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Design of Automatic 70T Oil Quenching Hydraulic Machine

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ABSTRACT: This paper narrates about the presence of automation in the hydraulic press manufacturing industry. The 70T oil quenching hydraulic press is fully automated by using PLC. The sensors act as a nerve for the machine to control the process. The presence of the servo solenoid pressure control valve maintains the force of the hydraulic press. The latest technology servo mechanism is used in this automation to give the high accuracy and precision output product. The more amounts of human efforts are reduced by the automation. The machine is divided into three units and they are transfer, pressing and spinning unit. The robotic arm is used to transfer the hot metal plate (900°C to 1200°C) from the conveyor to the dye. In the pressing unit, the cylinder gives 70T pressure to the hot metal, and the metal becomes the desired product according to the shape of the dye. The oil quenching process is starts to reduce the heat. The shaped product is transfer to the spinning unit to remove the oil, dust particles through spinner. The final is move to conveyor by using arm. The logics given to the PLC controls the machine process.

KEYWORDS: PLC, Servo, 70T, Motor control

I. INTRODUCTION

The hydraulic press is to transform the metal plate into desired product. A hydraulic system is works on the principle of "Pascal's law". The hydraulic press is mostly used in major industries like car, pipe, plate etc. In early days hydraulic machines are manually operated but now it is fully automated. The automation helps to reduce the man power and gives the accurate product within the given time. The Programmable Logic Controller (PLC) is a type of controller used to control the press which plays a vital role in today's automation field. The main purpose of PLC is to replace hard wired relays. The PLC can be programmed and controlled using ladder diagram which is easy to learn and write. The industry identifies the five PLC programming languages. They are Ladder Diagram, Instruction list, Function Block Diagram, Structured text, Sequential Function Chart. PLC is the advanced technology for improving the productivity and performance of the hydraulic press in industry. It provides flexibility, which means easily changing the process regarding with the consumer needs. The relay logic was replaced by the PLC logic for reducing the wiring and size of the panel to increasing the reliability. In existing control method rewiring required for any modification in circuit but not in the PLC only the reprogramming is suitable for that. The PLC logic work completion speed faster than the relay logic speed by changing the program in PLC. We can change the circuit connection regarding with user required input and output. The size of the PLC is very small compared to the relay logic. Hence the use of the PLC reduces the space occupied by the system installation. The use of solid state devices make PLC more reliable as compared to the electromechanical devices used in hardwired control panels.

The outputs of the sensors are given to the PLC as inputs. The output of the PLC is given to relay for switching the larger power equipments. The PLC size is very small compared to the relay logic. In automation any types of brands of controller can be used to program and control like SIEMENS, AB, ABB, MITSUBISHI, DELTA,

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OMRON etc. Every controller has a specific RAM, ROM and has number of inputs and outputs. The manually operated machines are controlled through the lever. There is no accuracy in products and increases the error rate.



Fig.1 Manually operated hydraulic machine



Fig.2 Automated hydraulic machine

II. PANEL DIAGRAM

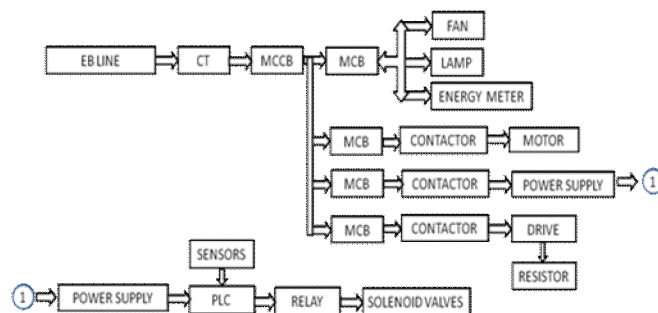


Fig.3 Blocks of Panel

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The image of the panel is given below.

