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## Design and Manufacture of Electronic Control System for Final Caulking Horn Machine Based on Omron CJ2M CPU13 PLC13 in XYZ Inc.

Abstract. XYZ Inc. is one of the companies engaged in manufacturing that produces vehicle spare parts. One of spare part produced is horn. The company expects to increase production of horn in every year. In 2015, the company has an expansion of the horn production in Malaysia. In order to meet these needs, then the transfer of machine was made from Indonesia to Malaysia and replaced with a new machine. One of the machines transferred is the final caulking machine. The final caulking machine used in horn production to combine the components; assembled of magnetic breaker and assembled of diaphragm by being pressed. New machine made by machinery division upon request from production engineering. In order to improve the yield produced of the final caulking machine then on the new machine made some improvements. The improved aspect of the previous machine was machining time. The machining time in this section is calculated to decrease. This is done through the process of replacing the work piece transfer mechanism using rotary index table mechanism to increase machine productivity. In order to meet these needs then made a final caulking horn machine based on Omron CJ2M PLC CPU13. The process of making electrical control system is done in several stages; design, manufacture, and testing. In the stage of making the control system there is the installation process of electrical components and wiring on the control system. The final caulking machine is expected to maintain product quality and can decrease machining time by 0.6 seconds. So that productivity in making horn can be increased.

Keywords: Control System of Final Caulking Machine, Horn, PLC Omron CJ2M CPU13

### INTRODUCTION

In the manufacturing industry, to support production activities XYZ Inc. has 3 divisions that

act as factory support, one of which is Machinery Division which is tasked to make machine, jig, dies, and tools used in production process.

In October 2015 the Machinery Division of XYZ Inc. received engine demand for horn assembling line. This line serves to perform the process of horn assembly. The ordered machine will replace the old machine that the plan will be moved to another factory. Horn is generally called a horn is a vehicle component that produces sound when the electric current flows, the resulting sound is used as a warning sign of the existence of the vehicle. The process of making horn includes several processes.

One of the machines made by the machinery division is the Final Caulking machine. This machine serves to assemble the components of Magnetic Breaker assembly (Assy) and Diaphragm Assy become Horn Assy.

The process of caulking the component is done with the principle of press. The process is divided into two processes. The process is the laying of components (loading / unloading), and process caulking. For the distribution of the workpiece from one process to the next, the final caulking machine uses a rotary index table. Rotary index table is a table that is rotated by a motor with a certain speed to a certain angle position.

Therefore, to assemble the horn component and rotate the rotary index table automatically, the final caulking machine requires a dick system. The final engine control system caulking is based on Omron CJ2M-CPU13 PLC as the main control device. Expected by the existence of this control system on the final machine caulking, caulking process can be done automatically and can reach the time machine that has been determined.

#### STATE OF THE ARTS AND THEORITICAL

Based on the introduction above, the formulation of the problem in this paper are; (1).How to design and make electrical control system final machine caulking PLC-based OMRON CJ2M-CPU13 for the machine can work in accordance with the specified work steps, (2).How to test the electrical control system that has been made in doing final machine work caulking in order to produce horn assy, (3).How to reduce machine time final machine caulking by 11%.

This paper discusses design and manufacture of electrical control system final machine caulking, also discuss the final step sequence of the caulking machine. The mechanical design and its calculations are discussed limited to functional only. Not discussing Omron CJ2M-CPU13 PLC program and HMI (Human Machine Interface).

## CONTROL SYSTEM

The control system consists of a set of tools and electronic devices that can be used to control, govern, and regulate conditions. The components are available in the form of diagrams.

Block diagrams are the words used to set the system. One of the control system components used in the block diagram of FIGURE 1 is as follows.

FIGURE 1. Block diagram of the control system

## UNDERSTANDING PLC (PROGRAMMABLE LOGIC CONTROLLER)

PLC or Programmable Logic Controller is a digital electronics tool that uses programmable memory to store instructions and to perform special functions such as: logic, sequence, timing, calculation, <sup>4</sup> and arithmetic operations to control machines and processes especially in manufacturing production.

The PLC is equipped with digital input and output with standard connection and signal levels so that it can be directly connected to a variety of devices such as switches, lights, relays, or various sensors and actuators. The PLC types are shown in FIGURE 2.

FIGURE 2. Types of PLC

## DATA COLLECTING

Product Knowledge

XYZ Inc. produces many kinds of automotive components one of them is horn. Horn is a warning signal product that produces a voice. This is one of XYZ Inc. product. In Figure 2 show various components that produce by XYZ Inc. that sign on red dots.

FIGURE 3. Horn position on a car

### Final Caulking Machine

Caulking **1** is the process of pressing the workpiece using hydraulic cylinders boost power for the purpose of locking the workpiece. The final caulking machine **2** is one of the machines used to manufacture horn products. The final caulking machine serves to compress the outer part of the horn product which aims to combine the assy magnetic breaker and diaphragm assy.

This machine uses Omron CJ2M CPU13 PLC as its control. Below is **1** an overview of the concept the final roller and the final caulking process undertaken by the machine.

FIGURE 4. The final caulking machine

Final Caulking is pressing the outer until locked by Diaphragm Housing. Detail of the process is show by figure below.

