

**DEVELOPMENT OF AN AUTOMATIC REWINDING
MACHINE FOR CABLE TAPE CONSIDERING
AFFECTIVE ANALYSIS**

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FOR CABLE TAPE CONSIDERING AFFECTIVE ANALYSIS**

This report submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor Degree of Manufacturing Engineering (Robotic and Automation) with Honors

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This report is submitted to the Faculty of Manufacturing Engineering of UTeM as a partial fulfillment of the requirements for the degree of Bachelor of Manufacturing Engineering (Robotic and Automation) (Hons.). The member of the supervisory is as follow:

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Dr. Fairul Azni bin Jafar

ABSTRACT

The objective of this project is to develop an automatic rewinding machine for the cable tape, and to analyze the machine's performance on doing the job. The affective analysis is used for a side research of this project. The application can be seen by solving the problem facing by the operator while doing their job in a machine. The worker is facing body ache because of conducting a process manually that is cutting the cable tape for a long period. By doing a survey on the operator and used the survey for affective analysis, an automatic product was suggested to solve the problem that is rewinding cable tape machine. The project starts with review on the existing rewinding machines and understanding affective analysis in surrounding work. It continues with creating suitable design and material for the product (machine). The fabrications steps then held and the machine was make sure function correctly. An experiment was held to ensure the machine performance. All problems and related issues were explained clearly in this report.

ABSTRAK

Objektif projek ini adalah untuk membangunkan sebuah mesin gulung semula automatik untuk pita kabel, dan untuk menganalisis prestasi mesin untuk melakukan kerja. Analisis Afektif adalah digunakan untuk penyelidikan sampingan projek ini. Penggunaan kaedah ini boleh dilihat dengan menyelesaikan masalah yang dihadapi oleh pekerja semasa melakukan tugas mereka dalam mengendalikan mesin. Pekerja akan menghadapi sakit badan kerana menjalankan proses secara manual dimana memotong pita kabel dalam tempoh yang lama. Dengan melakukan kajian ke atas pekerja dan menggunakan sedikit kajian Analisis Afektif, satu produk automatik telah dicadangkan untuk menyelesaikan masalah menggulung kabel mesin pita. Projek ini bermula dengan banyak kajian pada mesin yang sedia ada dan analisis pemahaman afektif dalam kerja-kerja di sekitarnya. Ia diteruskan dengan mencipta reka bentuk yang sesuai dan bahan-bahan untuk produk (mesin). Kaedah fabrikasi kemudian diadakan dan mesin telah dipastikan menjalankan fungsi dengan betul. Satu eksperimen telah dijalankan untuk memastikan prestasi mesin. Semua masalah dan isu-isu yang berkaitan telah diterangkan dengan jelas dalam laporan ini.

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CHAPTER 1

INTRODUCTION

1.1 Background

Machine is widely used in many industries. In cable manufacturing industry, many large machines are being use and operated by a few persons. However each machine conducted by not more than five people per machine types. Each machine is differentiates by its functions and process undergo by it. Sometimes, one process will undergo many types of machine. In this report, the process that will be focused is cutting the cable tape manually by ordinary cutter.

To conduct the task, an operator is required to cut the cable tape manually using cutter. The time needed to complete the task is very long because the average length for electric cable per drum is 1000 meter. The time needed to complete the task is three hours per kilometer. This means that the operator will seat at the workspace for a long period. An ergonomic affect can be seen clearly by observing the operator behavior while doing the task. With this situation, an automatic machine is believed to be suitable in replacing the operator work. Furthermore, the machine development by a proper method, design, and system is required.

To solve this situation, an analysis method is going to be adopted in order to find the burdening part in carrying out the job, so that the solution route (which is to build an automatic machine) will take consideration of the analysis findings. The analysis method that has been chosen is Affective analysis which is supported by the Affective Engineering.

To analysis and solve this situation, one method of analysis is useful to be used. Affective Engineering (also known as Kansei Engineering) is a technology for translating human feelings into a product design. By conducting survey and other method on the operator of the machine, a data will be found and a product will be produced to solve their problem.

Affective Engineering (also known as Kansei Engineering) is a technology for translating human feelings into a product design. It is believe that human emotion is playing an important role in determining problems arise in manufacturing environment, hence affect the development of instrumentation or machine which is apply to solve or reduce the problem. By conducting survey to the operator of the machine, set of data will be collected and a product (machine) will be produced to solve the problem.

