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To Improve Cop of Domestic Refrigerator with the Help of Water Cooling Condenser

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ABSTRACT: Refrigerator is one of the home appliances utilizing vapour compression cycle in its process. Performance of the system becomes main issue and many researches are still on going to evaluate and improve efficiency of the system. The main objective is to improve performance of the refrigeration system in term of refrigeration Capacity, Compressor work and Coefficient of performance (COP) by determining three important parameters during in operating mode which are temperature, pressure and refrigerator flow rate. A household refrigerator designed to work with F-12 which is use as an investigation unit to assess the prospect of using refrigerants. Work on condenser in domestic refrigeration is pretty development. We are going to introduce the thermoelectric module in a model of domestic refrigerator for sub cooling the refrigerant and the effect of condenser temperature on COP and refrigerating effect is in investigated. The energy consumption of the refrigerator during experiment with refrigerant F-12 will be measured.

KEYWORDS: COP, Copper tube, F-12 refrigerant, submersible pump

I. INTRODUCTION

A vapour compression refrigeration system is an improved type of air refrigeration system in which a suitable working substance termed as refrigerant used, it condenses and evaporates temperate and pressure close to the atmosphere conditions. The refrigerant used, doesn't leave the system, but it's circulated throughout the system alternatively condensing and evaporating. In evaporating, absorb its latent heat from the brine which is for circulating around the chamber. The vapour compression refrigeration system is now-a-days used for all purpose refrigeration. It is generally used for all industrial purpose from small domestic refrigeration to big air conditioning plant.

We are deciding to walk on the path of refrigeration system. In refrigeration system, there are four main components:
(1) Evaporator
(2) Compressor
(3) Condenser
(4) Expansion Device.
Evaporator, Compressor and Expansion Device are the inbuilt inner parts of the system body so we can't change in them. Condenser is the outer part of the system body. Doing various changes on condenser we can improve in refrigeration system.

To increase COP, condenser is the best option so that we are going to work on condenser tubes. [1]

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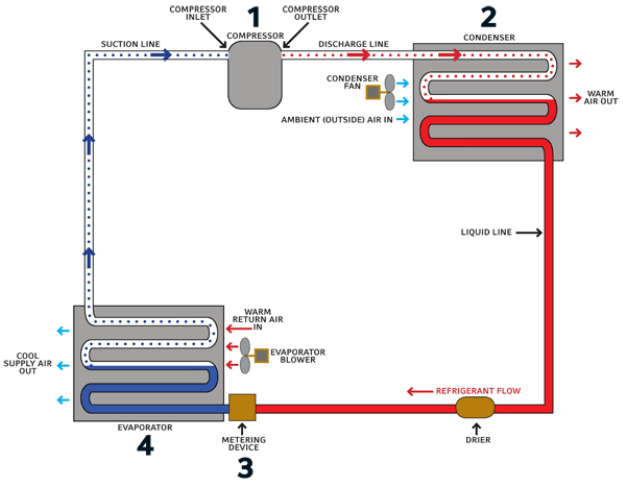

Fig.I Basic VCRS system [2]

II. CONDENSOR

The condenser is an important device used in high pressure side of refrigeration system. Its function is to remove heat of the hot vapour refrigerant discharged from compressor. The hot vapour refrigerant consists of the heat absorbed by the evaporator and the heat of compression added by the mechanical energy of the compressor motor. The heat from hot vapour refrigerant in a condenser is removed first by transferring it to the walls of the condenser tubes and then from the tubes to the condensing or cooling medium.

CLASSIFICATION
a. Air cooled condensers
b. Water cooled condensers
c. Evaporative condensers

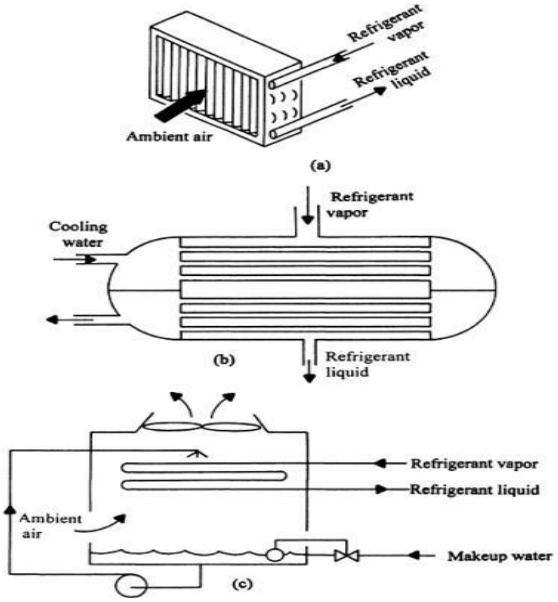

Fig.II.I Types of Condenser [3]

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An air-cooled condenser is one in which the removal of heat is done by air. It consists of steel or copper tubing through which the refrigerant flows. The size of tube usually ranges from 6 mm to 18 mm outside diameter, depending upon the size of condenser. Generally copper tubes are used because of its excellent heat transfer ability.

