DESIGN OF AUTOMATIC FIXTURE FOR SCANTOOL DRILLING MACHINE

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

(Robotics and Automation) (Hons.)

by

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APPROVAL

This report is submitted to the Faculty of Manufacturing Engineering of Universiti Teknikal Malaysia Melaka as a partial fulfilment of the requirements for the degree of Bachelor of Manufacturing Engineering (Robotics and Automation)(Hons.).

The members of the supervisory committee are as follows:

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ABSTRACT

This project report presents the work done on the design of an automatic fixture for SCANTOOL drilling machine. This is a bench type drilling machine that is used in Fabricating Workshop at Block B of Faculty of Manufacturing Engineering, Universiti Teknikal Malaysia Melaka (UTeM). The machine is still using conventional power screw workpiece clamp vise that is required a lot of force applied by the operator to clamp the workpiece. If the clamping force applied toward the workpiece is not enough, the work piece could come out from the vise and could cause an injury to the operator or anybody nearby the machine. The objectives of this design project are to design and developed soft prototype of an automatic fixture for SCANTOOL drilling machine. To achieve the objectives, a flow chart was developed as a guide line to be followed. This project focusing on fully-automatic fixture that needs to customize to suite with the SCANTOOL drilling machine. Several designed ideas are generated and presented in this report. The listing of all parts need to be designed and fabricated, and the standard parts are also presented. SolidWorks software is used as designing tool and Automation Studio as a stimulation platform to animate the design. Finite Element Analysis (FEA) that available in SolidWorks has been used to analyse the design to make sure that the good design is produced. As a result, it was discovered that the design is strong enough to withstand the maximum drilling thrust force given to the surface of workpiece and factor of safety (FOS) of this design is greater than value of two as the minimum value. Suggestion for further work is also included in this report.

ABSTRAK

Laporan projek ini menerangkan tentang hasil kerja reka bentuk lekapan automatik untuk mesin penebuk SCANTOOL. Mesin penebuk ini adalah salah satu jenis mesin dipasang di atas lantai yang terdapat di Bengkel Fabrikasi Blok B Fakulti Kejuruteraan Pembuatan, Universiti Teknikal Malaysia Melaka (UTeM). Mesin ini masih menggunakan ragum bahan kerja lazim yang memerlukan daya yang banyak daripada pengendali mesin untuk meragum bahan kerja. Jika daya ragum yang dikenakan tidak mencukupi, bahan kerja akan tercampak keluar dari ragum dan boleh menyebabkan kecederaan kepada pengendali mesin atau sesiapa yang berdekatan dengan mesin. Objektif reka bentuk projek ini adalah reka bentuk dan menghasilkan prototype secara maya lekapan automatik untuk mesin penebuk SCANTOOL. Bagi mencapai objektif ini, carta alir telah dihasilkan sebagai garis panduan yang perlu diikuti. Projek ini tertumpu kepada lekapan automatik spenuhnya yang disesuaikan untuk mesin penebuk SCANTOOL. Beberapa idea telah dihasilkan dan dipaparkan di dalam laporan ini. Kesemua senarai bahagian-bahagian yang perlu difabrikasi dan bahagian-bahagian asas juga dipaparkan. Perisian SolidWork telah digunakan sebagai alat untuk mereka bentuk dan perisian Automation Studio sebagai platform stimulasi menganimasikan reka bentuk ini. Finite Element Analysis (FEA) yang disediakan di dalam perisian SolidWork telah digunakan untuk menganalisa reka bentuk ini bagi memastikan reka bentuk yang dihasilkan adalah baik. Keputusannya, melalui analysis yang dijalankan reka bentuk ini mampu untuk menampung daya maksimum yang dikenakan ke atas permukaan bahan kerja melalui proses penebukkan dan nilai faktor keselamatan (FOS) bagi reka bentuk ini lebih besar dari nilai dua sebagai nilai minimum untuk faktor keselamatan. Cadangan untuk kajian selanjutnya juga disediakan di dalam laporan ini.

DEDICATION

Only

My beloved father, Raja Dziauddin Bin Raja Dziauddin

My appreciated mother, Faridaton Hanim Binti Md Amin

My adored Brothers, Raja Mohd Firdaus and Raja Mohammad Zulfakar

For giving me moral support, money, cooperation, encouragement and also understandings

Thank You So Much & Love You All Forever

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In the name of ALLAH, the most gracious, the most merciful, with the highest praise to ALLAH that I manage to complete this final year project successfully without difficulty.