1.2 Problem statement

In cable manufacturing industry, one of the processes, which is extruding plastic material over the conductor, required a lot of human effort. In this case, the process that involve is discarding the rejected cable tape due to its undesired requirements, and considering the next insulation step on the cable. In order to discard the cable tape from the cable, manual method has been used by using human effort. The operator needs to cut the cable tape manually for a long period of time. The average time required to complete the job is three hours per kilometer length of the cable. Through affective analysis method the effects of long hour job on the operator's job performance can be observed. Therefore, an automatic product will help to solve the problems stated. It is believe that human working performance will drop after a long hour working and thus, will create another problem (which can cause defects on the product).

1.3 Objectives

- (a) To develop a machine which able to rewinding the cable tape.
- (b) To analyze the machine's performance on doing the job.

1.4 Scope

The work in this project is focusing more on the developing the rewinding machine, which is believe can help solving the problem of long hour job to rewind the cable tape. The design of the machine will consider the affective factors which can be drag out through the Affective analysis method.

The affective analysis will be conducted before the development of the machine. It is conducted before the machine development in order to find out the factors that will give effect to the design and fabrication processes of the machine development.

1.5 Report Structure

Chapter 1 is the introduction of this project. This chapter will give the overview of the report on the background, problem statements, objectives, and scopes.

Chapter 2 is the literature review for this project. This chapter will analyze all the references found related the cable tape product and can be related to this project. The description on the affective analysis also will be included and explained.

Chapter 3 would describe the methods and procedures used for the project implementation. This chapter also describes the details of each method.

Chapter 4 is a chapter that describes and shows all the result from the experimental activities, surveys, and designs. A few brief explanations were stated in each result. A discussion part is made in order to explain cases that happen during conducting this project.

Chapter 5 would conclude the project. Future recommendation also stated in order to make the project better.

CHAPTER 2

LITERATURE REVIEW

In this chapter, all the information that can be related for this project is reviewed. All information about the machine that can be related with cable tape, and study about the Affective Engineering will be explored through many sources of journal and others.

2.1 Tape Rewinding Machine Types In Industry

Tape rewinding machine is used to rewind back the tape into its roll. According to the research from the journals, there are many types and functions of tape rewinding machine that been invented for the cable manufacturing industry.

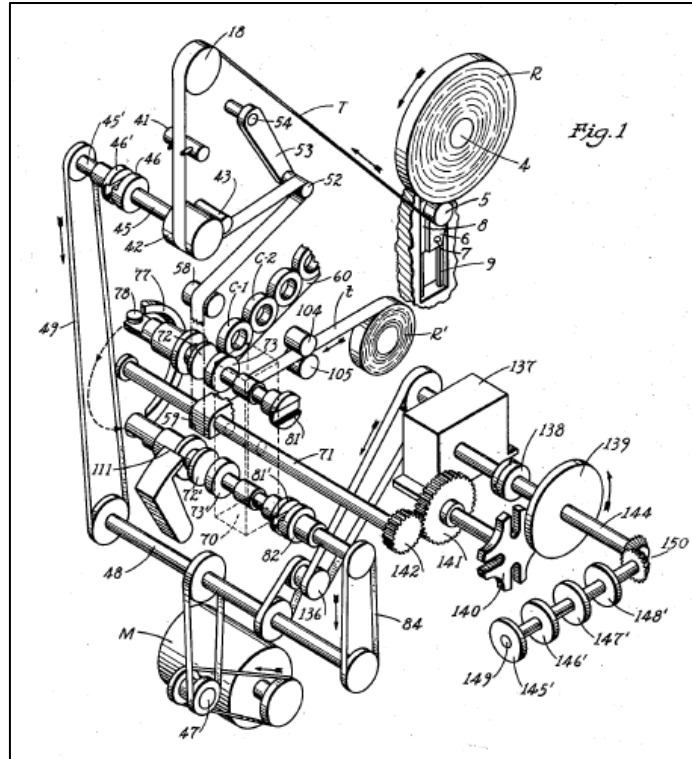


Figure 2.1: Tape winding machine

Tape winding machine (Figure 2.1) relates to machines for winding rolls of tape, particularly to machines for winding in succession a large number of rolls of relatively short lengths of tape from a relatively large supply thereof (Keller, 2000). Winding cable machine is an apparatus and method, suitable for cable wrapping apparatus for securing the cable of a spooled or a coiled product and for packaging such products (Barnes, 1998). The next type of rewinding machine is portable cable tape winding machine as shown in Figure 2.2. The machine conducted by hand taping on the job during construction (Sakabe, 2001). Automatic traverse winding of tapes on a cylindrical core relates to the winding of plastic or metallic foil tapes, or combinations or laminations, used in the manufacture of telecommunication cables and others (O'Connor, 1981).

