"I confess that have been read this outstanding piece of works and at my this piece of work is acceptable from the scope and the quality for the awarded Bachelor of Mechanical Engineering (Thermal-Fluids)"

Signature :...

Name : Prof. Madya Ir. Mustafar B. Ab Kadir

Date :....12/5/2009............................

DEVELOPMENT OF PROTOTYPE FOR DOMESTIC VACUUM COOKER

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(Automotive)

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"I declare that all parts of this report are the result of my own work, except a few sections which were extracted from other resources as being mention"

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Special for my mom and dad, Haliza Bt. Yussof and Ruzlan B.Yusof

Project supervisor, P. M. Ir. Mustafa B. Ab Kadir

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ABSTRACT

In this modern era, many technologies have been produced so that it can be easier, effective and suitable with every condition. Every technology that produced will give comfort to customers. The objectives of this project are to study the various proposed design of domestic vacuum cooker, to design domestic size vacuum cooker and to test the prototype vacuum cooker. The design that has to be studied depends on the cooker that is available in the markets. Vacuum cooker needs vacuum pump to make sure that it would function. The choice of the vacuum pump is very important and should be suitable with the cooker size that has to be designed. The cooker to be produced must have the specifications that are user friendly, ease of installing, handling, portable, have enough capacity for home uses, and have aesthetics value.

ABSTRAK

Di era serba canggih kini, pelbagai teknologi dicipta supaya lebih mudah, efektif dan bersesuaian dengan keadaan. Setiap teknologi yang dicipta memberi kemudahan pada setiap penggunanya. Objekif projek ini ialah mengkaji bentuk-bentuk atau rekaan yang sesuai untuk periuk pemasak vakum tempatan, mereka rekabentuk periuk pemasak vakum serta menghasilkan dan menguji prototaip periuk pemasak vakum. Bentuk-bentuk periuk dikaji melalui periuk pemasak yang ada di pasaran. Periuk pemasak jenis vakum memerlukan vakum pump untuk membolehkan ia berfungsi. Pemilihan vakum pump adalah penting dan perlu bersesuaian dengan bentuk periuk yang ingin dicipta. Penghasilan periuk ini mesti memiliki ciri-ciri mesra pengguna, mudah dikendalikan, mudah alih dan mencukupi untuk masakan seisi keluarga dan memiliki nilai-nilai estetika.

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INTRODUCTION

1.1 BACKGROUND

Cooker is one of the technologies that have been produced to make it easier for people who do not have much time to cook dishes for their family. Types of cooker we have in the market are pressure cooker, electric cooker, vacuum flask cooker, vacuum frying cooker and others. This project is to produce a prototype of a vacuum cooker for domestic users. It is a method of cooking in a low pressure and reduces temperature and it would retain their natural flavours and aroma. This cooker requires 10 to 20 times less energy without thermal insulation. The project will focuses on the feasibility study on various proposed design of domestic vacuum cooker, design the domestic size of the cooker and test the prototype.

1.2 PROBLEM STATEMENT

To cook dishes, it will take quite long time. It would be difficult for those who are busy and especially for the career women. Hence, to prevent this problems many types of cooker are produced, and so that a vacuum cooker that is going to be produced and will make our life easier. Usually, the nutrition and the structure of the food will be destroyed if it takes long periods of time to cook but for the vacuum cooker, all this will not happen. A vacuum pump is needed to removes gas molecules from a sealed volume in order to leave behind a partial vacuum, so that the cooker will be function. It is important to have a suitable vacuum pump and can functioning well along with the cooker. Comparison of common cooking and vacuum cooking:

