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THE DESIGN AND DEVELOPMENT OF PNEUMATIC IMPULSE ROCKET FOR NIGHT PARACHUTE SEARCH LIGHTING

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This report is submitted in accordance with requirement for the
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"I hereby declared that this thesis titled
„The Design and Development of Pneumatic Impulse Rocket for Night Parachute Search Lighting" is the result of my own effort except as cited in references".

Signature : _____
Name of Author : _____
Date : _____

I hope that this report may save the hands, eyes, and lives of countless youngsters who might never have learned about pneumatic impulse rocket. I also hope it may set many young people on their course toward becoming astronauts, engineers, technicians, and other kinds of scientists. I hope it may serve as a guidepost to many people, young and old, who are interested in rockets.

I have given much time and effort to it and I have learned that "knowledge is the enemy of learning." In other words, if you think you already know it all, your mind becomes closed to learning anything new. Read this report, learn something, and if at all possible, go ahead and pass your knowledge on. "Do the same for others when you grow up."

Finally, I would like to dedicate this to my father, Low Teck Seng, mother, Yeu Kim Tick, my brothers, sister and my beloved one Sylin Lee for supporting me all the way long.

LOW CHIT KEE
Malaysia
2009

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Thank you very much. Your sincere help will be remembered for my whole life.

ABSTRACT

Design of pneumatic impulse rocket for night parachute search lighting is considered as an aerodynamic and also mechanical field of engineering study. Since the use of brimstone and burnt or explosive material to produce force in rocket has caused pollution during the process of launching the rocket for night parachute search lighting, an environmental friendly solution needed to be searched, thus pneumatic impulse rocket for night parachute search lighting had been proposed and designed. It is a device used to carry night parachute search lighting to the sky and it uses pneumatic impulse to create launching force instead of using brimstone burnt or explosive material which had cause pollution. The method used in preparing this project include the preparing of project mission statement, project outline, research, data analysis, product design specification (PDS), functional model analysis, generate concepts, metrics evaluation, concept selection, detail design, fabrication and hardware procurement, implementation and modification. When the part of product had been fabricated and assembled, experimental testing will be conducted before project realisation and verification started. This project will end by verification of supervisor and panel of seminal. The design of pneumatic impulse rocket for night parachute search lighting that work efficiently and environmental friendly has been successfully designed in the end of this project. It is able to carry night parachute search lighting to the sky and by just using pneumatic impulse to create launching force. Lastly, I recommend for those who interested to proceed with this project, they should try to modify the design using more suitable material which is cheaper but at the same time has the equal or better quality design.

ABSTRAK

Reka bentuk roket desakan pneumatik bagi payung terjun pencarian waktu malam boleh dikategorikan dalam bidang pengajian kejuruteraan aerodinamik dan mekanikal. Penggunaan belerang dan bahanapi roket telah mengakibatkan pencemaran semasa proses pelancaran roket bagi payung terjun pencarian waktu malam. Satu kaedah yang mesra alam perlu dicari. Pada masa inilah, roket desakan pneumatik bagi payung terjun pencarian waktu malam telah dicadangkan dan direka. Ia adalah sebuah alat yang mampu membawa payung terjun pencarian waktu malam ke langit di mana ia menggunakan desakan pneumatik untuk menghasilkan daya pelancaran tanpa menggunakan belerang dan bahan letupan yang menjadi punca pencemaran. Kaedah yang digunakan dalam menyediakan projek ini termasuk menyediakan misi projek, garis panduan projek, penyelidikan, data analisis, spesifikasi reka bentuk produk (PDS), fungsi model analisis, penjanaan konsep-konsep, penilaian metrik, pemilihan konsep, reka bentuk perinci, pembuatan dan perkakasan pemerolehan, pelaksanaan dan pengubahsuaian. Apabila semua bahagian produk telah difabrikasi dan disambungkan keseluruhannya, ujikaji akan dijalankan sebelum pengesahan projek dimulakan. Projek ini akan berakhir selepas mendapatkan pengesahan daripada penyelia dan panel-panel yang terbabit. Reka bentuk roket desakan pneumatik bagi payung terjun pencarian waktu malam yang berfungsi dengan cekap dan mesra alam telah berjaya direka di akhir projek ini. Ia berupaya mengangkut payung terjun pencarian waktu malam ke langit dengan hanya menggunakan desakan pneumatik untuk menghasilkan daya pelancaran. Akhirnya, saya mencadangkan bagi sesiapa yang ingin meneruskan kajian dengan projek ini, mereka harus cuba mengubahsuai reka bentuk ini dengan bahan yang lebih sesuai dan menggunakan kos yang lebih murah sama ada serupa atau dipertingkatkan lagi kualiti reka bentuknya berdasarkan reka bentuk roket yang dihasilkan dalam projek ini.

