THE DESIGN AND DEVELOPMENT OF OVEN USING DISSIPATIVE HEAT FROM REFRIGERATOR.

MUHAMMAD FADHLULLAH BIN HASAN

This report is written as a partial fulfillment of terms in achieving the award for Bachelor of Mechanical Engineering (Thermal-Fluid)

Faculty of Mechanical Engineering
Universiti Teknikal Malaysia Melaka

MAY 2009

'I declared that we have read this thesis thoroughly and in my opinion, this thesis is has fulfilled the criteria covering all the aspects of scope and quality and satisfied to be Awarded for Bachelor of Mechanical Engineering (Thermal-Fluid).'

Signature :......................

Supervisor I : SUHAIMI BIN MISHA

Date : 18/05/09

"I admit that this report is all written by me except for the summary and the article Which I have stated the source for each of them."

Signature:........................

Writter :MUHAMMAD FADHLULLAH B. HASAN

Date :18/5/09

DEDICATION

To beloved family, friends and lectures who supported me throughout this project.

ACKNOWLEDGEMENT

First of all, thank to Allah for His blessing and His Messenger Muhammad S.A.W for his bonds of love in order to allow me undergoing my Projek Sarjana Muda (PSM I & II) and being able to finish the (PSM I & II) it within the time at year 2008/2009.

In a particular, I would like to express my gratitude to my supervisor, Mr Suhaimi Misha for giving me a chance to do the project under his guide and attention. I also would like to forward my thanks to Mr Wahab to helping me to finished this project during the fabrication and create a new design for this project. I also want to thanks to all technicians especially to Mr. Jufri for giving me lots of information and good advice during implementation of this project.

Last but not least and not to be forgotten special thanks to my beloved family for the sacrifices they made for me and for staying firmly beside me through many obstacles that I have to face and to all my friends especially to Mr Salim B. Md Yunos , thank you for the helping me. Thanks for the courage and strength you all gave to me during my practical training period. Thanks for the guidance and cooperation. May Allah bless all of us. Amin.

ABSTRACT

Nowadays, Refrigerators stay cool through a continual process of heat transference known as the refrigeration cycle. This process requires a refrigerant fluid that can change from a gas to a liquid and back again. Substances such as ammonia, chlorofluorocarbons (CFCs), and Freon have been used as refrigerants in the past, but modern refrigerators use compounds that are environmentally safer. These refrigerants have names like R-134a and R-22. The heat from condenser is released to the environment. This project is to utilize the heat to warm the oven compartment. The temperature distribution from the condenser to oven compartment will be investigated by experiment. The heat can be used to develop warm oven at the top of the refrigerator. The oven is not required any electrical sources. The results show that the heat is capable to warm the oven compartment at 43.64°C.

ABSTRAK

Sistem penyejuk berada dalam keadaan sejuk melalui proses lanjutan pemindahan haba dan dikenali sebagai kitaran penyejukkan. Proses ini memerlukan cecair penyejuk yang boleh berubah dari keaadan wap kepada keadaan cecair dan seterusnya. Bahan- bahan seperti ammonia,chloroflourocarbon(CFC) dan freon telah digunakan dalam system penyejuk terdahulu, tetapi masa kini sistem penyejuk digunakan untuk dalam kawasan yang baik dan selamat contohnya dengan menggunakan R-134a dan R-22. Jadi untuk project PSM I & II ini, objektifnya untuk mengkaji haba dari system pemeluwap yang akan digunakan terus ke sistem pemanasan haba oven yang sebelum ini menggunakan sumber dari arus elektrik. Secara terperincinya haba dari pemeluwapan terus ke udara di mana udara tersebut akan terus masuk atas penyejuk itu melalui medium yang digunakan dari bahan tembaga untuk dijadikan saluran dari pemampat ke pemeluwap dan terus ke dalam ruangan oven. Haba dari saluran akan bebas keluar dalam ruangan oven tersebut. Masalahnya adakah haba yang diterima oleh oven dari sistem pemeluwapan itu cukup untuk pemanasan dalam sesuatu penggunaan? Tanpa menggunakan sistem elektrik, apakah perbezaan di antara sifat atau haba yang berlaku di dalam oven dan perubahan system penyejuk itu sendiri. Selain itu juga untuk mengetahui perbezaan yang berlaku apabila beban yang dikenakan dan beban yang tidak dikenakan terhadap sistem yang berlaku di dalam sekitar oven tersebut dapat menyerap haba dengan banyak atau sebaliknya. Keputusan menunjukkan haba yang keluar bebas di dalam oven itu dapat digunakan sebanyak 43.64°C.