FIGURE 5. The final caulking process

## EXPERIMENTAL DETAILS

### Improvement Analysis

The final process of caulking which **2** is one of the stages in making horn is very

important to evaluate the stages. This is because the improvement in the work process has a fairly high effectiveness. Based on the table below is a step done on the final process of caulking. Based on the steps there is one step where the operator waits for the pressing process and does not do any work.

The waiting time is done when the operator will do the workpiece setting on the jig. This waiting time will be improved to be eliminated in order to work more effectively. The details are on TABLE 1 will display data process and time required in final process caulking.

TABLE 1. Current machining time

Based on the final process table caulking then analyzed the cause of the waiting time is the laying of mechanism the workpiece. This can be seen in detail in the following FIGURE 6.

FIGURE 6. Linear movement of workpiece

FIGURE 7. Rotary movement of workpiece

Based on the detail, the mechanism of laying of the workpiece from the operator to the pressing process is done in a linear manner so that when the machine is doing the posting then the operator can do is wait. This is what causes the operator's waiting time. If we can fix this linear mechanism into a rotary mechanism then the waiting time can be eliminated. This rotating mechanism will be performed by the rotary index table as shown below. In this rotary mechanism is expected when the workpiece is being done pressing process then the operator can do the next workpiece setting.

## Design of Control System

2 The control system of machine is based on PLC as the main control device. PLC plays a role in managing the entire machine control system consisting of sensors as input devices and actuators as output devices. Figure 8 is a final engine control system design caulking.

In the picture below it is explained that the final caulking machine uses the key input device used for 2 the operation of the machine. Area sensor is used as a safety sensor on the machine that aims to prevent the occurrence of work accidents. The proximity sensor is used to detect the piston position on the pneumatic cylinder used on the machine.

Pressure sensors are used for hydraulic pressure indicator and adjustment. Laser 4 sensors are used to detect workpieces on machines. Photoelectric sensor is used for jig detection in home position. HMI serves as a screen monitoring machine and machine operation panel.

The output devices used consist of Absodex CKD motor controllers, manifolds, relays, indicator lights, buzzers, pneumatic solenoid valves, and hydraulic solenoid valves. The Absodex CKD motor controller 1 is used to control the Absodex CKD motor. The manifold is used to control the pneumatic solenoid valve which is then connected to the actuator. The relay is used to control the hydraulic solenoid valve which is then connected to the actuator. The indicator light 2 is used as a sign / indicator when the machine is operating. Buzzer is used as an alarm on the machine.

FIGURE 8. Block diagram of the control system

The actuator used consists of the Absodex CKD motor used to rotate the rotary index table. Pneumatic cylinders are used to drive rotary index table locks, horn jig jacks, and split punch movers. Hydraulic cylinders are used to drive punch caulking which aims to

compress the workpiece.

## Wiring of Control System

The main panel is designed as a place of electrical components such as relays, 24VDC power supply, circuit protector, terminal block, and PLC module. Here are the main panel drawings and layouts of the electrical components used <sup>1</sup> are shown in FIGURE 9.

FIGURE 9. Layout of the main panel

Base on the figure above there are component <sup>that will be used.</sup> The table below describes <sup>2</sup> the components used in the main panel.

TABLE 2. Components on main panel

## Wiring of Rotary Index Table

The main wiring lies in the power and motor wiring with the control system. In the following Figure 10 is the wiring for the power system.

FIGURE 10. Power wiring diagram

In FIGURE 11 below there is wiring on the motor with PLC. The main parts of this wiring are in motor drivers, actuators and resolver cables.



FIGURE 11. Motor wiring diagram

In FIGURE 12 is the communication between master and slave. In this section, communication uses device net between PLC module and motor driver for rotary index table.

FIGURE 12. Omron PLC CJ2M-CPU13 Device Net Network

TABLE 2 is the detail of the address and the definition **1 of the use of the** address. At this address is defined the address of input and output.

TABLE 2. PLC addressing and definition

## RESULTS AND DISCUSSION

### Machine time Comparison

Machine time final machine caulking new decreased by 11%. The decline is due **to the use of the** rotary index table on the final caulking machine. Figure 13 is a graph of decreasing machine time of final machine caulking.

FIGURE 13. Machining time of Final Caulking Machine

## SUMMARY

**1 The design and manufacture of** electrical control system final machine caulking horn

PLC OMRON CJ2M-CPU 13 have SUMMARY that:

- PLC OMRON CJ2M-CPU13 as the main control device is done in several stages, such as: design of control systems, installation of sensors and actuators, electrical device wiring, addressing input devices and outputs on PLC.
- Control system testing **5 is done in several stages:** test of master device on, testing of PLC input device (button and sensor), testing of marine PLC (actuator) device, and testing of machine work process. Based on these tests, the results obtained that the machine can produce horn assy.
- Reduction of machine time of final caulking machine about 0.6 or 11%.

#### ACKNOWLEDGEMENTS

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## Sources

- 1 [http://docshare.tips/electrical-engineering\\_57707de4b6d87fb2918b5406.html](http://docshare.tips/electrical-engineering_57707de4b6d87fb2918b5406.html)  
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- 5 [https://www.researchgate.net/figure/1-preparation-diagram-2-wiring-diagram-of-Safety-Sensor-3-wiring-diagram-of-HMI\\_fig7\\_322690889](https://www.researchgate.net/figure/1-preparation-diagram-2-wiring-diagram-of-Safety-Sensor-3-wiring-diagram-of-HMI_fig7_322690889)  
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