INTEGRATED FILLING AND CAPPING SYSTEM IN BOTTLING OPERATION

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Integrated Filling and Capping System in Bottling Operation

Thesis submitted in accordance with the partial requirements of the
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By

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APPROVAL

This PSM submitted to the senate of UTeM and has been as partial fulfillment of the requirements for the degree of Bachelor of Manufacturing Engineering (Robotics and Automation). The members of the supervisory committee are as follow:

……

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(Official Stamp & Date)

ABSTRACT

This thesis is concerning with the system filling and capping beverages bottle operation in one undertaken in beverage industry currently. These thesis spotlights are relevant with analysis undertaken in repairing which does and accuracy to achieve high target and to issue low cost. There were 3 main parts that there were in this thesis which filling part, capping part and transportation conveyor. In filling, the product in used is a liquid and it will be transfer into the bottle that has been prepared. Then second process capping. When the first process was completed, the conveyor will be function as a transport to bring bottle had been filled to do capping process. Among process fabrication carried out while carrying out this project is as overtaking such as cutting, bending, drilling, and assembling. Other machines also will used for the task do according to work that should be done to this project. Among machine that being used are lathe machine, laser cutting machine, bending machine, abrasive machine, welding machine and drilling machine.

ABSTRAK

Tesis ini adalah berkenaan dengan sistem pengisian dan penutupan botol minuman dalam sesebuah operasi yang dijalankan dalam industri minuman pada masa kini. Tumpuan utama tesis ini adalah berkaitan dengan analisa yang dijalankan dalam pembaikan yang dilakukan dan ketepatan untuk mencapai target yang tinggi dan mengeluarkan kos yang rendah. Terdapat 3 bahagian utama yang terdapat di dalam tesis ini iaitu bahagian pengisian, penutupan dan pengangkutan conveyor. Dalam pengisian, produk yang digunakan adalah cecair iaitu ia akan dimasukkan ke dalam botol yang telah disediakan. Kemudian proses kedua iaitu penutupan. Apabila proses pertama selesai, converyor berfungsi sebagai pengangkutan untuk membawa botol yang telah diisi untuk melakukan proses penutupan. Antara proses fabrikasi yang dijalankan semasa melaksanakan projek ini adalah seperti memotong, membengkok, menggerudi, dan memasang. Penggunaan mesin-mesin lain juga dilakukan mengikut kerja yang perlu dilakukan pada projek ini. Antara mesin yang digunakan adalah seperti mesin larik, mesin pemotong laser, mesin penbengkok, mesin pelelas, mesin kimpalan dan mesin penebuk lubang.

DEDICATION

For my beloved mother and father.

ACKNOWLEDGEMENT

Alhamdulillah, I thank Allah S.W.T, The Most Beneficent and The Most Merciful, for his guidance and for granting me knowledge and patience throughout doing this project. I would like to take this opportunity here to express my deepest gratitude and highest appreciation to my supervisor; En Shariman Abdullah for their strong support, encourage and guidance during my Final Year Project 2 during this semester.

As we know the scope of this final project is to train student on real life working environment that include learning something new and training what we had learn before. I had learned so many things and the most important thing is about the objective of the project for my future working.

Thanks for everything that giving me the opportunity to learn in here, especially for all that created my characteristic on my ambition to be an engineer with fully responsibility on work.. I also want to extend my thanks to those who helped me, especially to all lecture from Faculty of Manufacturing for their brilliant ideas, comments and advices.

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CHAPTER 1

INTRODUCTION.

1.1 General Introduction.

Filling and capping system is the most commonly system that have been used in industrial machinery to produce product such as sauces, syrups, light gels and shampoos, foamy cleansers and chemicals, water and beverages. It also used to produce heavy sauces, salsas, salad dressings, cosmetic creams, heavy shampoo, gels, and conditioners, paste cleaners and waxes, adhesives, heavy oils and lubricants.

For this project, I have been given a task to develop Integrated Filling and Capping System in Bottling Operation. This project has 2 tasks, filling system and capping system. Filling is usually the aspect of filling the bottle with the product such as the example that has been given forward.

