

AN IMPROVEMENT TO INTEGRATED MODEL OF ELECTRO
PNEUMATIC CIRCUIT FOR MATERIAL HANDLING IN A
MANUFACTURING CELL

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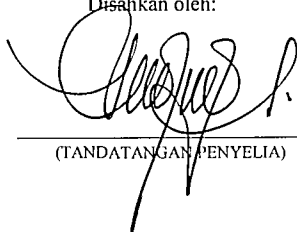
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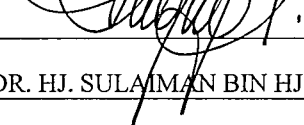
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**An improvement to integrated model of electro pneumatic circuit for
material handling in a manufacturing cell**

Presented in Partial Fulfillment of the Requirement for
the Master in Mechanical Engineering in the Graduate School
of Kolej Universiti Teknologi Tun Hussein Onn

By
Mohamad Norani Bin Mansor

Kolej Universiti Teknologi Tun Hussein Onn

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Signature : *Mohamad*
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DEDICATION

To:

All Muslimin and Muslimat

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Abstract

Pneumatic circuit are very widely used in automating plants especially manufacturing plants. These circuits are implemented for material handling, process control and general automation. Selecting an effective design, components and appropriate system will be a critical item in installing an effective and efficient system. One sure way of acquiring this is the application of software especially those that have comprehensive analytical capability. In this project the author used Automation Studio to study the effect of adding extra component and valve to a three cylinder integrated material handling system. The evaluation has shown that adding components have shown some positive effect on the system. However some components provide advantages some do not. Automation Studio has prove to be an effective tool to determine this.

Abstrak

Penggunaan sistem pneumatik sangat banyak digunakan dalam loji automatik terutamanya dalam sektor pembuatan. Ianya banyak diguna pakai untuk pengangkutan barangan, proses kawalan dan kegunaan automasi. Pemilihan untuk rekabentuk yang berkesan, komponen dan sistem yang baik adalah perkara yang kritikal ketika pemasangan hendak dilakukan untuk kecekapan sistem tersebut. Suatu penyelesaiannya ialah dengan menggunakan 'software' yang berkebolehan untuk menganalisa secara komprehensif. Projek ini menggunakan 'Automation studio' untuk menganalisa kesan terhadap penambahan komponen dan injap pada tiga selinder dalam sistem rangkaian pengangkutan barangan. Dapatan yang diperolehi menunjukkan bahawa dengan menambah komponen dan injap telah mendatangkan kesan kepada sistem tersebut. Walaubagaimanapun, ada komponen dan injap yang dipasang itu mendatangkan kebaikan dan ada yang tidak. Penggunaan 'Automation studio' ini menunjukkan salah satu kaedah yang sangat berkesan dalam kajian projek ini.

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CHAPTER I

Introduction

1.1 Introduction of pneumatic material handling

Pneumatic technology is very important in automation. This is especially important in manufacturing industries. Pneumatics like hydraulic in an industry is used to move material, control movement and assist in automatic process and operation. Thus pneumatic is an important source of power in material handling. Certain characteristics of compressed air have made this medium quite suitable for use in modern manufacturing and production plants.

As a key component of manufacturing systems, material handling interacts with the facility layout and system control or scheduling problems. The material handling system requires the logical and physical aspects of material flow and equipment to be justified from both performance and economic perspectives.

The work takes into account the various of material handling operations that take place during manufacturing like the processing machines, equipments and character of the part types. It is an integrating of operation allocation problem and the considerations of material handling systems.

1.2 Problem overview

Pneumatics is low cost alternative to material handling tasks in term of support and service available in the manufacturing system. The potential of this drive medium is now recognized, particularly for linear motion application. However, a number of problem and challenges still remain for it to realize for industrial control motion.

Pneumatic cylinder in an integrated form can perform a lot of task and assist engineer in operation. However normally it is difficult to ensure optimization because one need the right combination of valve, control and circuit to obtain optimization. This research will observe one aspect of the optimization or improvement of a pneumatic system. Three cylinder controlled by an additional valve may smoother the operation or may hinder an efficient system. This project will focus on one aspect of this improvement.

1.3 Objective of the project

1. To study the effect of additional component on a three cylinder integrated pneumatic system for material handling.
2. To compare performance of the above system and suggest the best combination.
3. To identify the best additional component for the system.

1.4 Scope of the project

Below are the scopes of the project:

1. The project will be focused on three cylinder material handling pneumatic system.
2. The project will also be limited to five types of additional valves or components added to the system and also the circuit selected are not modified throughout the experiment.

1.5 Definition of pneumatic

“The English word pneumatic and its associate noun pneumatics are derived from the Greek pneuma meaning ‘breath’. Originally coined to give a name to the science of the motions and properties of air, pneumatics has been adopted by engineers to identify the branch of physics treating of the mechanical properties of air and other gases, now used somewhat more restrictedly to refer to the phase of fluid mechanics dealing with the properties, actions and applications of gases, but chiefly air, at pressures higher or lower than atmospheric”.

(Werner Deppet and Kurt Stoll, 1975:7)

The technology of pneumatics deals with the behavior and application of compressed air. The science of air was known and used in industry before the beginning of the Second World War (1939-44). During the war, many industries like western countries started switching more automatic equipment and machineries. Many of these were operated by pneumatically and use in manufacturing and other activities. This was the present the concept of pneumatic material handling system to use compressed air in production plants.

