

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor & UGC Approved Journal)

Website: www.ijirset.com

Vol. 6, Issue 9, September 2017

Regenerative Dual Mode Air Conditioner

Ranjan panda

U.G Student, Department of Mechanical Engineering, Veer Surendra Sai University of Technology, Odisha, India

ABSTRACT: Air conditioning is the process of removing heat from a confined space, thus cooling the air, and removing humidity.. AC is a device that takes heat away through evaporating a refrigerant inside your room and rejects it through condensation outside the building. You push heat from cold area to a hot area (that's why you need energy because normally heat flows from hot to cold) to do the opposite you need to pay energy because we are going against the current. Basically in our project air conditioner works with dual cycle that is an energy saving process. The rejected heat from the air conditioner is being used in a beneficial way. Efficiency of air conditioner also increases in this air conditioner with dual cycle. The extra heat or unwanted heat used in heat up other product so we get dual output from single input.

KEYWORDS: Evaporator, compressor, condenser, expander, primary refrigerant, secondary refrigerant, throttling device,

I. INTRODUCTION

Air conditioning system have been used in many parts of world. The purpose of most of systems to provide thermal comfort and standard of living .lot of energy is being consumed in air conditioner. One of the consequence of worldwide energy crisis in 1970s is the public recognition of the importance of energy saving. So, we have to minimize energy consumption in modern society.

Currently india has a relatively low penetration of air conditioner, while the united states is a much more saturated market , the report said the latest from ETA's residential energy consumption survey 87% of us households have air conditioner equipment. While similar data for india show that 2% of indian households have air conditioner .An early analysis of program from Lawrence berkeley national laboratory(LBNL) estimated that the standard and labels would save 27 terawatt-hour of electricity annually by 2020 , nearly 14% of projected electricity use for air conditioning.[1]

Any air conditioning or refrigerating unit must have five core components in order to work:

- Compressor
- Condenser
- Expansion Valve
- Evaporator
- Refrigerant

Every air conditioner has got a compressor inside it. It works to compress and pump the refrigerant gas. Compression of refrigerant produces heat. To dissipate this heat, compressed refrigerant is pumped to the condenser coils where a fan blows the heat out to outer atmosphere. During this process, refrigerant takes the liquid form. This liquid refrigerant is pumped towards expansion valve. Expansion valve has a temperature sensor connected to it which works in correlation with thermostat settings. Expansion valve releases the appropriate amount of refrigerant to evaporator (cooling coils) where liquefied refrigerant takes gaseous form. Conversion from liquid to gaseous state due to expansion causes cooling because energy is absorbed from the surrounding. The gaseous refrigerant in cooling coils then enters the compressor and gets compressed once again. The cycle continues unless the compressor is shut down.

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In air conditioner heat travel from evaporator to condenser in a cyclic process. The heat collected at evaporator and energy consumed at compressor both releases as heat energy at condenser. That rejected heat termed as waste heat which we used in a beneficial way in our project. So that performance of air conditioner increased to some extent.

Air conditioning potential, top 12 countries

Country	Population (in millions)	Annual CDDs	Annual GDP per capita (in thousands)
India	1,252	3,120	1.5
China	1,357	1,046	6.8
Indonesia	250	3,545	3.5
Nigeria	174	3,111	3.0
Pakistan	182	2,810	1.3
Bangladesh	157	2,820	1.0
Brazil	200	2,015	11.2
Philippines	98	3,508	2.8
United States	316	882	53.0
Vietnam	90	3,016	1.9
Thailand	67	3,567	5.8
Mexico	122	1,560	10.3

Table 1. List of Most energy consumption countries in Air conditioner. [2]

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II. METHODOLOGY

In air conditioner internal air removed through a cyclic process. That cyclic process include Evaporator, compressor, condenser, expander, primary refrigerant, secondary refrigerant. The basic refrigeration cycle is used in air conditioner. At first primary refrigerant passing in closed path in which heat from indoor air taken out and rejected to outside environment. The refrigerant passed over the evaporator as a result it absorbs heat from the room. So that air get cooled at this coil. There is a blower which blows the cooled air throughout the room then room gets cooled. During heat absorption process, the refrigerant further evaporates and transfer into pure vapour. The fluid leaves as the low pressure cool gas to reach compressor. The compressor acts as the pump, causing refrigerant flows through system. its job is to draw in a low pressure, low temperature refrigerant in a gaseous state and by compressing it, raise the pressure and temperature. [3] This high pressure and high temperature refrigerant flows to the condenser coil. At condenser, latent heat of vaporization of primary refrigerant rejected to outside environment.

