DESIGN AND ANALYSIS OF HYDRAULIC SYSTEM FOR FIRE FIGHTING MACHINE

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This thesis is submitted to the Faculty of Mechanical Engineering, in partial fulfillment of the partial requirement for the
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FACULTY OF MECHANICAL ENGINEERING
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DECLARATION

"I hereby declaration that I have read through this thesis and found that it has comply the partial fulfillment for awarding the degree of Bachelor Mechanical Engineering (Thermal Fluid)

Signature : ……..
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DECLARATION

"I hereby declaration that this thesis is my original work except for questions and citations, which have been duly acknowledgement

Signature : ……..
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ABSTRACT

Fire fighting machine is a newly developed machine design where its function is to reduce the fire fighter risk in the dangerous situations. This fire fighting machine is operated using joystick, which is controlled by the fire fighter. A new dozer blade is designed and to be installed on the existing fire fighting machine. The dozer blade is used to move or clear object and save life by carry the victims away from danger during rescuing process. Besides that, this machine is designed to be connected to fire hydrant which is high in pressure in terms of it. The machine is capable to operate and monitor remotely for danger area which have cooling acetylene and other flammable cylinders. By utilize the decontamination materials that containing Chemical, Biological, Radiation or Nuclear Incidents which is easy to explode can be removed without endanger the fire fighter. The dozer blade is designed to save victim retrieval or removal from danger areas and moving flammable cylinders away from this danger. This machine is useful in the workshop, factory, power plants, tunnels, warehouses and in the building where fire fighting process is very risky.

ABSTRAK

Mesin memadam kebakaran adalah satu rekaan baru untuk menolong dan mengurangkan bebanan atau risiko ahli bomba didalam keadaan yang berbahaya. Mesin memadam kebakaran ini berfungsi atau dikawal mengunakan joystick yang disambung kepada mesin. Joystick ini akan dikawal oleh ahli bomba itu sendiri. Satu rekaan baru iaitu "dozer blade" akan ditambah kepada mesin memadam kebakaran ini. "Dozer blade" ini berfungsi untuk mengerakan objek atau memberi laluan dan menyelamatkan mangsa kebakaran, iaitu dengan membawa mangsa ke tempat yang lebih selamat daripada bahang kebakaran. Selain itu, mesin memadam kebakaran ini membantu ahli bomba dengan memegang paip bomba yang bertekanan tinggi dan meninjau tempat kebakaran dari jarak jauh. Mesin ini membantu meninjau dari jarak 200 meter dari tempat kebakaran seperti "cooling acetylene", silinder mudah meletup, bahan kimia, bahan biologi dan bahan radiasi atau kejadian nuclear tanpa membahayakan nyawa ahli bomba. Rekaan "dozer blade" berfungsi memyelamat atau membawa mangsa kebakaran dan juga bahan mudah meletup seperti "cooling acetylene" dan silinder mudah meletup ke tempat yang lebih selamat. Mesin memadam kebakaran ini amat sesuai digunakan di bengkel, kilang, pusat penjanaan tenaga, terowong dan dalam bangunan.

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AD	Assembly Design
CAE	Computer Aided Engineering
PDS	Product Design Specification
UTeM	Universiti Teknikal Malaysia Melaka
SINTEF	The Foundation for Industrial and Scientific Research
TDM	Total Design Method

ANNOTATION

Q	= Flow
n	= revs per second
V stroke	= swept volume in m3
η vol	= volumetric efficiency
P	= Power in Watt (Nm/s)
Δ p	= pressure difference over pump in N/m^2
η mech, hydr	= mechanical/hydraulic efficiency
Fe	= Extension Force
Pp	= Pressure Piston
Ap	= Piston Area
Ar	= Rod Area
Fr	= Retraction Force
Pa	= Pressure on Annular Side
Tt	= Theoretical Torque
Qt	= Theoretical flow rate
T_T	= Actual torque delivery by motor
T_A	= Torque motor should theoretical deliver
η_o	= actual power delivery by motor / actual power delivery to motor
H_L	= Head loss
Le	= Equivalent length
F_{ext}	= Cylinder Extending Force
P_{pr}	= Working Pressure