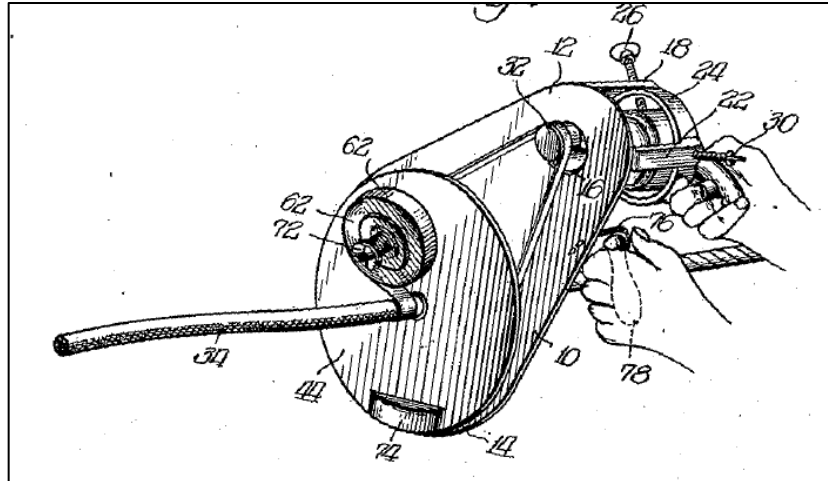


Figure 2.2: Portable cable tape winding machine

Cable wrapping machine involves in wrapping tape, strips, cords and the like around conductors, cables, cores and the others (Barnes 1998). Machine for rewinding film or tape have a function that rewind on one reel from another or rewind on the original reel (Nagamichi, 2008). The next type of machine is multi-roll segment package for plastic tape and winding machine for same. It comprises a first tape guide fixed transversely on a frame of the machine (French, 1935)

According to the explanation of each type of the rewinding tape machine, even though they have different name, but the major function on rewinding the cable is almost the same.

2.2 Cutting or Spinning Mechanism?

According to the finding, there are two types of mechanism can be found in order to produce the rewinding machine; cutting and spinning. Based on the original technique used to discard the waterproof cable tape that is by cutting it manually, a machine of cutting the tape is possible to be produced.

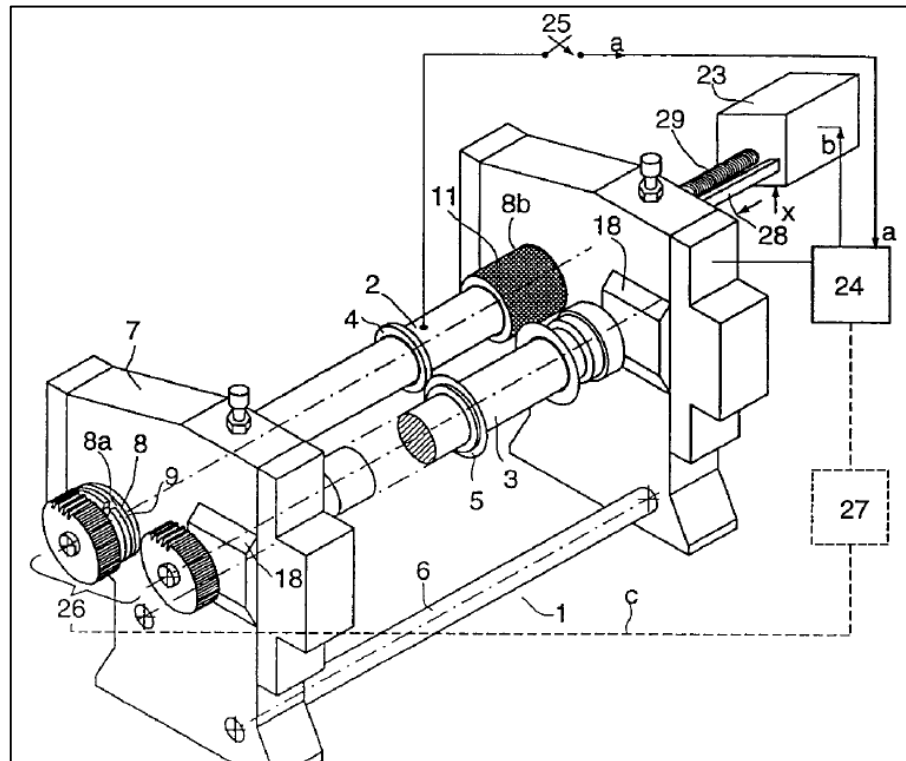


Figure 2.3: Cutter-Infeed apparatus

Cutter-infeed apparatus is for cutting installations for articles in tape or strip form or film-like articles, circular cutters being fastened on upper and lower shafts and displaced with respect to another for fixing the cutter infeed, and an electrical insulation between the upper and lower shafts making it possible to detect the cutter contact during infeeding and thereby make the infeeding operation automatable. It is also possible to make the infeeding of the individual cutters or cutter-box cutters such that it can be set depending on the difference in speed of the upper and lower shafts. The apparatus can be used for cutting machines of all types in which thin, uncoated or coated polymer films or metal foils can be cut (Cramer, 1969)