In filling system, the equipment that will be use is pipe, nozzle, conveyor, reservoir and piston system. There are many type of machine system of filling operation such as Overflow Fillers, Servo Pump Fillers, Peristaltic Fillers, Time Gravity Fillers and Piston Fillers. Bottle filling means suitable for filling a liquid with contain in a bowl at super atmospheric pressure, comprising a float valve which establish a liquid level therein.

A bottle filling device which raises in case bottles to be filled to engagement with a fill valve assembly which control fluid communication between a fill tube inserted into each bottle and pressurized fill tank. Cup members, which engage the bottle opening in fill position, communicate with a vacuum line such that the combination of pressurized fill source and air-evacuated bottles realizes extremely fast

filling. The fill tube are the shaft of respective double acting fluid pressure operated cylinder of simple construction which position a port in the fill tube upper wall extremes within the fill tank confines or within pressure sealing cylinder end bushing to define respective open and closed fill valve condition.

Usually, capping is the most difficult aspect of a packaging line for several reasons. Sometimes the range of geometry and size of caps and bottles is so wide that the capping machine components become expensive or the platform of the machine is not suitable for all sizes in the range. Sometimes the bottle and cap combination are not ideal with the threads of the bottle being in conflict with the threads of the cap. Sometimes, caps can only be placed vertically on the container which increases the capital cost of the machinery. A bottle cap positioning apparatus positions bottle caps beneath the orbiting capping heads of a rotary bottle capping machine for pick up. A cap feeder places the cap on a semi circular pick up path directly under the orbital path of the capping heads. An endless belt is supported on a pair of pulleys and orbits around a guide block. The guide block has a convex surface that pushed the belt outward to parallel the pick up path. Gears drive the pulleys and synchronize the endless belt with the capping heads to reduce factory floor space requirements and worker exposure to moving parts.

1.2 Problem Statement

Nowadays in industry there are a lot of filling and capping operation process. There are lot types of filling and capping that is use in industrial. Filling actually is the system that in use in a high cost. There will be a problem about the measurements of the quantity of each bottle during the process. There are many type of machine that is difficult to handle and this will cause the production of the company. In capping system, the tool that been use is also a high cost. Another problem is to use this system, it can affect the quality for the cap and bottle during capping process.

1.3 Objective of Project

The main objectives of this project are:

a) To develop filling machine from the overflow piston system which is low cost and maintenance but it can access high production rate and efficiency and operate with high accuracy and precision.
b) To develop capping machine with the new capping system which is low cost and maintenance but it can access high production rate and efficiency and operate with high accuracy and precision.
c) To analyze the piston systems performance for the filling operation including the efficiency and the output stability.
d) To analyze the performance for the capping operation including the efficiency and the output stability.
e) To design and fabricate the filling and capping machine with the suitable material selection in order for manufacturing assembly of the system that has the effectiveness with low cost maintenance.

1.4 Scope of Project

The project emphasis on designing a model of filling and capping operation system which using the same operation and to reduce the cost. Then, later on in the project, a concept of the system will be fabricated based on the design. The design that will be fabricated are based from the bottle that to be used. Finally, test and analysis will be carried out on the developed system. This is the related scope of the project:-

Working space:

a) Transportation conveyor.
b) Transport the bottles from filling workstation to capping workstation.
c) Only one line or path to transport the bottles.
d) The driven motor is using DC motor.

Filling workstation:

a) Reservoir to load the liquid.
b) Pipe to transfer the liquid to mechanical pusher piston system.
c) Overflow filler piston system.
d) Nozzle exits the liquid.
e) Mechanical pusher piston to push the load through inside the bottle.
f) DC Driven motor to move the piston inverse and forward.

Capping machine:

a) DC driven motor to rotate the cap until tight.
b) Roller to support the cap.
c) Aluminum hollows to holder the cap.
d) Timers relay to estimate the running time of driven motor.

Conveyor system:

a) Belt to carry the bottle.
b) Roller to move the belt.
c) DC driven motor to operate the roller.

Material:

a) Aluminum and mild steel for the fabrication part.