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LIST OF SYMBOL

T	=	thrust
$\frac{dm}{dt}$	=	rate of change of mass with respect to time
v	=	velocity of the object relative to the fluid
P_d	=	power required to overcome the aerodynamic drag
F_d	=	force of drag
ρ	=	mass density of the fluid
A	=	Frontal area of rocket / reference area
C_d	=	drag coefficient (a dimensionless constant)
I_t	=	total impulse
m	=	mass
t	=	time
mv	=	momentum
s	=	distance / altitude
a	=	acceleration
g	=	gravitational acceleration
F	=	force / thrust of the pneumatic impulse at that instant
W	=	weight of the object

LIST OF APPENDIX

CHAPTER I

INTRODUCTION

1.1 Project Background

A rocket is a missile, aircraft or other vehicle which obtains thrust by the reaction of the rocket to the ejection of fast moving fluid from a rocket engine. Chemical rockets work by the action of hot gas produced by the combustion of the propellant against the inside of combustion chambers and expansion nozzles. This generates forces that accelerate the gas to extremely high speed and exert a large thrust on the rocket (since every action has an equal and opposite reaction).

The history of rockets goes back to at least the 13th century. Rockets are used for fireworks and weaponry, as launch vehicles for artificial satellites, human spaceflight and exploration of other planets. While inefficient for low speed use, they are, compared to other propulsion systems, very lightweight and powerful, capable of attaining extremely high speeds with reasonable efficiency.

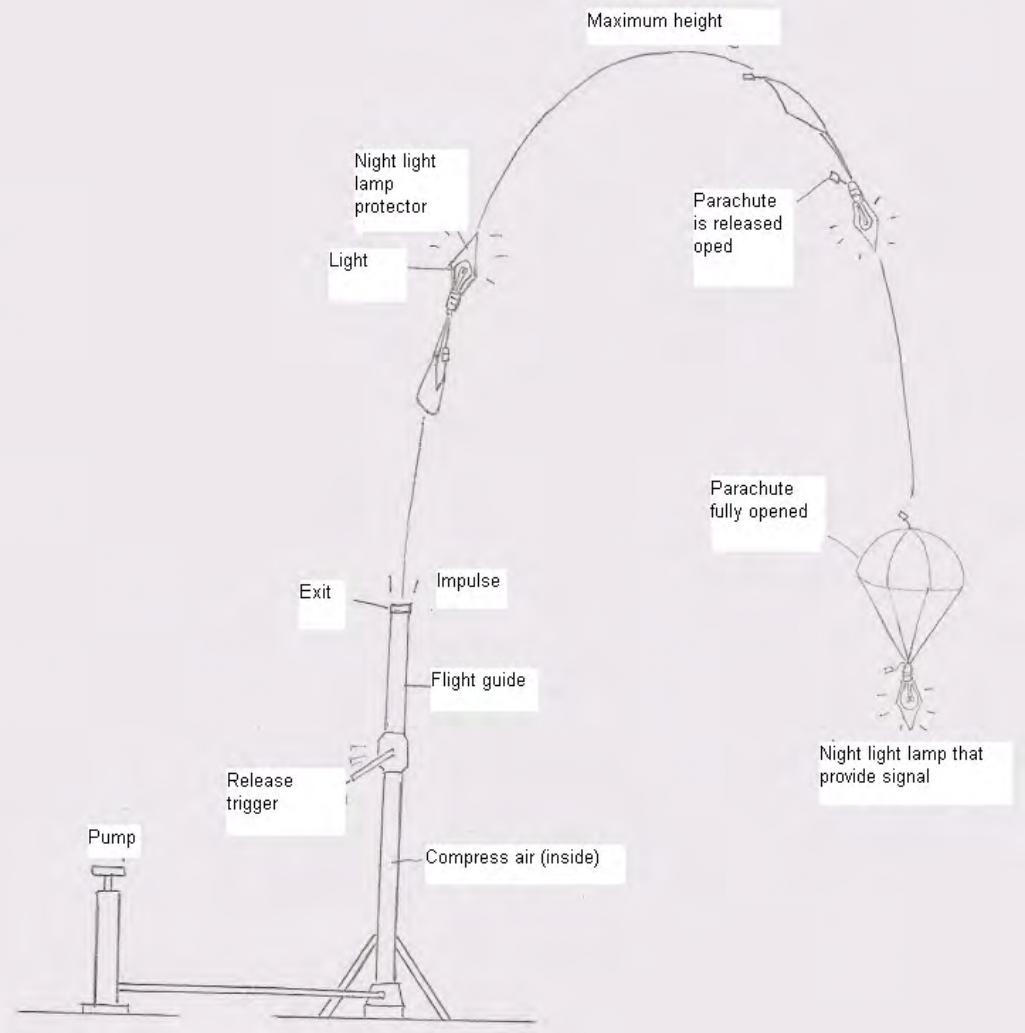

Figure 1.1: The idea of pneumatic impulse rocket for night parachute search lighting