A water cooled condenser is one in which water is used as the condensing medium. They are always preferred where an adequate supply of clear inexpensive water and means of water disposal are available. These condensers are commonly used in commercial and industrial refrigerating units.

The water cooled condensers are classified, according to their construction, into the following three groups:

1. Tube-in-tube or double tube condensers
2. Shell and coil condensers
3. shell and tube condensers [4]

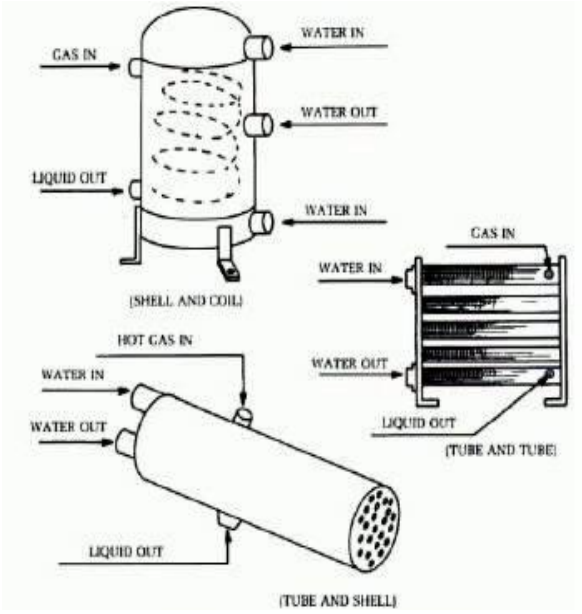

Fig.II.II Types of Water Cooled Condenser [5]

III. EXPERIMENTAL SETUP

For this experiment, we use domestic refrigerator, water circulating pump, copper tubes, temperature sensors and other miscellaneous parts. First of all we arrange the refrigerator for start our project. After that we cut the fins which were brazed with condenser tubes with purpose of that we can place copper tubes easily on condenser. Then we check there are no leakages in condenser tubes by using soap-water experiment. After cleaning of refrigerator, we placed copper tubes with condenser tubes with the help of aluminium wires. One end of copper tube is connected with water pump in sump which circulates the water through the copper tubes and other end is free at sump. Water pump is ON for 5 minutes & OFF every 25 minutes which is operated by electronic circuit. We used another electronic circuit for measuring temperatures at different components of refrigerator.

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Fig.III.I Project setup

Fig.III.I is our project setup which including copper tube condenser, water sump, submersible pump, electronic circuit of the water pump.

Fig.III.II Water circulating circuit & Energy meter

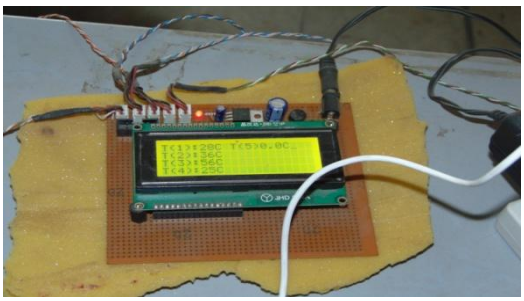

Fig.III.III Temperature measuring circuit

Fig.III.II including electronic circuit for water pump and energy meter. Circuit timer is used to ON pump for 5 minute after every 25 minute. Energy meter is used for measuring power consumption. Fig.III.III including circuit which is used for measuring temperature at different part of refrigerator.

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Fig.III.IV Freezer temperature sensor

Fig.III.V Room temperature sensor

Fig.III.IV including freezer of refrigerator and thermocouple which is used to measure minimum temperature. Fig.III.V including thermocouple which measured room temperature.

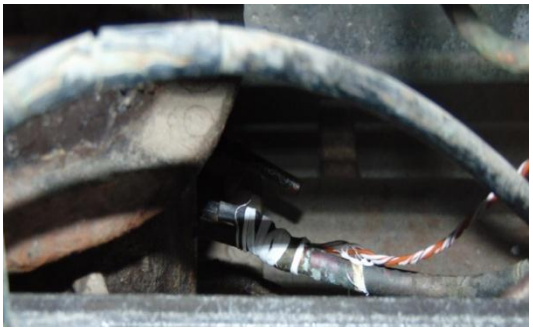

Fig.III.VI Compressor output temperature sensor

Fig.III.VII Compressor input temperature sensor

Fig.III.VI including thermocouple which measured output temperature of refrigerant in compressor. Fig.III.VII including thermocouple which measured input temperature of refrigerant in compressor.