The spinning mechanism can be seen in the introduction of rewinding tape part of this report. However, the problems of controlling the speed of the reels in accordance with requirements and regulating the course of the film have presented difficulties and caused the machines to become complicated. In order to provide an efficient machine, it is one object of the present invention to apply a motor drive to the reels which can be controlled by simple means to rotate either reel for a winding operation (Nagamichi, 2008).

2.3 Tape tensioning

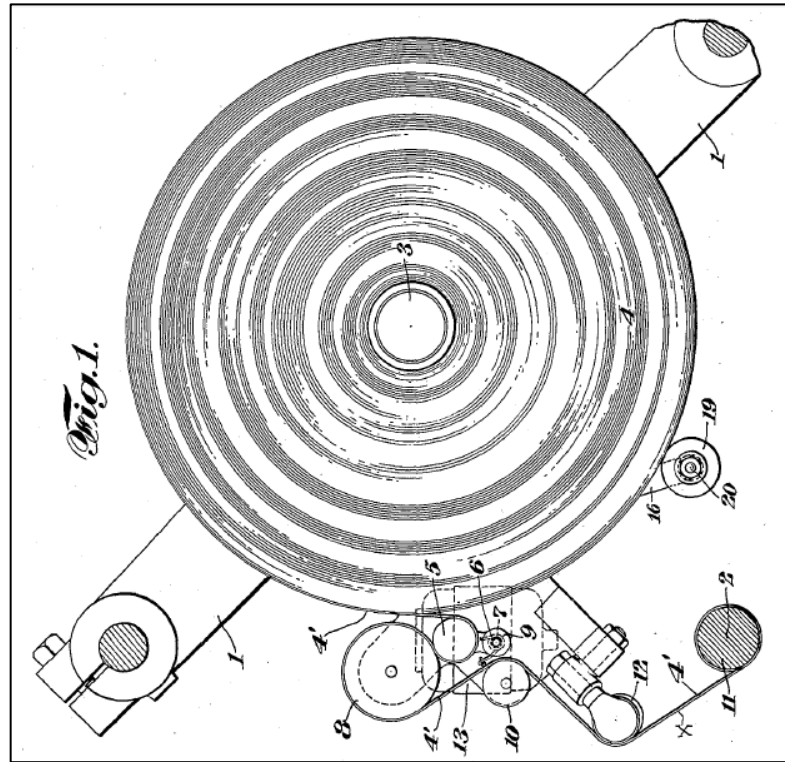


Figure 2.4: Cable tensioning for cable wrapping machines

In cable wrapping, conductor and core wrapping machines and more particularly to machines adapted to apply one or a number of wrappings such as tapes, flat strips or cords and the like of paper, insulating material, spirally or in concentric layers to any object such as cables, conductors, and wires (Masterson, 1956). Electrical operating and controller is used in order to control the tensioning of the tape while wrapping the cylindrical figures (Masterson, 1956) (Schutte, 2005) (Childs, 2006).

2.4 Affective/Kansei Engineering

Affective/Kansei engineering was developed as a consumer-oriented for new product development. It is define as translating technology of a consumer's feeling and image for a product into design elements. Kansei engineering technology classified into three types, KE type I, II, and III. KE type I is a category classification on the new product toward the design elements. Type II utilizes the current computer technologies such as Expert System, Neural Network Model and Generic Algorithm. Type III is a model using mathematical structure (Koehn, 2006).

Type I of Kansei engineering is a method in which a Kansei category of broken down in the tree structure to get the design details. Type II is a computer-assisted Kansei engineering system. Kansei engineering system is a computerized system with the Expert System to transfer the consumer's feeling and image to the design details. The computerized Kansei engineering system architecture basically has four database; Kansei database, image database, knowledge-base, and design and color database.

2.5 Chapter Summary

Through the literature review, various kind of rewinding machine for cable tape already used in industry. But each of them has different kind of design, mechanism, and system. Affective Engineering is useful to help inventor to create a product that can help to solve a problem.