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LIST OF ABBREVIATIONS

UTeM	-	Universiti Teknikal Malaysia Melaka
FKP	-	Fakulti Kejuruteraan Pembuatan
CAD	-	Computer Aided Design
CAM	-	Computer Aided Manufacturing
AE	-	Ampere Single-Phase
AT	-	Ampere Three-Phase
ATF	-	Ampere Three-Phase Feet (Floor Model)
MT	-	Morse Taper
DOF	-	Degree of Freedom
2D	-	Two Dimensional
3D	-	Three Dimensional
NCL	-	NCAR Command Language
AHP	-	Analytic Hierarchy Process
FOS	-	Factor of Safety
PLC	-	Programmable Logic Control
CNC	-	Computer Numerical Control
SFC	-	Sequential Function Chart
PID	-	Proportional-Integral-Derivatives

CHAPTER 1

INTRODUCTION

1.1 Background of the Project

A drill machine (also known as a pedestal drill, pillar drill or bench drill) is a fixed style of drill that may be mounted on a stand or bolted to the floor or workbench. (Wikipedia.2016). It is manually operated unlike the CNC machine which is controlled by a coding systems that enables it to be operated with minimal supervision. There are many parts and components of SCANTOOL Drilling Machine include a fixture that is focusing for this project. (Scantool-Group.dk.2016). Figure 1.1 shows the SCANTOOL Drilling Machine that was installed in Fabricating Workshop at Block B of Faculty of Manufacturing Engineering, UTeM (FKP).

Figure 1.1 SCANTOOL Drilling Machine in FKP

Fixture is a component that holds, supports and locate the workpiece for a specific operation without guiding the cutting tool. (Scribd, 2016). Example of simple fixtures are vises clamp and chuck. The clamping system of the fixture and the locating point should be strong enough to withstand the forces developed during the operation. Furthermore, the clamping force during tighten the workpiece should not dent or damage the workpiece.

1.2 Problem Statement

The SCANTOOL Drilling Machine that was installed in Fabricating Workshop at Block B of FKP is still using conventional power screw workpiece clamp. The operator need to use a lot of energy to clamp or release the workpiece due to chips of workpiece is sticked at the power screw if no maintenance and cleaning conducted by operator. Meanwhile, if not enough the clamping forces applied to the workpiece, the workpiece may be slipped out of the clamped and hit the operator or someone stand close to the machine and causes injury. It also need a lot of time and energy to load and unload the workpiece to the power screw clamp. An initiative to properly design the automatic fixture for drilling machine is taken to solve this problem by adding some locating pins or surfaces followed the workpiece given by lecturer for subject Manufacturing Practise to replace the conventional power screw clamp of SCANTOOL Drilling Machine. Figure 1.2 shows the SCANTOOL Drilling Machine with Conventional Power Screw vise and Figure 1.3 shows the Drill Chuck that will hold the drill bit.

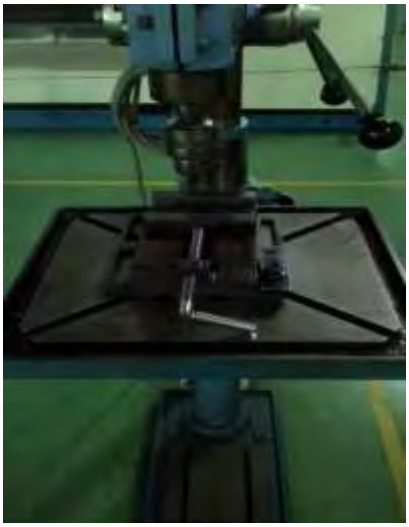

Figure 1.2 SCANTOOL Drilling Machine with Conventional Power Screw vise

Figure 1.3 shows the drill chuck of SCANTOOL Drilling Machine

1.3 Objectives

i. To design an automatic fixture for SCANTOOL Drilling Machine.
ii. To develop a soft prototype of the designed automatic fixture.

1.4 Scopes

i. To design an automatic fixture that is to be focused only on locating and clamping rectangular shape workpieces.
ii. Maximum dimension of rectangular workpieces:
Part A:
   a. Width: 45 mm
   b. Length: 30 mm
   c. Thickness: 8 mm

Part B:

a. Width: 45 mm
b. Length: 35 mm
c. Thickness: 8 mm

iii. The fixture will be designed based on the size of the drilling machine table which is 345 mm x 406 mm.

iv. Materials of workpieces to be clamped are Steel, and Aluminium.

v. To develop a soft prototype of the designed an automatic fixture using suitable Computer Aided Design and Manufacturing (CAD/CAM) software; SolidWorks software.

CHAPTER 2

LITERATURE REVIEW

This chapter presents the review on SCANTOOL Drilling Machine, workpiece holding devices for drilling operation, types of clamping system and the sensors that will be used to detect the presence of workpiece and force sensor for determine required clamping force, CAD software and a bit of locating pin and supporting that might be suitable for automatic fixture. All these information are obtained from journals, articles, and others source of information.

2.1 Definition of Fixture

Fixture is a production tool which is mainly used to locate, hold and support the workpiece firmly to the table (Kundu, 2014). Automated fixture design means a process in which without human interaction. An appropriate fixture is designed based on given workpiece (Retfalvi, 2013).