1.5.1 Definition of material handling

Materials handling involves the loading, moving and unloading of materials. The loading, moving and unloading of ore from a mine to a mill and of garments within a factory are examples of materials handling. There are hundreds of different ways of handling materials. These are generally classified according to the type of equipment used. For example, the International Materials Management Society has classified equipment as (1) conveyor; (2) cranes, elevators and hoists; (3) positioning, weighing and control equipment; (4) industrial vehicles; (5) motor vehicles; (6) railroad cars; (7) marine carriers; (8) aircraft and (9) containers and supports.

Every materials handling problem starts with the material - its dimensions, its nature and its characteristics. Engineers who fail to start here usually end up trying to justify equipment rather than achieving safe and economical movement of the material. The quantity to be moved both in total and in rate of moving desired is next in selecting the appropriate handling method. Then comes the sequence of operations or the routing. Basically, this what, when (how much and how often) and where is the minimum information needed to evaluate or determine any handling system or equipment.

Materials handling is both a planning and an operating activity. These two activities are generally separated in industry, an analytical group designs or selects the system or equipment and the operating group puts it to use.

(Mel Schwartz, 2002: Second Edition)

1.6 History of pneumatic

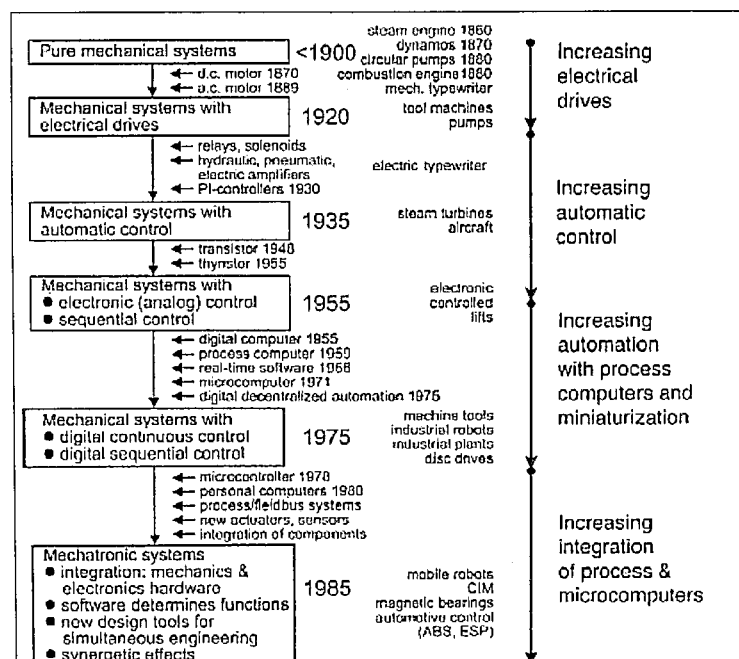
- 3000 B.C. :
 - Air pressure (wind) has been used to power ships since the beginning of civilization bellows were used to produce bursts of compressed air to start fires.
- 1700 :
 - Musical instruments were controlled by mechanical drums which operated valves to switch in pipes of different pitches.
- 1800s :
 - Pneumatic controls using perforated cardboard strips and by attaching long strips which could play the programmed melody.
 - Several railroads were built in Europe which operated by pneumatic power and pulled loads as fast as 42 mph.
 - Air brakes are used on most large vehicles today including trucks.
- 1858 :
 - Compressed air drills were being used in mining.
 - Make good quality cylinders allowed progress to be made in the development of pneumatic equipment as well as the steam engine.
- 19 centuries :
 - Great deal of development took place utilizing air as a power source and also as a means of control.
- 1950s :
 - Much fluid logic technology was developed in the mid 1950s at Oklahoma State University.
- 1960s :
 - Pneumatic systems were used primarily as power sources.

1.7 Application of pneumatics

With the introduction of pneumatics in the manufacturing process, the industry is benefited with a cheaper medium of material handling which easy to used and bring down the cost of production to a much lower level. Therefore, today air operated tools and accessories are a common in industry.

Few decades ago as shown in **Table 1.1** maximum application of pneumatics was probably in the field of construction where the main source of power for tools like power hammers, drills, nut runners, riveting and hammers. Now, compressed air is used in industrial such as starting with pneumatic cranes to the use of air in the brake system of automobiles, railway coaches, wagons and printing presses.

Table 1.1 : Historical development of mechanical, electrical and electronics system



The basic features that make application of pneumatics in industries more advantageous and suitable in material handling system because of the following features:

1. Wide availability of air.
2. Compressibility of air.
3. Easy transportability of compressed air in pressure vessels, containers and in long pipes.
4. Fire proof characteristics of the medium.
5. Simple construction of pneumatic elements and easy handling.
6. High degree of controllability of pressure, speed and force.
7. Possibility of easy but reasonably reliable remote controlling.
8. Easier maintenance.
9. Explosion proof characteristics of the medium.
10. Comparatively cheaper in cost than other systems.

Therefore in my opinion, pneumatic system has better operational advantages and accuracy are concerned in manufacturing system. In areas of hazards, probably air will be a better medium than the hydraulic system.