

Contactor Logic Circuit Replacement In Die Casting Machine (LK-12T) Using MITSUBISHI PLC

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Abstract— The paper discusses the replacement of Contactor Logic Circuit (CLC) in Die Casting machine (LK-12T) with Mitsubishi PLC and Graphics Operator Terminal (GOT1000) controller. The demand for higher quality, greater efficiency and lesser downtime has lead to the need of automation in industries. Due to automation, the downtime in the industry has reduced significantly and the productivity of industries has increased to a large scale. The previously Contactor Logic Circuit in Die Casting machine is replaced by a PLC(Programmable Logic Controller) so that it has more enhanced capabilities when it comes to speed, storage, programming and power consumption. The improvement in the product quality in Die Casting machine is done by replacing the Contactor Logic Circuit with Mitsubishi FX3U-64M PLC which is being interfaced with the help of Graphics Operator Terminal (GOT1000) controller for easy maintenance. The aim of our system is to reduce the down time of the die casting machine i.e. to increase the productivity of products. Apart from down time, our objective is to improve the quality of the products. Quality defines the speed, precision and efficiency of products. Reduction of the cost of maintenance of the machine is also our prime objective.

Keywords- PLC, CLC , LK-12T Die Casting Machine, Downtime.

I. INTRODUCTION

Automation is the use of control systems and information technologies to reduce the need for human work in the production of goods and services. Whereas mechanism provided human operators with machinery to assist them with muscular requirement of work, automation greatly decreases the need for human sensory and mental requirements as well. The main objective of the project is to replacement of contactor logic circuit using Mitsubishi PLC. The existing machine is consisting of a relay, thumb switch, contactor logic circuit which is hardwired and because of this wiring the circuit becomes complex. Therefore the problems which we are facing in this system are that circuit becomes complex as

the wiring is hardwired, and because of this there is more wastage of time and therefore the space requirement is also more in this case. Hence due to these reasons the delay requirement increases and the disadvantages seen over here will be overcome by doing further modifications in the PLC system to make the system more user friendly and easy.

II. LITERATURE SURVEY

Initially we studied about the machine cycle of the system. We came across the problems with contactor logic circuit, relays, thumb switches in the Die Casting Machine. Before replacement the system used contactor logic circuit, relays, thumb switches as its controlling element. There are various disadvantages of CLC like the circuit was complex as it was

hardwired, more wastage of time and therefore the space requirement was also more in this case. The parts of CLC are also outdated. The size of the CLC panel is too large. Fault detection is also difficult in CLC. GOT1000 is able to overcome these disadvantages of the machine. Also with the help of Mitsubishi controller we can overcome the difficulties faced by CLC. Hence we are replacing our system with GOT1000 and Mitsubishi PLC.

III. DIE CASTING PROCESS

Die casting is a precision, high volume production process in which molten metal is injected under high pressure into a die having a cavity in the desired shape of the part. Upon solidification, facilitated by a coolant flowing through the die sections, die clamping is relaxed and the part is ejected for additional cooling (quenching) and any required finishing, trimming, or machining. The most common metals used are aluminum, zinc, and magnesium alloys. Less frequently, due to their higher melting temperatures, copper and copper alloys such as the brasses. Castability is primarily related to a metal's melting temperature, followed by other factors including:

- part complexity
- minimum wall thickness
- minimum draft or taper
- required precision of the part

Die casting machines are most often hydraulically actuated and usually in the horizontal position. There are two principle types of die casting machines in use; the hot chamber type and the cold chamber type. The hot chamber type is used for the lower melting temperature alloys like zinc and in some instances magnesium. In operation a reservoir of molten metal (holding pot) is seated in a furnace from which the metal is injected into the die. Injection pressure can range from 1500 psi to more than 4500 psi.

IV. BLOCK DIAGRAM

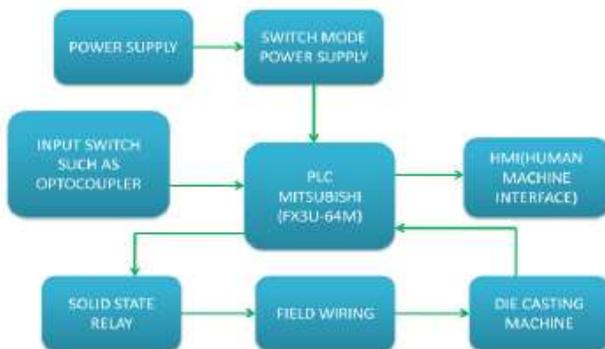


Fig.1: Block Diagram of the proposed PLC.