CHAPTER 2
LITERATURE REVIEW

2.1 Introduction

The Filling and Capping Bottling Operation system is using three main parts that are filling process, capping process and conveyor system. To understand this project, some research has been done throughout making this project to be successful. The research included the type of motor, the conveyor system, system operation, material and other more that required developing a Integrated Filling and Capping System in Bottling Operation.

2.2 Techniques Operation Filling System

2.2.1 Overflow Filler Selection Guide.

Application:

This type of filler is best suited for liquids with low to medium viscosity. Liquids with solid particulates not exceeding 1/16" can also be filled. Note that overflow fillers are the machine of choice in handling very foamy products at higher speeds.

Examples:

Sauces, syrups, light gels and shampoos, foamy cleansers and chemicals, water and other no carbonated aqueous beverages.

Advantages:

High performance, easy to clean, easy to operate, expandable at low cost. Offers greatest flexibility at lowest cost.

The supply side of a two part nozzle is used to pump product into the container. When the container fills up to the target fill height, the excess product and foam is forced out of the container via the return side to the original product source tank.

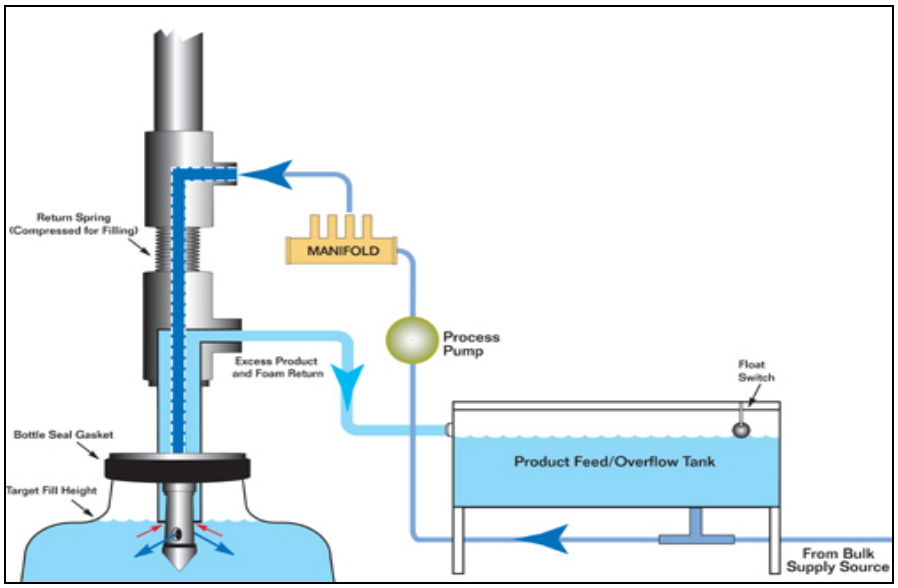

Figure 2.2.1a – Liquid transfer from tank to bottle

Elements of a Bottling Process

Bottling machines are designed to automate the filling of glass and plastic containers to produce carbonated drinks, mineral water, and beer and wine products. The bottles (transported on a conveyor belt) are spaced out from each other by means of a worm before being taken up by a holder and cleaned. Afterwards, they are taken up by an inlet star that positions them on a carousel. The bottles are then successively raised towards a filling valve. The filling starts after the bottle has been raised from the filling valve bracket, and the top has touched the opening control. The filling ends when the product in

the bottle has reached the end of the spout, therefore, setting the level. The filling valve is then set mechanically closed by the `closing control system' which operates the throttle. After filling, the bottles are then taken by a star which positions them under the crowner or capper where they are sealed. Another star positioned at the end of the capper picks the bottles and places them on the conveyor belt, where they are again sprayed with water on the outside, then transported to the labeler.