A pneumatic impulse rocket for night parachute search lighting is a device used to carry night parachute search lighting to the sky that give out bright light to people who lost in the jungle, sea and others emergency situation. Its function is originated by the initial function of a flare gun which is a gun that shoots flares. They are typically used as a distress signal as well as other signalling purposes at sea, between aircraft and people on the ground. Flare guns may be used whenever someone needs to send a distress signal. The flares must be shot directly above, making the signal visible for a longer period of time and revealing the position of whoever is in need of help. Pneumatic impulse rocket is a device that provides such functional characteristic. The different between it and the flare gun is that it uses pneumatic impulse to create launching force instead of brimstone and burnt or explosive material. It is portable, safe to use and simple.

1.2 Problem Statement / Definition

The use of brimstone and burnt or explosive material to produce force in rocket has cause pollution during the process of launching the rocket for night parachute search lighting.

a. An environmental friendly solution needed to be searched. Pneumatic impulse rocket for night parachute search lighting had been proposed and to be designed. It is a device used to carry night parachute search lighting to the sky and it uses pneumatic impulse to create launching force instead of brimstone and burnt or explosive material which had cause pollution.
b. This device is a new product platform which is still not exists in the market.

1.3 Objectives

The objectives that needed to be achieved in this project are:

a. To design mechanical part of a slow able falling movement of night light parachute and easily operate pneumatic impulse rocket for mission in night search.
b. It should be able to carry night parachute search lighting to the sky.
c. It uses pneumatic impulse to create launching force instead of brimstone and burnt or explosive material which had cause pollution.

In order to achieve objectives above, a pneumatic impulse rocket for night parachute search lighting is fabricated to prove that it is working. Some equations derived from literature review are used to determine and analyse the engineering calculation for this product. Product refinement and implementation are done repeatedly in order to solve the problems faced and improve the product.

1.4 Scope of Studies

A structure of pneumatic impulse rocket for night parachute search lighting will be generated at the end of this thesis. Its design is based on the concept of rocket technology and other mechanism that produce force to shoot object into the sky.

Here are some scopes of study of the pneumatic impulse rocket for night parachute search lighting:

a. Study all available rocket technology.
b. Study its parameters that directly influence its velocity, height of cruising.
c. Design a pneumatic impulse rocket for night parachute search lighting.

1.5 Thesis Outline

Here are the summary of every chapter that will be described in each chapter. Chapter I introduced about the basic theory, problem encounter, also the main objectives and scopes of producing pneumatic impulse rocket for night parachute search lighting. In Chapter II of this thesis, previous rocket technology and its parameters that directly influence its velocity, height of cruising is reviewed. Chapter III addresses the methodology that including generating designs and data analysis from collected data and information for the implementation of this thesis until the design was verified. Fabrication and result about the pneumatic impulse rocket for night parachute search lighting will be presented in Chapter IV and Chapter V respectively. The result of this project will then be discussed in Chapter VI. Conclusions and recommendations for the whole project are presented in Chapter VII.

CHAPTER II

LITERATURE REVIEW

2.1 Introduction of Pneumatic Impulse Rocket

There are no source found on pneumatic impulse rocket for night parachute search lighting itself due to it is a first design to be created, but there are some source related to the idea used or applied in the design of the rocket, which are:

Firstly, the rocket itself represents the same function as the chemical rocket use in today market. Thus, the rocket technology can be review from current rocket field. This including reviews its parameters that influence its velocity, height of cruising and so on.

Secondly, the functional of pneumatic impulse rocket for night parachute search lighting is initially gain from the idea of signal / flare gun which use brimstone and burnt or explosive material to shoot flares into the night sky. They are typically used as a distress signal as well as other signalling purposes at sea, between aircraft and people on the ground. Not more related information can get from it due to it just using combustion application for the flare and not rocket.

Thirdly, the rocketry model which uses chemical combustion rocket engine can be a guideline to produce the rocket due to its small scale which is more nearer to the size of rocket to be produced in the end of this project.

