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**Department of ECE, Adhiyamaan College of Engineering, Hosur, Tamilnadu, India**

# **PLC Based Safety Enhancement in SPM Machine LA-4421 H-Series Cylinder Block Line**

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**ABSTRACT:** This paper aims to improve safety in the H-Series Cylinder Block Bay 2 LA-4421 tappet drilling SPM (Single Purpose Machine). The LA-4421 machine is used to tappet drilling in the engine component's head face. The machine operator may interrupt their hand while running the machine and at the unloading conveyor the component may fall from the machine due to the miscommunication between the index table and the conveyor. It stops the production. In order to prevent such accidents in industries, the paper is implementing a safety improvement on the machine's door by deploying a limit switch, along with a photoelectric sensors on the unloading conveyor. This paper focuses on modifications in machines door limit switch and photoelectric sensor which is used to prevent accidents in Industries.

**KEYWORDS:** PLC, Door Limit Switch, Photoelectric Sensors.

## **I. INTRODUCTION**

The Programmable Controller (PLC) is a solid-state equipment, basically designed to perform logical decision making for industrial control applications. Since their development in early 1970's, PLCs have evolved to challenge not only relays but also other discrete control devices such as stepping switches, drum sequencers, etc. The simplicity of reprogramming a PLC, when modifications are required in the existing control system, as compared to the cumbersome process of rewiring a hardwired relay control panel has been widely accepted. The comparatively small size of PLC accompanied with less hardwired interlocks reduces the control panel size considerably. The powerful instruction set has reduced number of components as timers, counters, etc. and made sequence development faster and easier. The use of solid-state devices makes PLC very reliable as compared to electro-mechanical devices used in relay control panels.

In any kind of industries, we may encounter unexpected breakdown of Machine and these losses or breakdown affect in the production process either temporarily/permanently. Hence we must find the problem of the machine/part in the possible time and must be in a condition to solve it so that the loss due to failure of the part/equipment is minimum. Rough tappet drilling on the oil cooler face of H-series cylinder blocks is done with this tappet drilling machine LA4421. If the operator interrupts their hand while the machine is running, it might result in a serious accident and Machine failure, as well as a miscommunication between the index table and the Unloading conveyor so the result leads to the index table get quick return and it causes the component may fall in between the index table and the conveyor. To avoid the hazards mentioned above, the door limit Switch and photoelectric sensors are deployed.

## **OBJECTIVE**

The objective of this paper is to provide a safety precautions in SPM Rough tappet drilling machine In the H-series cylinder block of LA-4421. The operator interrupts their hand while the machine is running, it might result in a serious accident and machine failure, as well as a miscommunication between the index table and the

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unloading conveyor. To avoid the hazards have mentioned above, the door limit Switch and photoelectric sensors are deployed to make sure the safety precautions.

## II. RELATED WORK

[1]T. Menakadevi et al. (2014),“Automated Printing Process Using a Robot ”, Automation has become the prior need to meet up the growing trends of industries today. The biggest benefits of automation is that it saves labour. This paper deals with the printing of days and dates on the watch indicator using the automated system. This automated system comprises of a robot (cobra i600) and PLC controlled machines. The manual operation involve (70%-80%) human effort, number of indicators being printed in span of 8 hours (1500-2000 indicators) and it also depends on the workers efficiency.[2] Ted Mortenson, “Limit Switch - Oct 19, 2020”, Ted Mortenson have proposed a method that operated by a physical force applied to it by an object. Limit switches are used to detect the presence or absence of an object. These switches were originally used to define the limit of travel of an object, and as a result, they were named LimitSwitch.

