UNIVERSITI TEKNIKAL MALAYSIA MELAKA

DESIGN ANALYSIS OF RETRACTABLE HOSE MECHANISM USING DFMA METHOD

This report submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor Degree of Manufacturing Engineering (Manufacturing Design) with Honours.

By

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2015

DECLARATION

I hereby, declared this report entitled "Design Analysis of Retractable Hose Mechanism Using DFMA Method" is results of my own research except as cited in references.

Signature : …….

Author's Name : …….

Date : …….

APPROVAL

This report is submitted to the Faculty of Manufacturing Engineering of UTeM as a partial fulfilment of the requirement for the Degree of Bachelor of Manufacturing Engineering (Manufacturing Design) with Honours. The member of the supervisory committee is as follow:

(Signature of Supervisor)

…….

(Official Stamp of Supervisor)

ABSTRACT

Nowadays, the retractable hose mechanism is one of the common mechanism used in daily life. However, there are some improvement need to be done to the design itself to fulfil the daily activity. This report presents the methods to design a universal retractable hose mechanism that can be used for any kind of diameter of the hose. Existing design was studied for upgrading to a new universal design. Both designs were simulated by the help of Solidwork software. At the end, a set of information or model on related design evaluation to be analysed according to the study. From the research and methodology conducted, the new design had successfully be design to be used for different diameter of hose with a safety lock.

ABSTRAK

Pada masa kini, penggunaan mekanisma hos sentap automatik adalah pada tahap yang tinggi. Namun terdapat pengubahsuaian yang perlu dilaksanakan terhadap rekabentuk mekanisma tersebut bagi memenuhi keperluan aktiviti harian. Laporan ini menerangkan kaedah-kaedah yang digunakan untuk merekabentuk mekanisma hos sentap automatik universal yang boleh digunakan untuk pelbagai jenis diameter. Rekabentuk produk sedia ada telah dipelajari untuk penambahbaikan ke arah mekanisma hos sentap automatik universal. Kedua-dua rekabentuk di simulasi dengan menggunakan perisian Solidwork. Akhir sekali, setiap maklumat dan model yang berkaitan dengan penilaian rekabentuk akan dikembangkan bergantung pada projek ini. Daripada kajian dan kaedah yang dijalankan, rekabentuk yang baru telah berjaya diubahsuai untuk digunakan pada hos yang berlainan diameter dan mempunyai kunci selamat tersendiri.

DEDICATION

Specially dedicated to my beloved father Yakabasah bin Selamat and my mother Kamsiah binti Abdul kadir who had been so consistently and patiently supporting me in this research. I also dedicated this to all my colleagues who interested in this research.

ACKNOWLEDGEMENT

First of all I would like to express my gratitude to ALLAH s.w.t for his blessing on me through this while in completing this research. I also would like to thank to all those who gave me the strength and encourage completing this Final Year Project (FYP). Specifically, I am deeply indebted to my supervisor Mr. Abdul Rahim bin Samsudin for all of his guidance, encouragement help, stimulating suggestion and being patiently through this FYP to ensure it come to the finish line. He had been so helping me through his advance and times he spent just to ensure accomplishment of this project.

Last but not least, I would like to say my special thank you to my parents and my family for their patient and encouragement to help me always to be in the right track.

TABLE OF CONTENTS

Chapter 3: Methodology

Chapter 4: Result and discussions

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1

INTRODUCTION

The chapter briefly shows the view of the general idea of the research study, which consist of the background of the project, the problem statement to come with the idea, the objective need to be achieved and lastly the scope of the study and Gantt chart that shows the overall process of the study.

1.0 Background of the Research Study

Retractable mechanism is a mechanism that allows retractable movement when the part either hose or cord, being pulled towards an anticlockwise direction to perform a function. There are two types of mechanism which is manual or automatic locking system.

Nowadays, there are many art or product that used the concept of the mechanism. Basically, the retractable mechanism was substituted on the product itself to perform the retractable movement in order to roll a hose or cord back to its normal position. The movement occurs due to the energy stored in the spring whenever the hose or cord was pulled. The movement of the hose or cord back to its original position can be locked by manual or automatic operation without interrupting the function itself.

A research was conducted to study the existing product that uses the concept of the mechanism. A study was then conducted to perform one basic unit of an automatic

retractable mechanism so that the mechanism can be used for different kind of diameter of hose whenever needed.

Existing patients were observed and the function of the parts was compared. The existing mechanism was then redesigned to be used for different kind of diameter of the hose and a simulation was done for both designs.

1.1 Problem Statement

Nowadays, the existing design of the mechanism always comes with the product itself. For example, a retractable hose mechanism always comes with the respective hose and the mechanism can only be used for the product or that specified hose. In some cases in daily life, we may need a kind of tool or mechanism that can be used to perform the same function, but to be used in a different part or product with different diameter. Therefore, a unit of retractable mechanism should be designed to perform its function for any kind of diameter of the hose.

1.2 Research Objectives

The objectives of the research study of the retractable mechanism are listed as below:

a) To study the concept of the retractable mechanism.

b) To redesign the retractable mechanism as one basic unit that can be used for water hose with different diameter

c) To analyse the designs by DFMA method and solidwork simulation.

