THE DESIGN AND DEVELOPMENT OF WARNING DEVICE FOR LOW PRESSURE LPG TANK

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‘I hereby declared that I have read through this report and I found that it has comply the partial fulfillment for awarding the degree of Bachelor Mechanical Engineering (Thermal-Fluid)’

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This dissertation is submitted as partial fulfillment of the requirement for the degree of Bachelor of Mechanical Engineering (Thermal Fluid)

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” I declare that this report is done by my own exclude the citation with the mentioned references for each”

Signature :…….

Author Name :…….

Date :…….

For my lovely parent

Encik Md. Saad Bin Ahmad dan Puan Manisah Binti Hussien

My brothers

Fadhlizil Fashriq Bin Md. Saad
Fadhlizil Faiq Bin Md. Saad

My classmate, my housemate and my beloved girlfriend.

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ABSTRACT

Nowadays, LPG tank is used for cooking. There are many dealers and manufacturers of LPG tank such as Petronas, Shell and BP. Lpg tank weight for cooking is 30.5 kilogram while gas weight in the LPG tank is 14 kilogram. Users that using LPG tank for cooking have a problem where the gas is reduce without any warning. This objectives of this research is to design and development of warning device for low pressure LPG tank. This research is conducts to help users to alert when the LPG tank is running out of gas. This device can help users to give early warning before the LPG tank is running out of gas and users can get ready to refill gas in the LPG tank. Experiment one is conduct to know the minimum pressure in the LPG tank. This minimum pressure also can be known when the weight of LPG tank reach to the minimum pressure. The weight gas in the LPG tank is fix for 14 kg, 11 kg, 8 kg, 5 kg and 2 kg. Stove will be used in burning process for half an hour for each weight. Experiment two is conduct to determine which regulator suitable for this project. The adjustable regulator is the suitable regulator for the project. While experiment three is conduct to determine the suitable pressure for cooking. The suitable pressure for cooking is 0.10 bar. Finally experiment four is conduct to determine the duration of LPG tank pressure to decrease from 0.1 bar to 0 bar. The duration of LPG tank pressure to decrease from 0.1 bar to 0 bar is 6 minutes.

ABSTRAK

Pada masa kini, tangki LPG digunakan untuk memasak. Terdapat banyak pengedar dan pengeluar tangki LPG iaitu Petronas, Shell dan BP. Berat tangki LPG untuk memasak ialah 30.5 kilogram manakala gas di dalam tangki LPG mempunyai berat sebanyak 14 kilogram. Pengguna yang menggunakan tangki LPG untuk memasak mempunyai masalah kehabisan gas tanpa disedari. Tujuan kajian ini adalah untuk mencipta satu alat yang dapat memberikan amaran jika terdapat tekanan rendah di dalam tangki LPG. Kajian ini juga dijalankan untuk membantu pengguna supaya lebih berjaga-jaga sekiranya mengalami masalah kehabisan gas di dalam tangki LPG. Alat ini dapat membantu pengguna dengan memberikan amaran awal sebelum gas di dalam tangki LPG kehabisan dan pengguna boleh bersedia untuk mengisi gas di dalam tangki LPG. Eksperimen pertama di jalankan untuk mengetahui tekanan yang paling minimum di dalam tangki LPG. Tekanan yang minimum ini juga diketahui melalui berat tangki LPG yang paling minimum. Berat gas di dalam tangki LPG ditetapkan iaitu 14 kg, 11 kg, 8 kg, 5 kg dan 2 kg. Dapur gas akan digunakan untuk tujuan pembakaran selama setengah jam untuk semua berat. Eksperimen untuk mengkaji kadar penggunaan pada berat gas yang berbeza dijalankan untuk melihat kesan amaun gas tetap kadar penggunaan. Eksperimen kedua dijalankan untuk menentukan pengawal atur yang sesuai untuk projek ini. Pengawal atur boleh ubah ialah pengawal atur yang sesuai digunakan untuk projek ini. Eksperimen ketiga pula dijalankan untuk menentukan tekanan yang sesuai untuk proses memasak. Melalui eskperimen yang dijalankan tekanan yang sesuai untuk memasak ialah 0.1 bar. Eksperimen keempat dijalankan untuk mengetahui anggaran masa bagi tekanan di dalam tangki LPG menurun dari 0.1 bar hingga 0 bar. Anggaran masa bagi tekanan di dalam tangki LPG menurun dari 0.1 bar hingga 0 bar ialah 6 minit.