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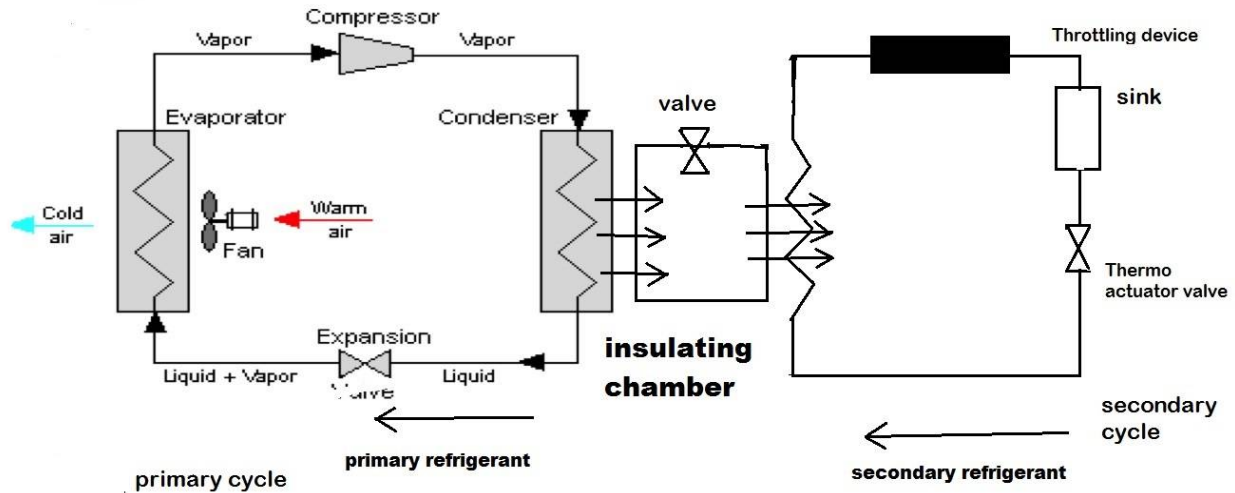


Fig.1 Diagram of dual refrigeration cycle

Whether that heat transfer to the outside we used it in another cycle i.e. secondary refrigeration cycle. At condenser heat transferred from primary refrigerant to secondary refrigerant. We can use pure water as a secondary refrigerant. At first heat is ejected to an adiabatic chamber from where secondary refrigerant absorbs the heat. The importance of this chamber is to control the flow of heat from condenser to secondary refrigerant in a regular manner. Secondary refrigeration circuit connected to that chamber. Secondary refrigerant absorbs the heat and it passes to the sink where heat is used. We can use that heat for different purposes i.e. keeping food warm, water heater etc. thermo actuator sensor is used for control the flow of heat as per temperature requirement at sink. After this secondary refrigerant passed through a throttling device where its temperature decreases to normal state. Then cycle will continue as per the above.

III. ENERGY SAVING

According to report large amount of heat is being released to atmosphere by the air conditioner. The indoor hot air goes out to the atmosphere in refrigeration cycle so that we will get a standard and cool indoor environment. In our project those waste heat is being used for other purposes like water heater, keeping food warm in kitchen. The heat collected from indoor environment (Q) and the amount of work done (w) in compressor both rejected to outside as heat energy at condenser and that amount of heat used in secondary refrigeration cycle. If you take both primary and secondary cycle at a time then performance will increase and energy consumption remains constant but efficiency of getting output will increase.

IV. EXPERIMENTAL RESULTS

General refrigeration cycle principle is used in air conditioner. Heat absorbed at evaporator is passed over the compressor then to condenser, where heat rejected to outside environment. As per our project, we are using an adiabatic chamber in which two opposite faces are connected to two plate type condenser from two air conditioner. [4] In between these two faces we are using another plate as shown in figure. Both side of plate we have secondary refrigeration circuit. That middle plate absorbs heat from two air conditioner, sum off them and use those heat in different purposes. After absorbing the heat, it will go to the sink where it is used. Once secondary refrigerant rejects its heat, it passed over a throttling device where its temperature comes to normal state and the cycle continues. Another

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thermo actuator valve is used on the adiabatic chamber. That valve maintain the constant temperature inside the chamber. If the temperature of chamber increases then it will affect the efficiency of air conditioner so constant temperature should be maintained.