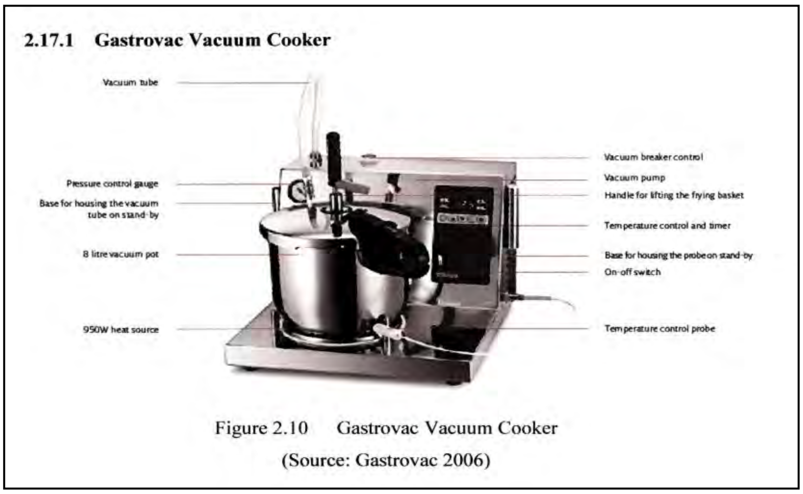

Figure 1.0: Gastrovac Vacuum Cooker

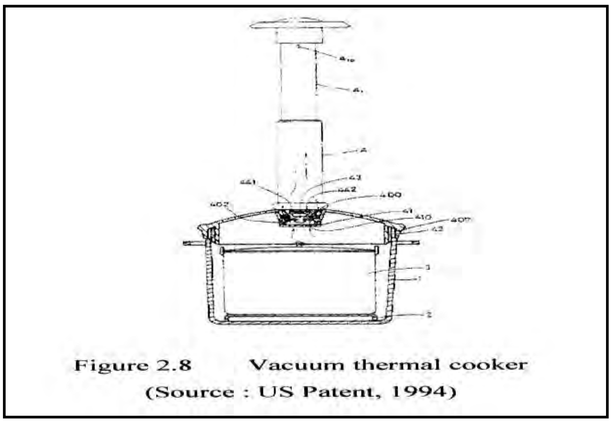

Figure 1.1:Vacuum Thermal Cooker

Figure 1.2: Rice Cooker

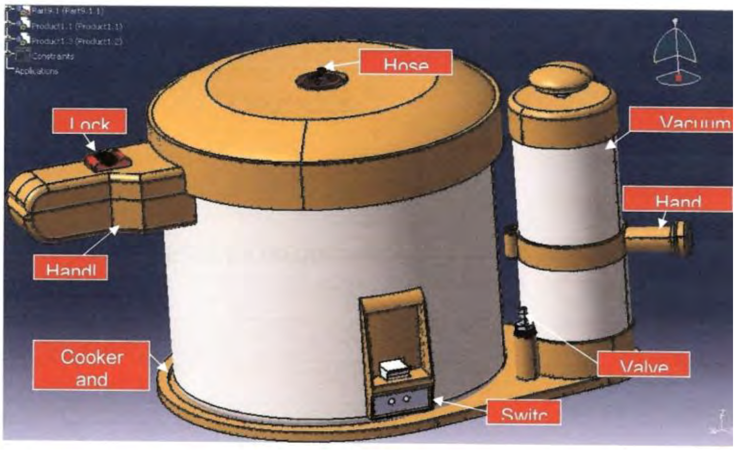

Figure 1.2: Vacuum cooker

1.3 OBJECTIVE

The objective of this project is to design and fabricate a variable domestic vacuum cooker suitable for daily use.

1.4 SCOPE

The scopes are to study various proposed design of domestic vacuum cooker, to design domestic size vacuum cooker and to test the prototype vacuum cooker.

1.5 SOFTWARE REQUIREMENT

Software that require in this project are:

i. Microsoft Office 2007 (Word, Excel)
ii. Catia V5

1.6 PROJECT SCHEDULE

Define all the activities in every phase starting from identifying problem until the detail design

1.6.1 Phase 1: Planning Phase (the introduction to _Projek Sarjana Muda' (PSM))

i) Attend PSM 1 briefing
ii) Find suitable project's title and the supervisor on their major.
iii) Do research on proposed system
iv) Define the objectives
v) Attend meeting with supervisor for the next step.