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LPG	Liquefied Petroleum Gas
m	molar mass
P	Absolute pressure
R	universal gas constant ($J.kg^{-}/K$)
T	Absolute temperature
V	Volume
V	Volts
NC	Normally closed

LIST OF APPENDICES

CHAPTER 1

INTRODUCTION

1.1 Project Background

LPG (Liquefied Petroleum Gas) has been formed over millions of years beneath the ground. Gas rigs produce the gases as a mixture, where they are separated into methane, the LPG's of propane and butane and other gases. LPG is also produced from crude oil at refineries by distillation process.

LPG exists as a gas at normal atmospheric pressure, only existing in a liquid form at very low temperatures, or under pressure. Normally, the gas is stored in liquid form under pressure in a steel container. When the pressure is released (e.g. when the gas supply valve is turned on), the liquid will boil and form a vapour. It's this vapour (gas) that is used to fuel appliances.

Heat is needed to convert the liquid to gas, known as the latent heat of vapourisation. As the liquid boils, it needs to take heat energy from itself and its surroundings. This is why containers feel cold to touch and if there is a heavy gas off-take, frost may appear on the outside.

Pressure increases with temperature, so if the temperature around the tank increases, so will the pressure inside the tank as the liquid expands. Tanks are normally fitted with a pressure relief valve to release any extreme build up of pressure safely.

Now day, LPG is used as a fuel for domestic (cooking) but people is only aware the LPG tank is empty when it can not produce gas to cook. That way, this project suggests the device that can give early warning to the user when the LPG tank is almost empty so that users are ready to change the tank.

1.2 Problem Statement

People are only aware the LPG tank is empty when it can not produce gas to cook. This situation will give problem to the user to change the LPG tank with the new one. It is better if there is early warning to the user when the LPG tank is almost empty so that users are ready to change the tank.

1.3 Project advantages

This project is easier for user to change the LPG tank when the devices give early warning that the LPG tank is almost empty. This project also improves student skill when designed the device to detect the minimum pressure in LPG tank. Beside that, this project also make student familiar with vapourization.

1.4 Objectives

Objective for this project are:

1. To design and fabricate device that can produce sound if the LPG tank pressure drop at certain level.
2. To investigate the pressure of LPG tank and identify the minimum pressure required to active the warning device.

1.5 Scope

The device designed and developed is small and can be connected to the LPG hose. The minimum pressure for the device to produce sound (warning) is determine. The alarm controlled by a pressure switch.

CHAPTER 2

LITERATURE REVIEW

2.1 LPG Tank

LPG is used as a fuel for domestic (cooking), industrial, horticultural, agricultural, heating and drying processes. LPG can be used as an automotive fuel or as a propellant for aerosols, in addition to other specialist applications. LPG can also be used to provide lighting through the use of pressure lanterns.