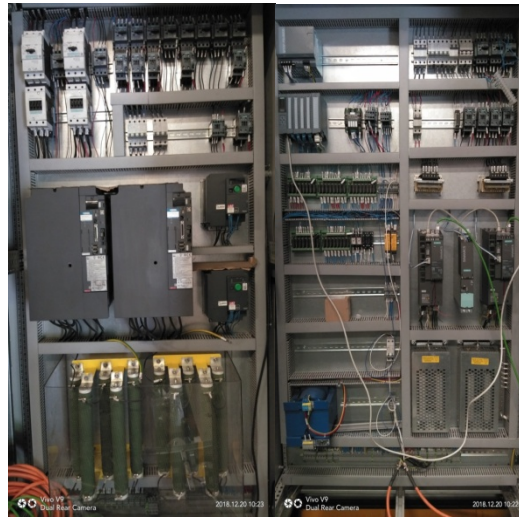


Fig.4 Image of Panel

The components used in the panel diagrams and their operations are explained below:

- A. PLC
- B. RELAY
- C. TRANSFORMER
- D. SMPS
- E. CIRCUIT BREAKERS
- F. BRAKE RESISTOR
- G. SENSORS
- H. ACTUATORS.

III. OPERATION

I. WORKING

The process starts with the pressing the start push button. The transfer unit picks the metal which is about 900°C from the conveyor and it places the hot metal plate on the die. The die can be used according to the company's requirement. The transfer unit return backs to the original position after 2 seconds.

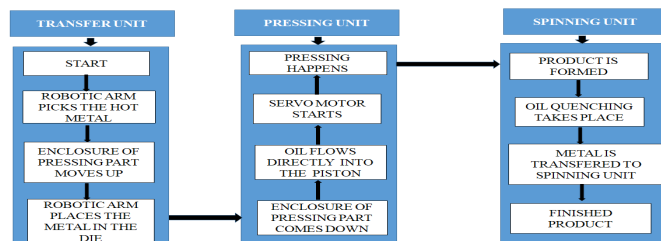


Fig.5 Blocks of Operation

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The IR sensors are placed outside of the pressing unit which senses the obstacle is either present or not. The side of the pressing unit is closed for the safety purpose. The main ram cylinder comes down at very high speed due to gravity of the piston up to the limit. To create a pressure, the servo 2T oil is pumped through the servo motors. The pressure sensor is used to monitor the pressure of the oil, pumping through the servo motors. The pressure sensor is present in the motor and it sends the data to the PLC. The output of the PLC is given to the drives using the encoder cable. When it attains a required pressure level, it waits for 2 seconds and the main ram cylinder returns to the original position for the next cycle. The metal plate placed on the dye is changed into a desired product.

The hydraulic machine consists of two oil tanks. One tank is mainly used for moving ram up and down and another tank is used for the oil quenching process. The hot metal gets cooled through the oil quenching process. The main process of the heat transfer will takes place. The oil returns to the recycling process, to convert the hot oil into moderate. During this process, the pressing part will entirely be closed for security reasons. All the processes were done automatically by presence of the sensor signals. The signals are sent to the PLC based upon the logic.

II. LADDER DIAGRAM

Totally Integrated Automation (TIA) is the world's leading automation concept. Totally integrated automation (TIA) is the interaction of extensive single components, tool and the services to achieve an Automation solution.

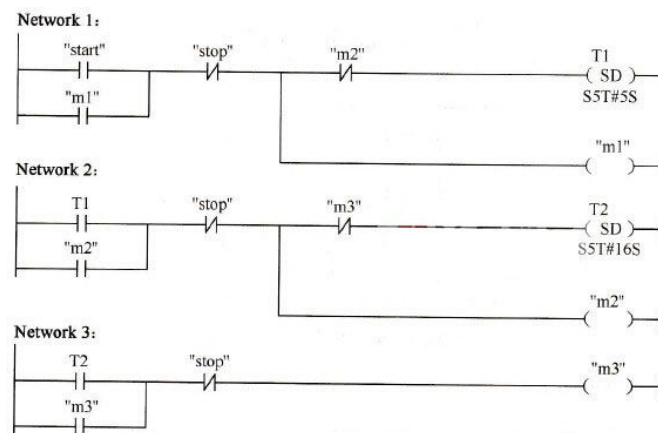


Fig 6 Ladder diagram

III. SERVO MECHANISM

A servomotor is a linear actuator that mainly used to control of angular or linear position, velocity and acceleration.