1.6.2 Phase 2: Preliminary Phase (Define Problem Statement)

Chapter 1: Introduction

i) Identify problem statement
ii) Define objective and scope of the project
iii) Identified Project Significant and Expected Output
iv) Develop project schedule
v) Submit chapter 1

Chapter 2: Literature Reviews

i) Study process planning, various design and size
ii) Do research on relevant methodology
iii) Decide on the suitable methodology based on research
iv) Submit chapter 2

1.6.3 Phase 3: Analysis Phase

Methodology

i) Study the process need to be use
ii) Study on how to get best solution or result
iii) submit chapter 3

1.6.4 Phase 4: Design Phase

Product Development

i) Study the product development and design process flow
ii) Identifying customers need
iii) Product specifications
iv) Conceptual design

v) Submit chapter 4

1.6.5 Phase 5: Detail Design Phase

Result

i) Concept selection

ii) Final concept

iii) Conclusion from result

1.6.6 Phase 6: Final Phase

i) Complete PSM II draft report

ii) Submit PSM II final report to supervisor and panel

iii) Final presentation

iv) Submit PSM II final report

CHAPTER 2

LITERATURE REVIEW

2.1 Vacuum

A vacuum is a volume of space that is essentially empty of matter, that its gaseous pressure is much less than atmospheric pressure. But no volume of space can be perfectly empty in reality.

How closely it approaches a perfect vacuum refer by the quality of a vacuum. The primary indicator of quality is the residual gas pressure, and measured in units called torr, even in metric contexts. Predicting that no volume of space can be perfectly empty, quantum theory sets limits for the best possible quality of vacuum. A natural high quality vacuum is the outer space, mostly of higher quality than can be created artificially with current technology. For many years low quality artificial vacuums have been used for suction.

In the 20th century, vacuum became a valuable industrial tool with the introduction of vacuum tubes and incandescent light bulbs, and a wide array of vacuum technology.

Vacuum is a pressure lower than atmospheric. Except in outer space, vacuums occur only in closed systems. In the simplest terms, any reduction in atmospheric pressure in a closed system may be called a partial vacuum. In effect, vacuum is the pressure differential produced by evacuating air from the system. In a vacuum system more sophisticated than a suction cup, the enclosed space would be a valve actuator or some appropriate work device. A vacuum pump would be used to reduce atmospheric pressure in the closed space. The same principle would apply, however. By removing air from one side of an air-tight barrier of some sort, atmospheric pressure can act against the other side. Just as with the suction cup, this action creates a pressure differential between the closed system and the open atmosphere. The pressure differential can be used to do work.

For example, in liquid packaging (bottling), reducing the pressure in a bottle (the enclosed space) makes the filling operation go much faster because the liquid or other material is literally pulled into the bottle, rather than simply falling by gravity.

2.1.1 Uses

In a variety of processes and devices the vacuum is useful. The incandescent light bulb which is to protect the filament from chemical degradation is its first widespread use. For electron beam welding, cold welding, vacuum packing and vacuum frying are useful for its chemical inertness. In the study of atomically clean substrates, the ultra-high vacuum is used as a vacuum preserves atomic-scale clean surfaces for a reasonably long time (on the order of minutes to days). High to ultra-high vacuum removes the obstruction of air, allowing particle beams to deposit or remove materials without contamination. These are essential to the fabrication of semiconductor and optical coating, and to surface science with the principle behind chemical vapour deposition, physical vapour deposition, and dry etching. Which is used in freeze drying, adhesive preparation, distillation, metallurgy, and process purging, the deep vacuum promotes out-gassing. The electrical properties of vacuum make electron microscope and vacuum tubes possible, including cathode ray tube. The elimination of air friction is useful for flywheel energy stored and ultracentrifuges.

2.1.2 Pumping

By creating a vacuum that water rushes in to fill, the water pump draws water up from a well. In addition, it acts to evacuate the well, although the high leakage rate of dirt prevents a high quality vacuum from being maintained for any length of time. It is technically impossible to create a vacuum by suction because fluids cannot be pulled. The vacuum has to be created first then suction can spread and dilute a vacuum by letting a higher pressure push fluids into it. The easiest way to create an artificial vacuum is to expand the volume of a container. For example, the diaphragm muscle expands the chest cavity, which causes the volume of the lungs to increase. It is soon filled by air pushed in by atmospheric pressure when this expansion reduces the pressure and creates a partial vacuum.