Fig.III.VIII Condenser temperature sensor

Fig.III.VIII including thermocouple which measured temperature of refrigerant in condenser.

IV. SAMPLE CALCULATION

T1 = room temperature = 27 ‘C
T2 = condenser temperature = 29 ‘C

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T3 = compressor output temperature = 55 ‘C
T4 = compressor input temperature = 34 ’C
T5 = freezer temperature = 0 ‘C

C.O.P. = (h1-hf3) / (h2-h1)
= (373.7 - 138.8) / (228 – 373.7)
= 20.11594

V. CONCLUSION

In the conventional refrigerator, condenser heat loss via conduction-radiation (copper tube-atmosphere). In our research work, we are trying to increase heat loss in condenser with some additional device attachment (copper tube flow with water). With the help of our arrangement heat loss increases via conduction-convection-conduction-radiation. So our arrangement increasing heat loss according to sub cooling type with more power consumption due to pump arrangement and our goal is achieve. With this setup we are increasing COP of refrigerator with little increasing power consumption.

REFERENCES

[1] R.S. KHURMI & J.K. GUPTA, “A Textbook of Refrigeration and Air Conditioning” PAGE NO.313, ISBN 81-219-2781-1,
[2] http://www.air-conditioning-and-refrigeration-guide.com/refrigeration-cycle.html
[3] http://www.globalspec.com/reference/65345/203279/chapter-7-condensers
[4] R.S. KHURMI & J.K. GUPTA, “A Textbook of Refrigeration and Air Conditioning” PAGE NO.314, ISBN 81-219-2781-1
[5] http://www.ref-wiki.com/content/view/31579/28/

Appenaxure

T1	T2	T3	T4	T5	h1	h2	hf3	h1-hf3	h2-h1	COP	DATE
20	25	52	23	0	362.6	372.8	224.1	138.5	10.2	13.57843	31/12/2014
21	29	55	25	0	363.4	373.7	228	135.4	10.3	13.14563	
22	30	55	26	0	363.8	373.7	229	134.8	9.9	13.61616	
23	31	60	27	0	364.2	375	230	134.2	10.8	12.42593	01-01-2015
23	32	60	27	0	364.2	375	231.1	133.1	10.8	12.32407	
24	33	60	27	0	364.2	375	232.1	132.1	10.8	12.23148	
24	33	61	28	0	364.5	375.3	232.1	132.4	10.8	12.25926	
25	34	62	28	0	364.5	375.5	233.1	131.4	11	11.94545	
26	34	63	28	0	364.5	375.8	233.1	131.4	11.3	11.62832	
24	32	57	28	0	364.5	374.3	231.1	133.4	9.8	13.61224	01-02-2015
25	33	60	29	0	364.9	375	232.1	132.8	10.1	13.14851	
26	34	61	29	0	364.9	375.3	233.1	131.8	10.4	12.67308	
25	33	60	29	0	364.9	375	232.1	132.8	10.1	13.14851	
24	33	60	28	0	364.5	375	232.1	132.4	10.5	12.60952	01-05-2015
24	34	60	30	0	365.3	375	233.1	132.2	9.7	13.62887	
26	34	63	30	0	365.3	375.8	233.1	132.2	10.5	12.59048	
26	34	61	29	0	364.9	375.3	233.1	131.8	10.4	12.67308	

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26	34	62	30	0	365.3	375.5	233.1	132.2	10.2	12.96078	
27	35	63	31	0	365.7	375.8	234.1	131.6	10.1	13.0297	
21	28	50	24	0	363	372.2	227	136	9.2	14.78261	01-06-2015
22	30	54	26	0	363.8	373.4	229	134.8	9.6	14.04167	
25	33	60	29	0	364.9	375	232.1	132.8	10.1	13.14851	
26	34	63	28	0	364.5	375.8	233.1	131.4	11.3	11.62832	
23	32	56	26	0	363.8	374	231.1	132.7	10.2	13.0098	01-07-2015
24	31	58	27	0	364.2	374.5	230	134.2	10.3	13.02913	
25	32	60	28	0	364.5	375	231.1	133.4	10.5	12.70476	
26	34	62	24	0	363	375.5	233.1	129.9	12.5	10.392	
23	32	58	24	0	363	374.5	231.1	131.9	11.5	11.46957	01-08-2015
22	28	55	22	0	362.2	373.7	227	135.2	11.5	11.75652	
24	33	62	29	0	364.9	375.5	232.1	132.8	10.6	12.5283	
25	33	59	29	0	364.9	374.8	232.1	132.8	9.9	13.41414	
27	35	63	30	0	365.3	375.8	234.1	131.2	10.5	12.49524	
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25	35	57	27	0	364.2	374.3	234.1	130.1	10.1	12.88119	19/1/2015
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