Fourthly, a water rocket that is a type of model rocket using water as its reaction mass where the water is forced out by a pressurized gas, typically compressed air. In producing pneumatic impulse rocket, the water will be totally replaced with air.

Fifthly, pipe-based cannons or launcher that use air pressure, or combustion of a gaseous fuel, or both, to launch large projectiles at low speed. Some of its application can be applied to this project especially the application of pneumatic launcher.

2.2 Available Rocket Technology

There are many available rocket technology used today in following field of the chemical rocket, small model rocketry, water rocket and more as shown below.

2.2.1 Chemical Rocket

Robert Hutchings Goddard (1919), Ph.D. U.S. professor and scientist, was a pioneer of controlled, liquid-fuelled rocketry, launched the world's first liquid-fuelled rocket on March 16, 1926. From 1930 to 1935 he launched rockets that attained speeds of up to 885 km/h (550 mph). Goddard began experimenting with liquid oxygen and liquid-fuelled rockets in September 1921, and bench tested the first liquid-fuelled engine in November 1923. It had a cylindrical combustion chamber, using impinging jets to mix and atomize liquid oxygen and gasoline. An engine using regenerative cooling was constructed that year, which circulated liquid oxygen around the combustion chamber, but the design was rejected as too complex. He launched the first liquid-fuelled rocket on March 16, 1926 in Auburn, Massachusetts.

The rocket, which was dubbed “Nell”, rose just 41 feet during a 2.5-second flight that ended in a cabbage field, but it was an important demonstration that liquid-fuel propellants were possible. Viewers familiar with more modern rocket designs may find it difficult, on viewing the well-known picture of “Nell”, to distinguish the rocket from its launching apparatus. The complete rocket is significantly taller than Goddard, but does not include the pyramidal support structure which he grasps.

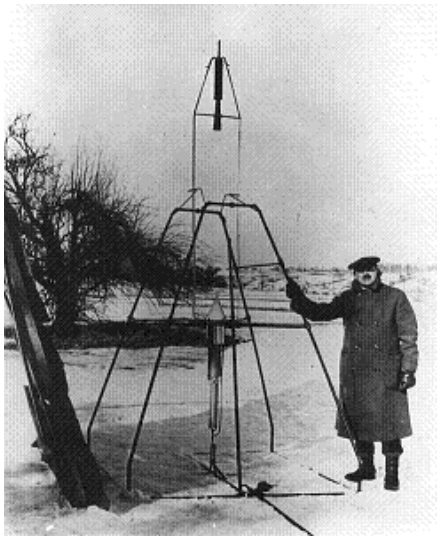

Figure 2.1: Robert Goddard and the first liquid-fuelled rocket
(Source: Goddard, R., 1919)

The rocket’s combustion chamber is the small cylinder at the top; the nozzle is visible beneath it. The fuel tank, which is also part of the rocket, is the larger cylinder opposite Goddard’s torso. The fuel tank is directly beneath the nozzle, and is protected from the motor’s exhaust by an asbestos cone. Asbestos-wrapped aluminium tubes connect the motor to the tanks, providing both support and fuel transport. This layout is no longer used, since the Pendulum Rocket Fallacy showed that this was no more stable than placing the rocket engine at the base. After a series of modifications, by May, the engine was placed in the classic position, at the lower end of the rocket to simplify the plumbing.

Chemical rockets store a large amount of energy in an easily-released form, and can be very dangerous. However, careful design, testing, construction, and use minimize the risks.

There are many different types of rockets, and a comprehensive list of the basic engine types can be found in rocket engine- the vehicles themselves range in size from tiny models such as water rockets or small solid rockets that can be purchased at a hobby store, to the enormous Saturn V used for the Apollo program, and in many different vehicle types such as rocket cars and rocket planes

Figure 2.2: Saturn V is the biggest rocket to have successfully flown
(Source: www.hq.nasa.gov)

Most current rockets are chemically powered rockets (usually internal combustion engines, but some employ a decomposing monopropellant) that emit a hot exhaust gas. A chemical rocket engine can use gas propellant, solid propellant, liquid propellant, or a hybrid mixture of both solid and liquid. With combustive propellants a chemical reaction is initiated between the fuel and the oxidizer in the combustion chamber, and the resultant hot gases accelerate out of a nozzle (or nozzles) at the rearward-facing end of the rocket. The acceleration of these gases through the engine exerts force “thrust” on the combustion chamber and nozzle, propelling the vehicle (in accordance with Newton's Third Law).