TABLE OF CONTENT

CHAPTER	TITLE	PAGES

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

CHAPTER I

INTRODUCTION

1.1 The History of the Refrigerator

There were a number of ways to keep food cool in earlier times, and humans made use of a diverse number of natural surroundings. Placing food in cold streams, secreting it in the backs of caves, or digging underground to create cellars were all early methods of cooling foods. People also cut ice in the wintertime, and stored it in deep cellars or icehouses. Such ice could keep for a significant period of time, especially if it was covered in salt.

The first kitchen "appliance" that bears some resemblance to the refrigerator is the icebox. These were developed just before the 19th century. They were simply wooden boxes, often installed in a home, and sometimes lined with metal or other materials. People would purchase ice, place it in the box, and then store foods that needed to be kept cool. The ice would slowly melt, so most ice boxes featured drip pans, which could be removed and dumped.

Many studies on the aspects of refrigeration were developed before the icebox, but simply hadn't been put into practice yet. Dr. William Cullen is often thought of as a pioneer in refrigeration technology since his scientific experiments in the early 18th century observed how liquids evaporated in a vacuum like setting. Other scientists set out to study aspects of cooling and chemicals.

According to Dr. John Goorie, he created an ice-making machine to help address the needs of patients with yellow fever, and Michael Faraday studied the properties of ammonia. Faraday realized ammonia had a cooling effect.

These early studies, and the ideas of many other scientists, led to the development of the first refrigerator in 1876 by the German engineer Carl von Linde. He had perfected a process by which large amounts of liquids could be converted into gas in order to keep a defined environment cool. Linde continued to perfect his invention, and others followed suit in attempting to create refrigerators. By 1920, over 200 companies were manufacturing different types of refrigerators, and at this same time, many companies had developed technologies to produce refrigerator/freezer combinations. They were still very much luxury appliances, and many people continued to use the old standby of the icebox instead of a refrigerator.

Over the few next decades, refrigeration technology improved but some of the chemicals used to create a cold environment would definitely give us pause today. For instance, Freon was frequently used to cool or freeze foods. While this may have been effective, Freon released CFCs (chlorofluorocarbons), which were later shown to be hazardous to the environment. Additionally, early fridges used a significantly higher amount of electric energy than their modern counterparts. Efforts on behalf on conservationists and environmentalists changed the modern refrigerator and by the 1980s most models ran on less power and did not use or release CFCs.

1.2 Problem Statement

The heat dissipated by the condenser to the air is carried away by air that enters through the bottom and sides of the refrigerator and leaves through the top.

The heat from condenser coil can be used to develop warm oven at the top of the refrigerator. The oven is not required any electrical sources and utilize the heat that released by the condenser.

1.3 Objectives and Scopes

Objective

- To design the oven compartment at the top of the refrigerator.
- To fabricate the oven compartment at the top of the refrigerator
- To investigate the temperature distribution from the condenser to oven compartment by experiment.
- Study the effect of the refrigerator performance after modified the condenser.

Scopes

- Study the refrigerator working principle
- Study the COP of refrigerator and system performance.
- Design and fabricate the oven compartment and modify the condenser if necessary
- Analyze and investigate the temperature distribution using data logger.

CHAPTER II

LITERATURE REVIEW

2.1 How Refrigerators Work

Refrigeration is a cycle, so the same steps are repeated over and over again, but we'll begin with compression. The compressor is a refrigerator part that compresses the refrigerant. This pressure causes the refrigerant to become a hot vapor.

The refrigerant then leaves the compressor and enters the condenser. A refrigerator's condenser allows the refrigerant to transform from a gas to a liquid as pressure eases. Heat exchanging pipes known as condenser coils pick up the heat given off during this transformation and dissipate it into the outside air, which is why the condenser coils, are located outside the back of the refrigerator.

The next stage of the refrigeration cycle involves the expansion valve. Even though the refrigerant has condensed and given off heat, it's still under increased pressure from its time in the compressor. The expansion valve is essentially a small hole. As the refrigerant passes through the expansion valve, it enters a low-pressure area. This sudden decrease in pressure causes the refrigerant to vaporize, i.e. evaporate. The process is similar to the pressurized contents of an aerosol can escaping through the spray hole to dissipate into the air.

With pressure reduced, the refrigerant suddenly becomes very cold. At this stage in the refrigeration cycle, the refrigerant has entered the heat-exchanging evaporator, sometimes referred to as the indoor coil or evaporator coil. It's there that the refrigerant absorbs heat from the refrigerator's food compartments.

To understand why this heat transference occurs, it's important to know the second law of thermodynamics, which states that heat travels from warmer areas to cooler areas. As the refrigerant moves through the coils, the compartments cool and the refrigerant gets warmer. To assist with this process and provide even cooling, refrigerators use a blower or fan to move the inside air around the coils.

2.2 The Purpose of Refrigeration

The fundamental reason for having a refrigerator is to keep food cold. Cold temperatures help food stay fresh longer. The basic idea behind refrigeration is to slow down the activity of bacteria (which all food contains) so that it takes longer for the bacteria to spoil the food.

