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DESIGN AND FABRICATION OF SOLAR BASED VAPOUR COMPRESSION REFRIGRATION SYSTEM

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ABSTRACT

Performance enhancement of refrigeration cycle is an emerging research topic now-a-days to reduce the electricity consumed, leading to mitigating the problem related to the environment pollution by utility power plants. In today's generation most of people are using water cooler because AC becomes more costly .Due to use of water cooler moisture is released in the atmosphere which is the biggest problem in today's time and other one is how to save electric energy ?.

In this model we modified VCRS (vapour compression refrigeration system) for the purpose of saving energy and also use in the rural areas .in VCRS system implies, these system belong to the general class of refrigeration cycle. In a VCRS, refrigration is obtained as refrigerants evapourate at low temperature, the main objective is to innovate this system to convert it into a fully DC and solar energy, and the compressor is run with the help of DC batteries.

KEYWORDS: Refrigration, environment pollution, electricity, solar energy, vcrs.

1. INTRODUCTION

The conventional fuel sources are getting depleted due to continuous use of it. Now a day's energy is continuously in demand and the world is facing problem with limited availability of conventional energy sources and on the other hand global warming because of pollutants from fossil fuels. Refrigeration systems are indispensable for human beings in the modern life. Currently, the mechanical vapour compression systems used for this purpose, use large amounts of electrical power that is produced in great proportion by fossil fuel combustion, which is a cause of the global warming. Which makes imperative need to develop alternative technologies that will reduce the use of electrical energy? Electrical energy can be remarkably saved by incorporating other energy sources such as the solar energy. Vapor compression refrigeration system is used in domestic refrigeration, food processing and cold storage, industrial refrigeration system, transport refrigeration and electronic cooling.

Refrigerators are one of the major energy consuming appliances in household environment [1]. R134a is the most widely used refrigerant in domestic refrigerators, due to its good thermodynamic and thermo physical properties. In India, about 80% of the domestic refrigerators use R134a as refrigerant [2]. But its GWP (Global Warming Potential) effect is 1300. The Kyoto Protocol of the United Nations Framework Convention on Climate Change (UNFCCC) asked for reduction in emission of six categories of greenhouse gases, including R134a, used as refrigerant in domestic refrigerators to prevent global warming [3].

The air conditioning units which uses the vapour compression refrigration system has four main components which are compressor ,condenser ,expansion valve ,and evaporator and refrigerant is used as working medium .

2. COMPONENTS AND THEIR WORKING

A. D.C. motor

A d.c. motor is any of the class of the rotary electrical machines that convert direct current electrical energy into mechanical energy .in our model we are using the motor to run the compressor .motor specifications are 230w, 24v, and1300 rpm.

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B. Compressor

Compressor is said to be the heart of the cooling cycle. Compressor here used is air cooled and to compress the refrigerant at high temperature and high pressure as well .The compressor here is run by the d.c. motor.

C. Condensor

It is the device used for the condensation of vapours .In the cooling cycle of refrigeration system heat is rejected by the vapour refrigerant and the high pressure and high temperature state of the refrigerant is then converted into liquid .it designed to condense effectively the compressed refrigerant vapour.

D. Capillary tube

Capillary tube is a throttling device used in refrigration and air conditioning system .It is a copper tube of very small diameter and long length. It is used as throttling device in the domestic refrigerators, deep freezers, water coolers and air conditioners.

E. Evapourator

Evapourator is the important component for the cooling system, it act as a heat exchanger .evapourator absorb the heat from the surrounding area which is being cooled and keep it cooled**.**

F. Refrigerant

Refrigerant is one of the most important components, it acts as the working fluid or working medium in the cooling cycle.r134a is the most commonly used refrigerant in the domestic and industrial cooling processes. According to the Montreal Protocol and its subsequent amendments and regional regulations, CFCs (chlorofluorocarbons) are banned since 1996 and the phase-out deadlines for HCFCs (hydro chlorofluorocarbons) are approaching (2030). Consequently, new fluids with zero ozone depleting potential (ODP), such as HFCs (hydro fluorocarbons) and natural refrigerants are being tested as substitutes for the ODSs. HCFC-22 has been widely used as working fluid in air conditioning and in medium and low-temperature applications within the commercial and industrial refrigeration. Nowadays, the replacement of HCFC-22 in existing and new systems without significant changes in equipment or lubricants constitutes a crucial challenge for the refrigeration industry. [4].