1.3 Research Scope

Basically, a research was conducted to study the part and its function of the existing design patents. The comparison was done for 3 existing designs and thus scoring and screening method was conducted to choose one of them to be analysed as existing product. The part was then redesigned by DFMA analysis to perform one basic unit of new designs that can be used for water hose with different diameter. Both designs were drawn on 3D solidwork software and was analysed by DFMA method and solidwork simulation. The research will only cover up to the simulation state and none of the product being fabricated.

CHAPTER 2

LITERATURE REVIEW

This chapter provides the overview for the research study of the retractable mechanism. This literature review will explain on Hooke's law that is related to the concept of retractable in physic view. Besides that, a brief explanation of existing patent was included in this chapter. Methods used to complete this project that is Pugh Selection Method and DFMA method was also explained in this chapter. Thus, the chapter will start with the study of Hooke's Law.

2.1 Hooke's Law

All movement happens with causes and effect. For example, in order to move an object, force is required, and the object starts to slow down or stop due to friction. In physic view, retractable movement happens due to the presence of energy stored in a compressed spring. Hooke's Law states that "A relatively small deformation of an object, the displacement or the size of the deformation is directly proportional to the deforming force or load" (Robert Hooke, 1660).

The law of elasticity was founded in 1660 by an English scientist, Robert Hooke. It is obviously stated that the object will return to its original shape and size upon removal of load or force. The behaviour of elasticity of an object can be explicated by Hooke's

Law by the fact that small displacement of their constituent molecules, atoms or ions from its normal position is also proportional to the force that causes the displacement.

From the Hooke's Law, it may relate to the retractable movement that consist of spring that being compressed after a hose or cord is pulled out and hence cause the reel to turn. The deforming force occurs when the hose is pulled out and cause the reel to compress the spring. The spring then will stored certain amount of energy that called as elastic potential energy. This energy will then help the spring to return to its original shape and hence retract the hose or cord back to its original position on the reel.

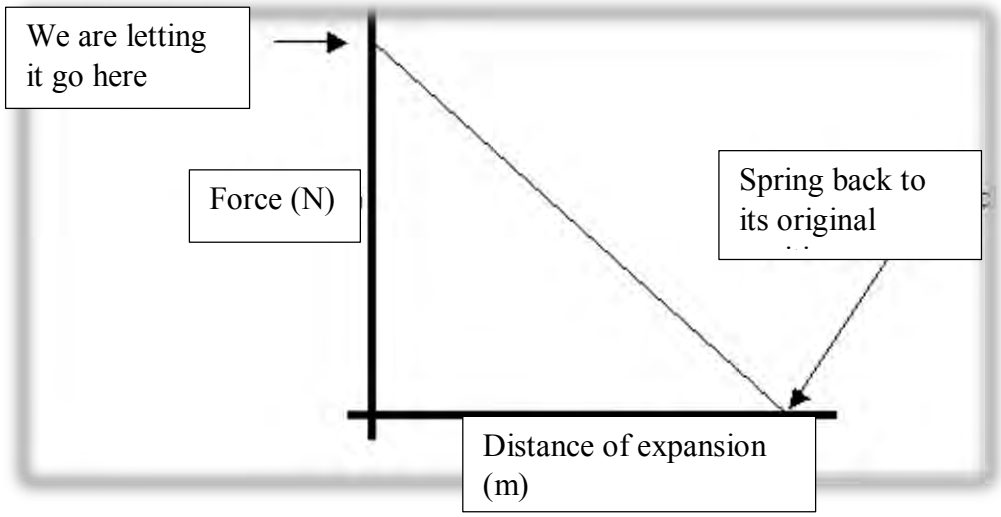
From Robert Hooke, the relationship of the force and spring can be noted by the following equation;

$$F=kx$$

Where F= Force (N)

k= spring constant for that object (N/m)

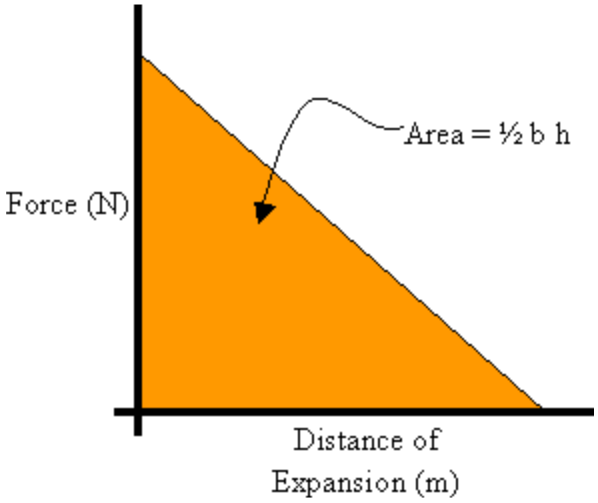
x= Amount of expansion or compression (m)



(Anonymous, 2005)

Figure 2.1: Graph of force against distance.

The work done or energy result from the compression of spring can be defined as area under graph shown below;



Area = 1/2 (b)(h)
= 1/2 (F)(x)
=1/2 (kx)(x)

Area = $1/2kx^2 = W$

(Anonymous, 2005)

Figure 2.2: Area under the graph