To continue evacuating a chamber indefinitely without requiring infinite growth, a compartment of the vacuum can be repeatedly closed off, exhausted, and expanded again. This is the principle behind positive displacement pump, like the manual water pump for example. Inside the pump, a mechanism expands a small sealed cavity to create a vacuum. Because of the pressure differential, some fluid from the chamber (or the well, in our example) is pushed into the pump's small cavity. The pump's cavity is then sealed from the chamber, opened to the atmosphere, and squeezed back to a minute size.

Multiple pumps may be connected in series called stages, to achieve higher vacuum. There will have an impact in choices of seal, chamber geometry, materials and pump-down procedures and those are called vacuum technique. Pumping systems differ in oil contamination, vibration, preferential pumping of certain gases, pump-down speeds, intermittent duty cycle, reliability, or tolerance to high leakage rates. The lowest pressures currently achievable in laboratory are about 10^{-13} Torr. However, pressures as low as 5×10^{-17} Torr have been indirectly measured in a 4K cryogenic vacuum system

2.1.3 Volumetric Efficiency

The theoretical pumping capability of a positive displacement compressor is the product of its displacement (the total volume transported by its pumping elements in one revolution) times its speed in revolutions per minute. Displacement is determined by the size and number of the pumping elements (piston chambers, vane compartments, etc.). Displacement alone should not be used as a sizing parameter, since it is a theoretical value that does not take into account pumping losses.

A pumping device's volumetric efficiency is how close it comes to delivering the calculated volume of fluid. Volumetric efficiency varies with speed, pressure, and type of pump. It is found by comparing actual delivery with computed delivery using this formula:

$$VolumetricEfficiency\ (\%) = \frac{FreeAirDeliveryincfm}{TheoreticalCapacityincfm} \times 100$$

The volumetric efficiency of an air compressor is highest at 0 psig-that is, when it is discharging to the atmosphere. Volumetric efficiency becomes progressively lower as pressure increases. This drop reflects a loss in rated capacity at higher pressures, mainly because of increases in the pressure of air trapped in the "clearance volume" and to an increase in internal leakage or slippage. The temperature and density of the incoming air also affect the efficiency.

2.1.3 Out-gassing

Out-gassing is a evaporation and sublimation into a vacuum. When the vacuum pressure falls below this vapour pressure, all material, solid or liquid, have a small vapour pressure and their out-gassing becomes important. Out-gassing has the same effect as a leak and can limit the achievable vacuum in man-made system. If they obscure optical instruments or react with other material so out-gassing products may condense on nearby colder surfaces, which can be troublesome. This is of great concern to space missions, where an obscured telescope or solar cell can ruin an expensive mission.

Water absorbed by chamber material is the most prevalent out-gassing product in man-made vacuum systems. It can be reduced by desiccating or removing absorbent material and baking the chamber. If gas ballasting is not used so that out-gassed water can condense in the oil of rotary vane pumps and their net speed drastically. To minimize out-gassing, the high vacuum systems must be clean and free of organic matter.

Ultra-high vacuum systems are usually baked, preferably under vacuum, to temporarily raise the vapour pressure of all out-gassing materials and boil them off. The system may be cooled to lower vapour pressures and minimize residual out-gassing during actual operation, once the bulk of the out-gassing materials are boiled off and evacuated. To shut down residual out-gassing and simultaneously cryopump the system, some system may be cooled well below room temperature by liquid nitrogen.

2.1.4 Quality

By the amount of matter remaining in the system, the quality of a vacuum can indicate so that a high quality vacuum is one with very little matter left in it. Vacuum is measured by its absolute pressure, but a complete characterization requires such as temperature and chemical composition. The mean free path (MFP) of residual is one of the most important parameters which indicate the average distance that molecules will travel between collisions with each other. As the MFP increase, the gas density decreases and the continuum assumptions of fluid mechanics do not apply when the MFP is longer than the chamber, pump, spacecraft, or other objects present. This vacuum state is called high vacuum, and the studys of fluid flows in this regime is called particle gas dynamics.