V. BLOCK DIAGRAM DESCRIPTION

1) GOT 1000 Series: Human Machine Interfaces are panel

mounted devices that provide effective dialogue between the operator and machine. Equipped with programmable display and keys, HMI allows easy operation and monitoring in the production area. HMIs display operational and fault messages, enables machine specific parameters to be monitored and modified in suitable formats. HMI keeps the operator fully informed of the current status of operations. The GOT (Graphic Operation Terminal) can be used as an electronic operation panel that enables such as switch operation, lamp display, data display, and message display on the monitor screen, which had been conventionally implemented with a control box. GOT1000 HMI can be directly connected to the Mitsubishi PLC via serial interface resulting in easy and quick installation Mitsubishi has introduced this series of touch screen terminals for effective communication between operator and machine.

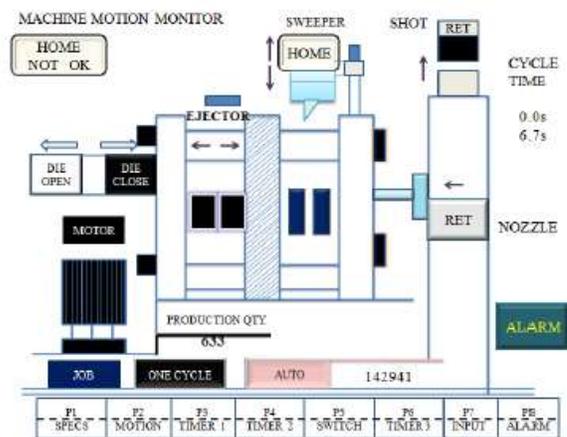


Fig.2: Front Panel Of GOT1000

2) Power Supply: 24Vdc voltage is given to PLC and 110V AC voltage is given to SMPS which acts as a switching regulator to convert electrical power efficiently.

3) Optocoupler: Basically optocoupler acts as a switch which transfers digital on/off signals. To isolate the input signals every input of PLC is optocoupler.

4) Mitsubishi FX3U-64M PLC: It is the heart of the system. It controls the overall operations of the system. Mitsubishi is a manufacturer of world class PLCs indigenously. Use of PLCs are stressed for the following reasons:

1. Service availability is excellent
 2. Maintenance required is less.
 3. Spare part cost is less and readily available.
- The FX3U is the original dual system-bus, high-speed, fully expandable compact PLC designed to seamlessly control communication, networking, analog, and positioning systems. This series gives you the freedom of modular expandability, with a wide selection of expansion modules and special function modules. The FX3U is the fastest PLC

available with a cycle time of 0.065usec per logical instruction. The FX3U series base units are available with 16, 32 , 48, 64, 80 or 128 input/output points expandable to 384 points. It possible to choose relay and transistor output type.

5) Switch Mode Power supply: A switched-mode power supply (switching-mode power supply, switch-mode power supply, SMPS, or switcher) is an electronic power supply that incorporates a switching regulator to convert electrical power efficiently. Like other power supplies, an SMPS transfers power from a source, like mains power, to a load, such as a personal computer, while converting voltage and current characteristics. 110v ac supply is given to smps from the power supply and the output of smps is given to PLC. SMPS provides greater efficiency because of the switching transistor it dissipates little power when acting as a switch.

6) Solid State Relay: It is a mechanical sensor used for the protection of PLC.

VI. RESULTS AND SIMULATION

The programming for the replacement system was done in GX Developer software for Mitsubishi FX3U-64M PLC. Soft touch software was used to interface HMI and Mitsubishi PLC. After replacement the down time of the machine is reduced and the efficiency of the machine is enhanced. Also the maintenance cost of the machine is reduced and the quality of the product is improved.

Parameter	Existing system	Automated system
To ON/OFF the system	Push-buttons	Optocoupler
Flexibility	Less	More
Space Requirement	More	Less
Complexity	More	Less



Fig.3: Front Panel Monitor Of GOT1000



Fig.4: Parameters results on Front Panel Monitor Of GOT 1000.

VII. ADVANTAGES

1. Reduced space: PLC is a solid state device and hence extremely compact compared to hard wired controller.
2. Energy saving: Power required by PLC is less as compared to the equivalent relay logic board.
3. Re-programmability: PLC can be re-programmed by using programming device.
4. Re-usability: PLC can be re-used if no longer required in original application.
5. Easy troubleshooting: Indicator lights are used provided at major diagnostic points to simplify trouble shooting.

VIII. CONCLUSION

In various industries Automation is used to increase speed of production, improve accuracy & avoid manual error. This project is a solution for easy maintenance and improvement in the product quality required for various automation purposes which is a big issue nowadays in the world. Through this project we are saving manual efforts to a great extent, reducing cost, improving the efficiency and reducing the required time of the expected work.

IX. ACKNOWLEDGMENT

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