3. WORKING OF VAPOUR COMPRESSION REFRIGRATION CYCLE

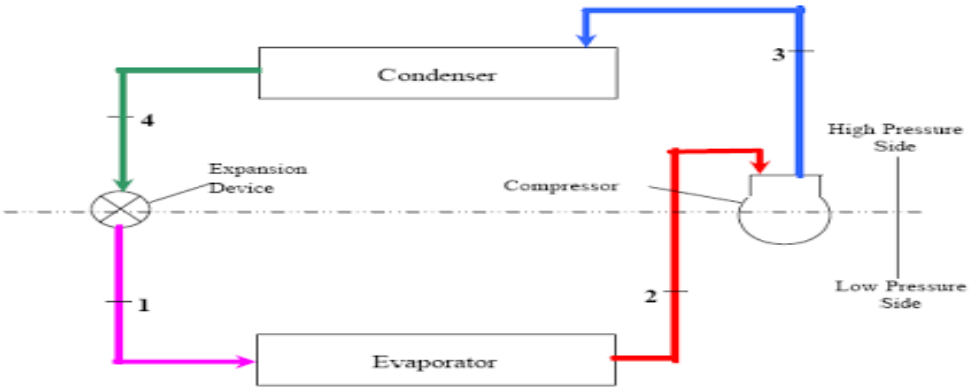

Fig.1 vapour compression refrigration system

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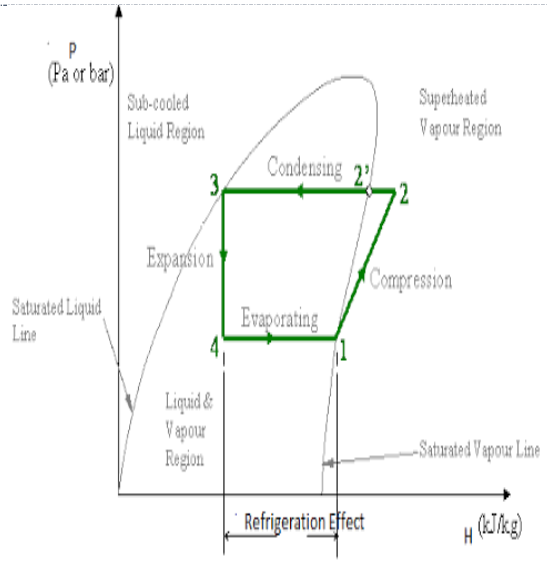

Fig.2 p-h diagram of VCRs

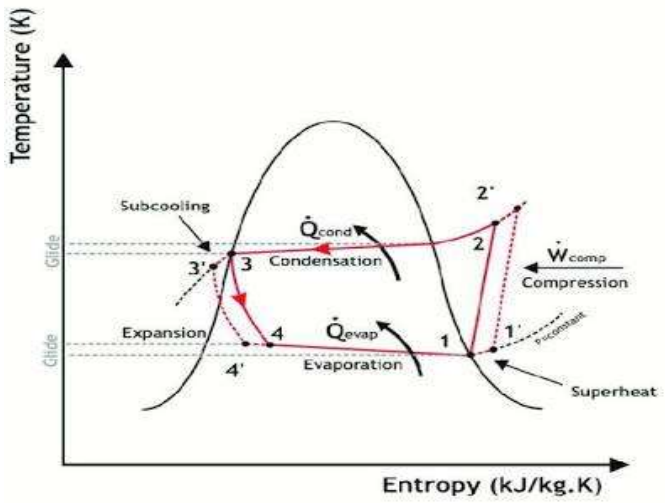

Fig. 3. T-S diagram of VCRs

The working principle of simple vapour compression refrigeration system is shown in Fig.1. It mainly consists of two units. [4] It is installed such that one unit comprising evaporator faces the room, and the other unit comprising condenser is projected outside the room, As shown in Fig. 2 & 3 the P-h diagram (Moeller diagram) for refrigeration cycle with four basic processes are frequently used in the analysis of vapour compression refrigeration cycle, process 1to 2 is compression, process 2 to 3 heat rejection in the condenser, process 3 to 4 expansion (Throttling) and process 4 to 1 is Evaporation i.e. heat absorbed in the evaporator. [5-6] described the performance of air conditioner components. The performance characteristics are can be computed for compressor work (Wc), Refrigeration Effect (QE) and Coefficient of Performance (COP) is expressed by the ratio of amount of heat taken by the cold body to the amount of work supplied by the compressor; this ratio is called Coefficient of performance. The system performance is calculated as follows:

The work done during the isentropic compression per kg of refrigerant is given by $Wc = Mr \times (h2 - h1)$ ---------- (1)

The refrigerant effect or heat absorbed or extracted by the liquid-vapour refrigerant during evaporation per kg of refrigerant is given by $QE = Mr \times (h1 - h4)$ ---------- (2)

The Coefficient of performance (C.O.P.) is the ratio of heat extracted in the refrigerator to work done on the refrigerator. COP = Refrigeration Effect/ Work Done ---------- (3)

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COP = $h1-h4/$ h2−h1 ---------- (4)
Pressure ratio = $Pc/$ pe ---------- (5)
Energy Efficiency Ratio (EER) =3.5× COP ---------- (6)
Capacity of the system = 1 TR = 3.5 kW----------(7)

4. RESULT

Following are the readings obtained while testing
Temperatures are in degree Celsius:
T1=25
T2=63
T3=T4= -7
Where,
{T1 =Ambient temperature
T2=Temperature of refrigerant after compression
T3=T4= Temperature at evapourator}
C.O.P. of the A.C. is 4.5(with the help of refrigeration table)

5. CONCLUSION

In today's time, we are consuming energy and also pollute our environment by using AC. For the purpose of saving energy, we have made a "VCRS (AC) by solar energy" model, which works on a completely renewable energy resource. This model requires only one time investment so we can use it in rural area also. To make this model for the purpose of save energy as well as using it in rural area without use of any non-renewable energy or resource.

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