2.2 Introduction of SCANTOOL Drilling Machine.

SCANTOOL Group is the largest and most experienced producer of drill and grinding machines in Europe. They have intended for both home workshop and industrial use. Nielsen's family was start up SCANTOOL with its own production in 1980. Since that he capable to take over several company such as KEF-MOTOR, Trige Titan and even their biggest competitors HM Machinery A/S in Thisted, Denmark to be as SCANTOOL Group (Scantool.dk, 2016).

They have been produced three main drill machine which are Magnetic Drill machine, V-belt Drill machine with five model 16AE/16AT/16ATF/25A and Geared Head Drill machine with two model SB 30 and SB 40 (Scantool.dk,2016). Hence I will focus on V-Belt Drill machine model 25A which UTeM have been used in Blok B at FKP. The table dimension of this drill machine is 475 mm x 425 mm. The output power of this machine produce is 1 ½ Horsepower (HP) and consist of twelve speed adjustment with using Spindle type of Morse Taper (MT) 3 (Scanttol.dk,2016). Morse Taper is type of spindle standard according the International

Organization for Standardization (ISO) 296. Figure 2.1 shows that the drawing of end of Morse Taper type spindle. Table 2.1 shows the dimensions of Morse Tapers type in millimetre (mm) (Wikipedia,2016).

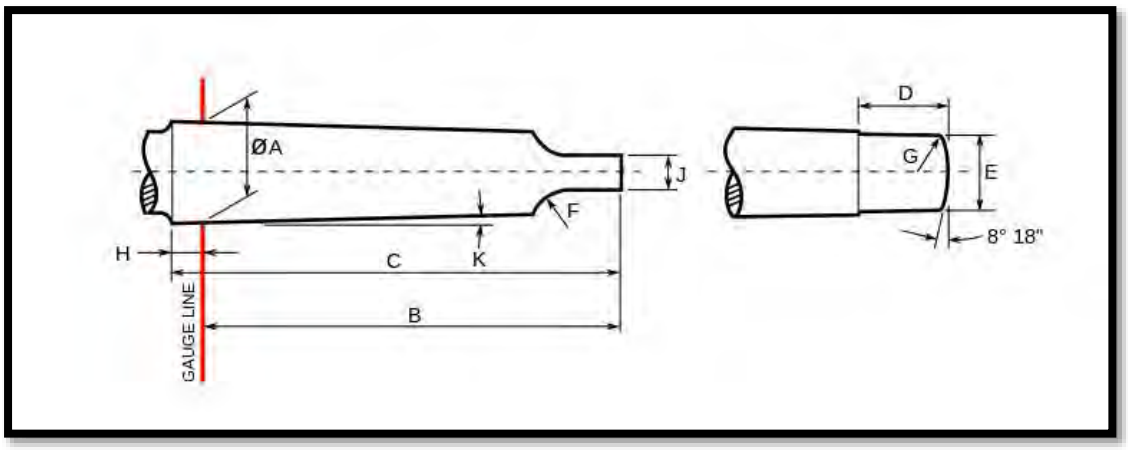

Figure 2.1 End of Morse Taper Spindle (Wikipedia.2016)

Table 2.1 Dimension of Morse Taper (mm)

Morse Taper number	Taper	A	B (max)	C (max)	D (max)	E (max)	F	G	H	J	K
0	1:19.212	9.045	56.5	59.5	10.5	6	4	1	3	3.9	1° 29' 26"
1	1:20.047	12.065	62	65.5	13	8.7	5	1.2	3.5	5.2	1° 25' 43"
2	1:20.020	17.780	75	80	16	13.5	6	1.6	5	6.3	1° 25' 50"
3	1:19.922	23.825	94	99	20	18.5	7	2	5	7.9	1° 26' 16"
4	1:19.254	31.267	117.5	124	24	24.5	8	2.5	6.5	11.9	1° 29' 15"
5	1:19.002	44.399	149.5	156	29	35.7	10	3	6.5	15.9	1° 30' 26"
6	1:19.180	63.348	210	218	40	51	13	4	8	19	1° 29' 36"
7	1:19.231	83.058	285.75	294.1	34.9	-	-	19.05	-	19	1° 29' 22"

2.3 Work holding device for Drilling Operation

A clamp is a fastening device used to hold or secure objects tightly together to prevent movement or separation through the application of inward pressure (Wikipedia,2016). This work holding device used in industry as to increasing the productivity and accuracy in mass production. Generally, workpiece is held by fixture and fixture is arranged in such a way that can easily loading and unloading the workpiece. To achieve this aim will concern on fastening of the fixture. Meanwhile, SCANTOOL Drill Machine at Block B in FKP used a drill press vise as clamping device which slotted base for easy installation and positioning. This is a type of conventional power screw clamp which used human power to drive the screw to tighten the vise. In this case to change the conventional Power Screw Clamp or vise to the automation fixture we will consider several requirements to achieve the goal.

- Type of clamping system
- Type of supporting and locating points
- Sensors to be used
- Drawing Software