For example, bacteria will spoil milk in two or three hours if the milk is left out on the kitchen counter at room temperature. However, by reducing the temperature of the milk, it will stay fresh for a week or two; the cold temperature inside the refrigerator decreases the activity of the bacteria that much. Refrigeration and freezing are two of the most common forms of food preservation used today.

2.3 Parts of a Refrigerator

Basic idea behind a refrigerator is to use the evaporation of a liquid to absorb heat. As the water evaporates, it absorbs heat, creating that cool feeling. Rubbing alcohol feels even cooler because it evaporates at a lower temperature. The liquid, or refrigerant, used in a refrigerator evaporates at an extremely low temperature, so it can create freezing temperatures inside the refrigerator.

There are five basic parts to any refrigerator:

- Compressor
- Heat-exchanging pipes - serpentine or coiled set of pipes **outside the unit**
- Expansion valve
- Heat-exchanging pipes - serpentine or coiled set of pipes **inside the unit**
- Refrigerant - liquid that evaporates inside the refrigerator to create the cold temperatures.

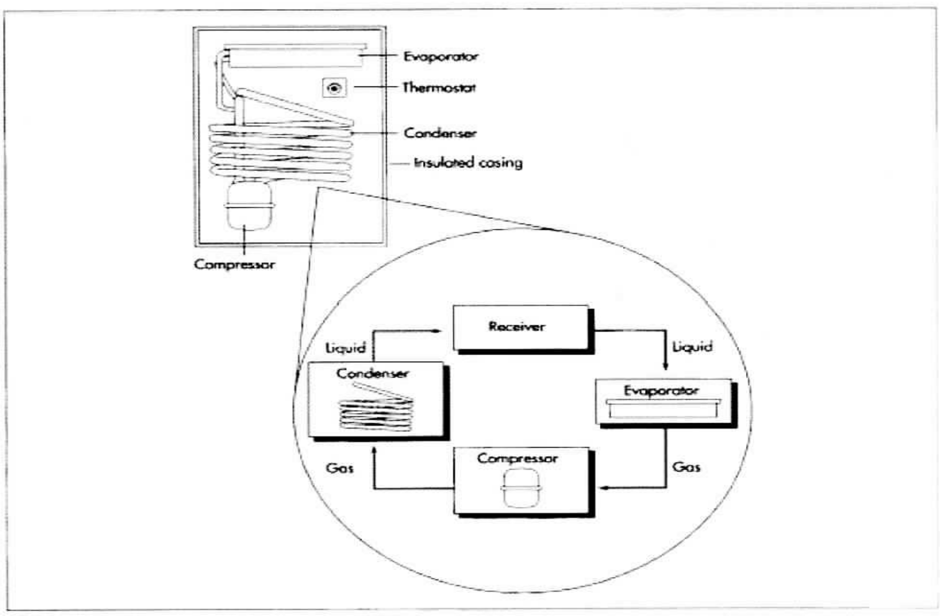

Figure 2.1: Basic parts of refrigerator

2.4 Basic mechanism of a refrigerator works.

The basic mechanism of a refrigerator works like this:

- The compressor compresses the refrigerant gas. This raises the refrigerant's pressure and temperature (orange), so the heat-exchanging coils outside the refrigerator allow the refrigerant to dissipate the heat of pressurization.
- As it cools, the refrigerant condenses into liquid form (purple) and flows through the expansion valve.
- When it flows through the expansion valve, the liquid refrigerant is allowed to move from a high-pressure zone to a low-pressure zone, so it expands and evaporates (light blue). In evaporating, it absorbs heat, making it cold.
- The coils inside the refrigerator allow the refrigerant to absorb heat, making the inside of the refrigerator cold. The cycle then repeats.

2.5 Old Refrigerators

If look at the back or bottom of an older refrigerator, a long thin tube that loops back and forth. This tube is connected to a pump, which is powered by an electric motor.

Inside the tube is Freon, a type of gas. Freon is the brand name of the gas. This gas chemically is called Chlorofluorocarbon or CFC. This gas was found to hurt the environment if it leaks from refrigerators. So now, other chemicals are used in a slightly different process (see next section below).

CFC starts out as a liquid. The pump pushes the CFC through a lot of coils in the freezer area. There the chemical turns to a vapor. When it does, it soaks up some of the heat that may be in the freezer compartment. As it does this, the coils get colder and the freezer begins to get colder.

In the regular part of your refrigerator, there are fewer coils and a larger space. So, less heat is soaked up by the coils and the CFC vapor.

The pump then sucks the CFC as a vapor and forces it through thinner pipes which are on the outside of the refrigerator. By compressing it, the CFC turns back into a liquid and heat is given off and is absorbed by the air around it. That's why it might be a little warmer behind or under your refrigerator.

Once the CFC passes through the outside coils, the liquid is ready to go back through the freezer and refrigerator over and over.