Figure 2.1: LPG tank for cooking

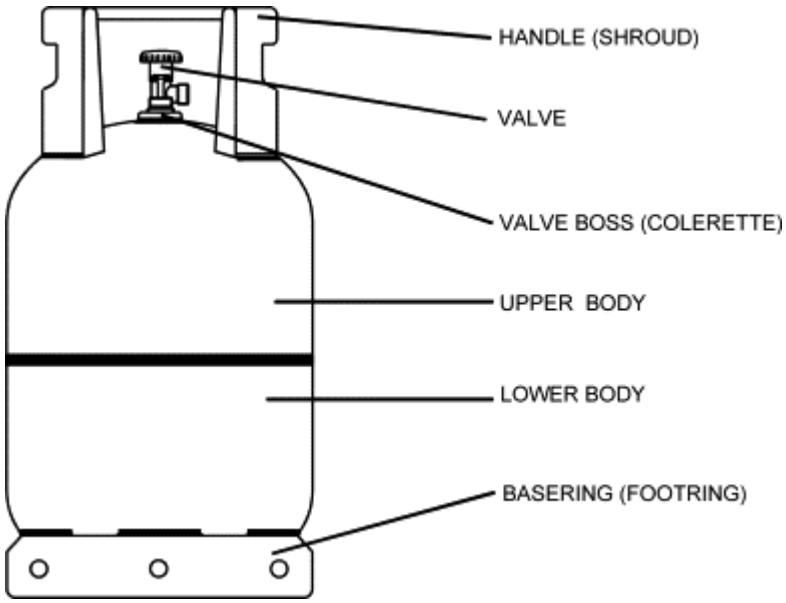

Figure 2.2: Structure of LPG tank model

(Source: Journal comparison of bursting pressure results of LPG tank using experimental and finite element method by Egemen Aksoley, Babur Ozcelik and Ismail Bican, 2007)

2.1.1 LPG Tank Advantage

The advantages of LPG are:

- Its relatively less components, it is easy to achieve the correct fuel to air mix ratio that allows the complete combustion of the product. This gives LPG its clean burning characteristics.
- Both Propane and Butane are easily liquefied and stored in pressure containers. These properties make the fuel highly portable, and can be easily transported in cylinders or tanks to end-users.

- LPG is a good substitute for petrol in spark ignition engines. Its clean burning properties, in a properly tuned engine, give reduced exhaust emissions, extended lubricant and spark plug life.
- As a replacement for aerosol propellants and refrigerants, LPG provides alternatives to fluorocarbons, which are known to cause corrosion of the earth's ozone layer.

2.1.2 The properties of LPG gas

Journal review from Babur Ozcelik and Ismail Bican (2007) state that liquefied petroleum gas is normally colorless and odorless. For easily distinguishing a possible gas leak by the user it has been specially aromatized. The boiling points of liquefied petroleum gases (the temperatures that they transform from liquid state to gaseous state) are very low. Propane can become gaseous at −42 °C, butane at −0.5 °C. By this property it can be used at very cold regions. The liquid butane and propane is approximately 50-50 lighter than water. Therefore, in a tube with a water capacity of 26.2 l approximately 12 kg of LPG can be filled. When the LPG is in gaseous state, it is approximately two times heavier than air. LPG has a low boiling point and lower than ambient temperature. Hence, LPG evaporates when leak happens. It accumulates in the cavities around the floor level. Thermal values of liquefied petroleum gases are higher than other gases. This height of thermal value gives an important advantage to gas.

Table 2.1: Typical Properties of LPG

(Source: Journal comparison of bursting pressure results of LPG tank using experimental and finite element method by Egemen Aksoley, Babur Ozcelik and Ismail Bican, 2007)

Typical Properties of LPG		
Hydrocarbon Composition (by Volume)		
Commercial Propane (C_3H_8)	%	30
Commercial Butane (C_4H_{10})	%	70
Vapour Pressure at ambient	kPa	500
Total Sulphur (stenched)	mg/kg	< 75
Free Water (Visual Inspection)		None
Relative density (compared to dry air)		1.85
Copper Corrosion Strip		1
Calorific Value, gross	MJ/kg Btu/lb	49.5 21,300
Calorific Value, nett	MJ/kg Btu/lb	45.7 19,600

Table 2.2: LPG Tank Properties

(Source: Journal comparison of bursting pressure results of LPG tank using experimental and finite element method by Egemen Aksoley, Babur Ozcelik and Ismail Bican, 2007)

Property	Units	Commercial Propane	Commercial Butane	Mixture 50% each
Specific gravity of Liquid at 15 deg C (Water=1)		0.504	0.582	0.543
Specific gravity of Vapor at 15 deg C(Air=1)		1.5	2.01	1.75
Vapor pressure at 38 deg C	Kg/sq.cm	13.8	2.6	8.0
Boiling point at atm pressure	Deg C	- 42	9	+ 9 to - 42
Ignition temperature in air	Deg C	495-605	480-535	480-605
Latent Heat of Vaporization	Btu/lb	184	167	175

2.1.3 Butane and Propane

According to the M.Egemen Aksoley (2007), LPG Tank usually uses butane and propane butane as a gas. This is because butane and propane consist very largely of these saturated hydrocarbons, but during the process of extraction or production certain allowable unsaturated hydrocarbons like ethylene, propylene and butylenes may be included in the mixture along with pure propane and butane. The presence of these in moderate amounts would not affect LPG in terms of combustion but may affect other