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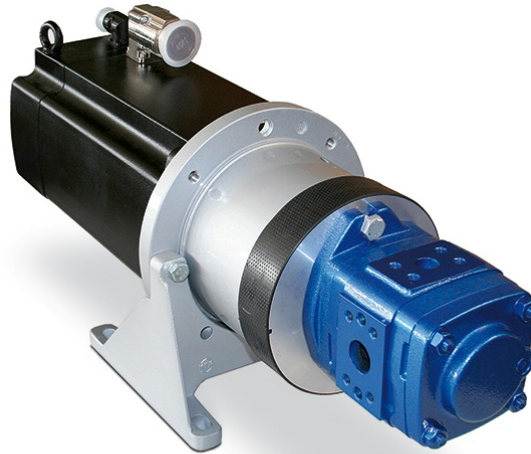


Fig.7 Servo Motor

It is a closed-loop servomechanism that uses position. The servo motor has a specific encoder to provide position and speed feedback to the controller. The measured speed and rating of the output is compared to the command position, the external input to the controller. The very simplest servomotors use position-only sensing through a potentiometer the motor always rotates at full speed or it is stopped. This type of servomotor isn't wide utilized in industrial management. More servomotors use optical rotary encoders to measure the speed of the output shaft and a variable-speed drive to control the motor speed. Both of those enhancements, usually in combination with a PID control algorithm, allow the servomotor to be brought to its commanded position more quickly and more precisely, with less overshooting. Simple servomotors might use resistive potentiometers as their position encoder. These are unit solely used at the terribly simplest and most cost-effective level, and are in close competition with stepper motors. They suffer from wear and electrical noise within the potentiometer track. Modern servomotors use rotary encoders. Instead of servomotors, generally a motor with a separate, external linear encoder is employed. These motor with linear encoder systems avoid inaccuracies in the drive train between the motor and linear carriage, but their design is made more complicated as they are no longer a pre-packaged factory-made system.

IV. OIL QUENCHING

Quenching oil and warmth treatment fluids are designed for fast or controlled cooling of steel or alternative metals as a part of a hardening, tempering or alternative heat-treating method. Quenching oil serves two primary functions. It facilitates hardening of steel by dominant heat transfer throughout extinction, and it enhances wetting of steel throughout extinction to attenuate the formation of undesirable thermal and transformational gradients which may lead to increased distortion and cracking. Oil contains a major advantage over water thanks to its higher boiling vary. A typical oil has a boiling range between 450°F (230°C) and 900°F (480°C). This causes the slower convective cooling stage to start, enabling the release of transformation stresses which is the major problem with rapid water cooling. Oil is ready to quench tangled shapes alloys. Quenching oils and warmth treatment fluids will embrace the variety of further options that add skillfulness and practicality. Biodegradable - fluids are designed or appropriate to decompose or break down into harmless chemicals once discharged into the surroundings. This is useful for high volume operations where disposal costs for degraded oils could otherwise be very high. Low foaming – fluids do not produce foam or produce only small amounts of foam. Non-foaming characteristics are achieved through the use of additives that break out entrained air. Water displacement - fluids have the flexibility to displace water from a surface supported wetting or surface energy characteristics. Fluids with low surface energy or interfacial surface tension compared to water can flow underneath the water or wet on a surface.

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Fig.8 Oil Quenching Image

V.RESULT

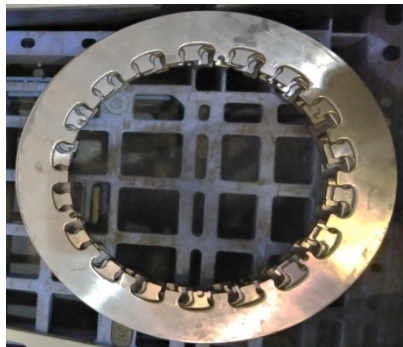


Fig.9 Oil Quenching Image

It is the output product of the hydraulic machine. These kinds of materials are also made in castings. During this process air bubbles are created in the product. It causes the inefficiency of the product. It leads to breakage. So, the products are made through the hydraulic pressing. Due to pressing, the errors are eliminated.

VI. CONCLUSION

The automation of 70T oil quenching press with PLC is more efficient. The industries have more benefits by using PLC because it reduces the human faults. By using this hydraulic press we can achieve the shape of the automobile parts accurately by automation. The servo hydraulic press which uses the PLC decreases the complexity in the manufacturing of various products like brake shoes, plates, and some of the specific product. It can also increase the production in the industries.

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