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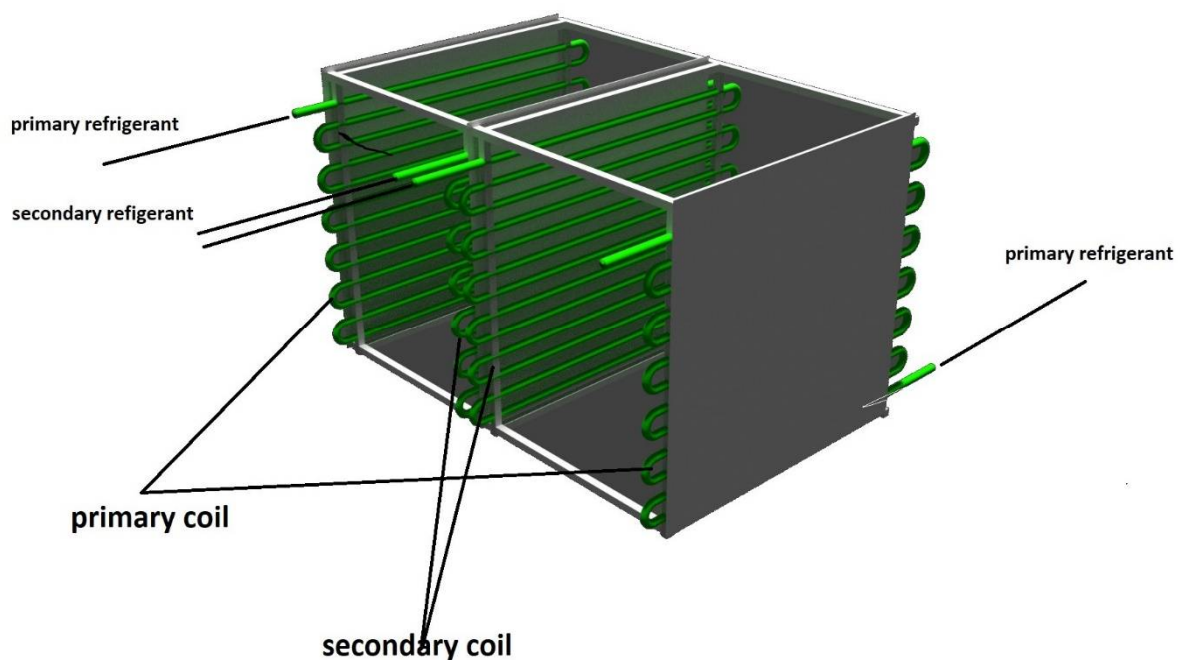


fig.2 image of adiabatic chamber

V. FUTURE SCOPE

This concept can be used in multiple purpose like in refrigerator, air conditioner, cold storage. In refrigerator same refrigeration cycle is used. Heat removed from refrigerator can be used in hot chamber where we can store food warm or heat can be used in heating water. In cold storage also lot of heat release to outside environment, so we can use this process to use that heat in beneficial way. It has more scope in future and we can use this idea in multiple sectors. In industrial sector, refrigeration cycle is used in many field like in chemical plant gas separation, crystallization of substance ,destruction of reaction heat along with cold in manufacturing and construction, snow ,ice sports and environmental test chamber etc .So in these sectors we can use this idea to get more output and efficient manufacturing.[5]

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Fig.3 Images of air conditioner, refrigerator and cold storage.

VI. CONCLUSION

Industrial development and population growth have led to surge in global demand for energy in recent years. Now a days energy crisis is a big problem. There are many causes of this energy crisis like overconsumption, over population, unexplored renewable energy, wastage of energy. We have to think about these problems and find solutions so that future generations will not suffer any problems towards this. We have already tested this idea in two 100 square meter rooms. The energy removed from these rooms is utilised in the kitchen.

VII. ACKNOWLEDGEMENTS

This work was supported by Idea And Innovation cell, Vssut, Burla. Sincere Thanks to Siddhanta Patro, Rahul Nayak, Jasaswi Sahoo, Apurwa Masook for contributing information and assistance to the article and to all those directly or indirectly involved for drafting the paper.

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