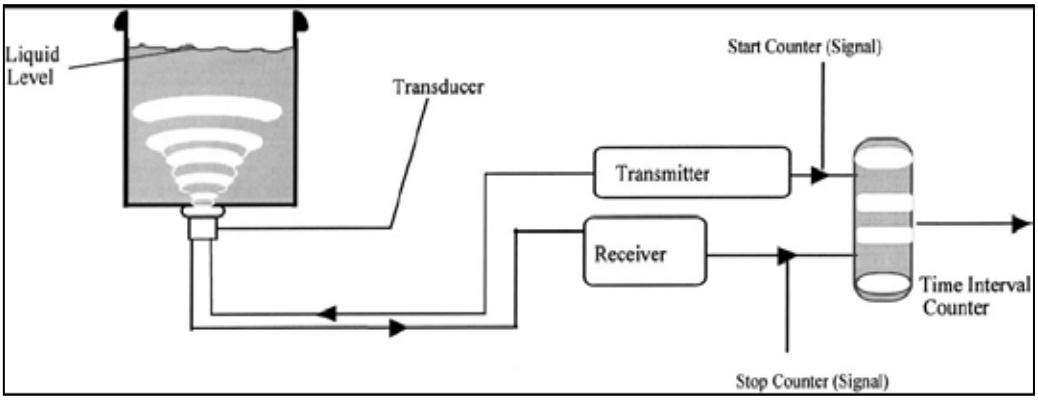

Figure 2.2.1b - Basic sonic liquid level sensor ± Bogue Electric Manufacturing Company

2.2.2 Peristaltic Filler Selection Guide.

Application:

Specifically designed for high value, small volume fills at very high accuracy. Suitable for aqueous and other light viscosity product

Examples:

Pharmaceutical preparations, fragrances, essential oils, reagents, inks, dyes, and specialty chemicals.

Advantages:

Fluid path is disposable; easy cleanup and elimination of cross contamination problems. Accuracies of 0.5% are achievable for fill volumes less than 1 ml.

The peristaltic pump makes intermittent contact on only the outside of the product tubing so that the product only touches the inside of the tubing. The filler's master computer independently tracks the speed of rotations of the peristaltic pump head so that it knows precisely how much product has been delivered. When the target fill volume is reached, the pump stops and the remaining product fluid do not drip out due to pipette action. The computer stores all fill parameters in memory for fast changeovers.

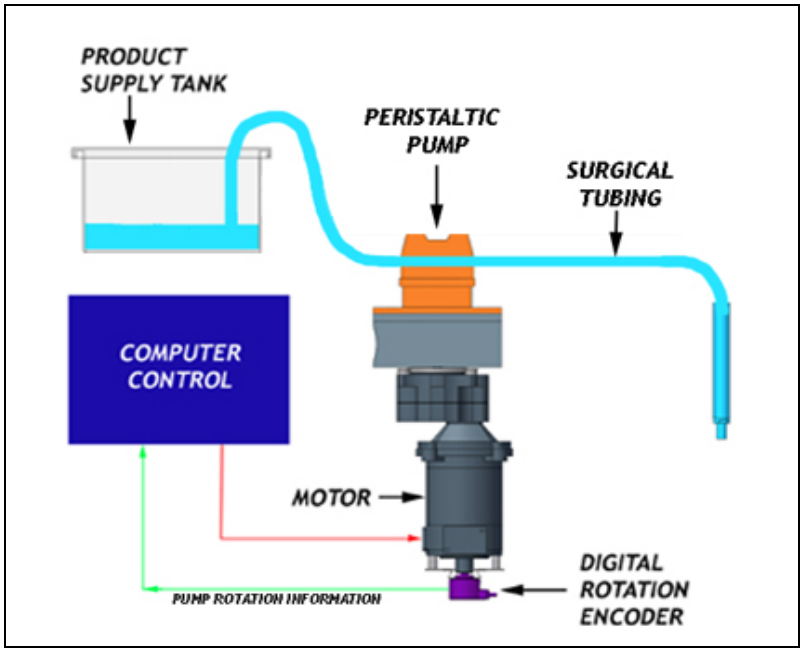

Figure 2.2.2a - Peristaltic Filler system

2.2.3 Piston Filler Selection Guide.

Application:

This type of filler is best suited for viscous products that are paste, semi paste, or chunky with large particulates. These fillers are built to meet food grade standards and can also handle various chemical applications.

Examples:

Heavy sauces, salsas, salad dressings, cosmetic creams, heavy shampoo, gels, and conditioners, paste cleaners and waxes, adhesives, heavy oils and lubricants.