K	= Buckling load
S_K	= Free buckling length
E	= Elasticity Module
J	= Moment of Inertia
S	= Safety Factor
n_p	= Pump Rotation Speed
n_{vol}	= Volumetric Efficiency

LIST OF APPENDIXES

CHAPTER 1

INTRODUCTION

1.1 Background Study

Firefighting is a process of act to avoid from destroying property, danger human life and environment. A fireman jobs is to fights these fires to prevent destruction of life, property and the environment. Fireman usually used fire engines, tools and equipments to fights these fires. Most of the tools and equipment are manually operated. The new era of technology, the fireman have an efficient way to fight fire with the new design of improvement on tools and equipment.

Remote firefighting machine is a newly design machine that is creates to reduce risk for human especially the fireman who rescuing in fights fire. It used to help fireman to carry the hose without fireman having to set up or operate monitors in danger areas. The main function for this design is a remotely control the machine and replace the fireman in the dangerous place. It used same concept with fire fighting engine using the fireman hydrant. The remote firefighting machine is connecting with the fireman hose to operate and the machine carries the hose and sprays it onto the fire area by using remote to control it. This machine is useful in the emergency situation, in the jungle and small building or spaces.

Besides, the machine is help to victim retrieval or removal from danger areas, moving flammable cylinders into a location where it's associated exclusion zone causes

less disruption and crowd control in civil disturbance situations. The ex rated electrical system for operation in Zone 1 hazardous areas. Zone 1 is a place of thing easy to explode for example the power plant. The job needs a lot of number fireman to do. The new design of tools or machine is important to dealing of this kind of problems and it can reduce the number of people. The machine design can enter the refineries areas and the small spaces. For example, a version that can fit through aircraft emergency exits in the event of a passenger airliner fire or buildings which is not suitable for human to do the jobs.

1.2 Problem Statement:

Mostly, people doesn't know the danger of being fireman, their risk their own life to saving people life who are their even don know or meet before. Most of the job of the fireman are danger and can sacrifice their own life. The problem that always encounters are entering the exclusion zones which is cooling acetylenes and other flammable cylinders which might be dangerous, decontamination in Chemical, Biological, Radiation or Nuclear Incidents. The fireman needs to fast response to the situation without danger they own life.

1.3 Objectives of Project:

The objectives of the project are:

1. To improve the current design of hydraulic system of fire fighting machine.
2. To design a dozer blade for obstacle removal and rescuing
3. To design a hydraulic system to be used in rescuing process related to the fire fighting machine.

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1.4 Scopes of Project:

The scopes of the project are:

a. To conduct literature review on current fire fighting technology.
b. To identify current problems in fire fighting process.
c. To identify current problems in existing design.
d. To analyze the proposed design.
e. To analyze the hydraulic circuit of dozer blade and telescopic scissor.
f. To analyze the kinematics analysis and mechanism of telescopic scissor and dozer blade.

CHAPTER 2

LITERATURE REVIEW

2.1 Development of Technology in Firefighting Machine:

In the research, the development of technology on firefighting is in progress around the world. Most of the tools and equipments are manually operated by the fireman. In the new era of technology, the advances technology of firefighting machines is most conquered by the Western Country.

They had created a machine to reduce a number of firemen to fight fire in dangerous situations. Besides, the machine also reduce the fireman risk, which are involve in cooling acetylene, flammable cylinders and exclusion zone. It helps the fireman with water or foam without fireman has to set up or operate monitors in danger areas. This kind of machine really helps a lot in the rescuing and to fight fire in the building or in the jungle difficult for fireman.

Western Country for example had made a machine that operates using remote control to do the fireman jobs. Their have sell the machine to the fire department at other countries. Example, United Kingdom with the product of The Washmote, a remotely operated vehicle for surface washing and decontamination and The Firemote, a remotely controlled mobile Fire fighting monitor, which is research funded by DTI through SEEDA from Ryland Research Limited Company.