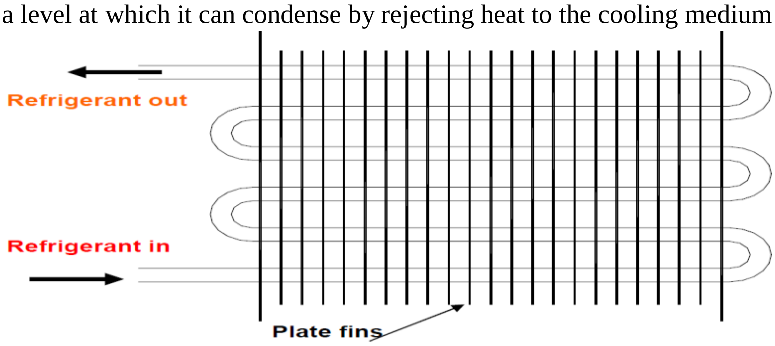

Figure. Reciprocating Compressor

Fig Actual compressor

3.6 DESIGN OF CONDENSER AND EVAPORATOR

A refrigeration system is an improved type of air refrigeration system in which a suitable working substance, termed as refrigerant is used. It condensed and evaporatesat temperatures and pressures close to the atmospheric conditions. The refrigerants usually used for this purpose are ammonia, carbon dioxide and sulphur dioxide.

Selection of Compressor:

- As per refrigerant and application the standard compressor isModel: - KCE444HAG 1phase.
- Refrigerating capacity (Q_0) =1077 wattPower consumption=450 watt

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- Given Conditions for Actual Design:-Ambient temperature=35°c Evaporating temperature=7.2°c Condensing temperature=54.4°c Suction gas temperature=35°c
- Suction pressure for R134a=40 psi (2.75 bar) Discharge pressure for R134a=196 psi (13.51bar) Pressure ratio=196/40=4.9

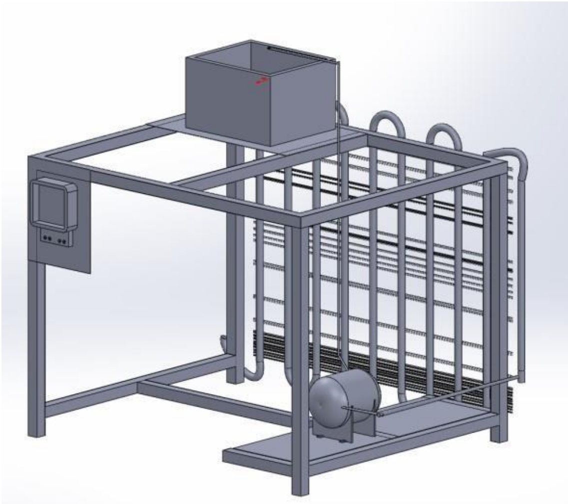

Fig. Actual project model

IV. RESULT

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V. CONCLUSION & FUTURE SCOPE

5.1 Conclusion:

- As per our experimental setup we are concluding that we can generate electricity any where heating surface is available by applying the ThermoelectricGenerator Plates on that hot surface at some quantity
- As we want more electricity from this setup then we require more hot surface and ThermoelectricGenerator Plates according requirement.

5.2 Future Scope:

1. In future we can use this system in cars for charging a car or any other appliances
2. We can also use for energy generation where heat is generated
3. By using this system, we can provide electricity to town replacing by any other system

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