[3]Zheng Chunjiao : “The application and development of photoelectric sensor - 2019”,Zheng Chunjiao have proposed a method that the photoelectric sensor is to reflect the measured objects changes by light signal,and then convert the light signal into electrical signals by optoelectronic components. Usually the photoelectric sensor is composed by light source, optical access and optical components.[4] Suman Adhikari,“Operator machine control using Siemens PLC and HMI - December 2018”,Programmable Logic Controllers (PLCs) are the small digital computers used in modern days control applications. They are flexible to program according to users need and are capable of generating control signals that can control machines and processes in industry.The PLC used for this paper is Siemens SIMATIC S7-1200, CPU 1214C DC/DC/DC model. It is a powerful controller with many capabilities. It has functions that can perform counting, measuring, closed-loop control, and motion control.

[5]Mallikarjun G. Hudedmani, Umayal R M, Shiva Kumar Kabberalli, Raghavendra Hittalamani, “ Programmable Logic Controller (PLC) in Automation – 2017 ”,The Proposed method that the process and safety considerations if programmed appropriately can meet the required objectives. The relay logic and contactor logics (RLC) were practiced in the olden days which include the human intervention and errors. The advent and application of microprocessors, microcontrollers and new specific tools such as PLCs, Supervisory control and data acquisition (SCADA) and Distributed control systems (DCS) have increased productivity, accuracy, precision and efficiency.. These systems reduced human intervention and increased the flexibility in the process control.

## III. METHODOLOGY

The major challenge is while machine running machine’s cabinet can be open or close without the intimation to the operator.so it leads to major hazard for operator and machine.There is a miscommunication between the machine and conveyor. Which is when the component get finish the rough tappet drilling process. The component get unloading from the station-2’s table index. So the component quick return from index table to conveyor it caused by component fall from the conveyor.To avoid this kind of hazards in the machine cabinet. The door limit switch is deployed in the cabinet of the machine, it perform a major role. If the door limit switch is typically open, the machine will indicating in HMI panel “The door limit switch is faulty; please close the door and recheck I8.2”.The Photoelectric sensor was proposed to address this problem. The sensor will detect the component when it reach the conveyor so it can moves a component without any hazards. It will reduces the component’s quick returns from the station-2’s index table.

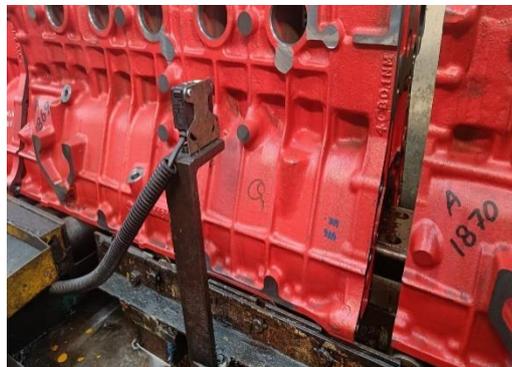
#### IV. EXPERIMENTAL RESULTS

The door limit switch performs a major and crucial role in terms of safety. If the door limit switch is typically open, the machine will not begin the cycle, and a warning will appear on the HMI panel, indicating "The door limit switch is faulty; please close the door and recheck I8.2"



**Fig. 1. (a)** Door limit switch is deployed on the machine's door

The unloader will proceed to station-2's table index. After finishing station-2, the component will return to the conveyor. The photoelectric sensor was mounted in the conveyor to prevent hazards caused by component falls from the conveyor as a result of the quick return from index table to conveyor. At this point the sensor will provide input and the conveyor will begin component get out from the index table to conveyor.



**Fig. 2. (b)** Photoelectric sensor is deployed on the conveyor

#### V. CONCLUSION

This paper was undertaken due to concerns about the safety issues of the machine operator and components in the LA-4421 6 Cylinder block line. During this cycle time, if the operator interrupts side, an accident could occur and the station cycle ends on the unloading side, the component may fall due to the quick unloading from the index table to the conveyor. It is our responsibility to ensure the safety and quality of machine operators and components. In order to solve this issue, we installed a door limit switch on the machine door, along with a photoelectric sensor on the unloading side conveyor. Therefore, this prevents accidents and ensures that no components fall between the index table and the conveyor.

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