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Implementation of PLC Control Panel for 2000 Ton Hydraulic Hot Forming Press

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ABSTRACT: This project presents a design and implementation of monitor and control system for 2000ton hot forming press. The truck rim is manufactured by using hydraulic hot forming press having the accurate shape and size automatically PLC is used .The PLC kit is placed in the control panel along with the devices like VFD ,breaking resistor, MCB, SMPS ,MCCB ,MPCB ,Relay ,Contactor and Transformer .The PLC used in this project is micro PLC of the SIEMENS company's S71500IPN SIMENTIC .The Human Machine Interface (HMI) displays the current process of the machine. For controlling hot forming machine is making a control panel programmed with PLC .The existing system involves more manual work and the errors are present during the operation, not accurate and its consumes more power .To avoid such issues control panel is designed and manufactured for an automatic process are used in the proposal system.

KEYWORDS: pressing machine, hot forming, PLC

I. INTRODUCTION

Industry has begun to recognize the need for product quality and increase the productivity seventies and eighties. Product quality and power consumption are also needed to satisfy the consumer needs .In the control panel there were a more number of interconnected electro-mechanical relays to make the whole system work. These relay schemes often contain hundreds of relays .The PLC type used here is "LADDER SCHEMATIC ".Ladder logic has evolved into a programming logic that represents a program by graphical diagram based on the circuit diagram of relay logic hardware. Ladder displays all switches, sensors, valves, relays are found in the system. In the existing system more than 6 induction motors were used for the same 2000ton project. The problem in this consumes more power as the induction motor cannot be stopped instantly and the speed control is very difficult and also has the poor starting torque .These problem can be overcome by replacing the induction motor by servo motor .the servo motor is the assembly of the four things: normal DC motor, gear reduction unit, position sensing device and control circuit. The gear and the shaft assembly connected to the DC motor lower this speed into sufficient speed and higher torque. Thus the speed control is very convenient here. The output of the project is to produce the RIM with the power rating of 45 KW. The automatic control of the whole machine is done with the help of PLC, where it is placed in control panel. The panel includes various components such as VFD, Braking Resistor, SMPS, MCCB, MCB, MPCB, Single Phase Preventer, Energy Meter, HMI is used to view the current process of the machine.

II. DESCRIPTION OF COMPONENTS USED

2.1 Power supply

A power supply is an electrical device that supplies electric power to an electrical load. The primary function of a power supply is to convert electric current from a source to proper voltage, current and frequency to power the load other function is to limit the current drawn by the load to safe level. The power source may come from electric power grid such as electric outlet, energy storage devices, solar power converters.

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2.2 SMPS

SMPS stands for Switched Mode Power Supply. SMPS is an electronic power supply that incorporates a switching regulator to convert electric power efficiently. The SMPS owes its name to the DC-to-DC switching converter for conversion from unregulated dc input voltage to regulated dc output voltage. The switch employed is turned 'ON' and 'OFF' at a high frequency.

2.3 TRANSFORMER

A transformer is a static electrical device that transfers electrical energy between two or more circuits. It works based upon the principle of faradays law of electromagnetic induction. Today they are designed to use AC supply, which means that fluctuation. In supply voltage is impacted by the fluctuation in the current. So, an increase in current will bring about an increase in the voltage and vice versa. It is device a converts an alternating (A/C) current of a certain voltage an alternating current of different voltage, without change of frequency, by electromagnetic induction. A 'step up' transformer receives a low voltage and converts into a higher voltage, and a 'step down' transformer does just the reverse. In domestic situations, the most common use for a step-up transformer is in an inverter. This takes a direct current and using switching methods (commonly an astable multivibrator) turns it into an alternating current which is fed to the primary of the transformer. If the supply is a 24 Volt battery, the transformer will need a ratio of 1:10 turns to get up to 240 Volts. Such a thing is seen in solar panel installations and in caravans. Step downs, there is either an external or internal one in your computer, your television, your radio and any other low-power electronic device that plugs into a mains socket. Looking at my computer, the input is 240V AC and output is 19V DC (the DC is achieved by taking 19V AC and running it through a rectifier, smoother and probably stabiliser).

2.4 BRAKING RESISTOR

Braking resistor is one types of RXHG resistors, it's been used in controlling motor brake in variable frequency drives mechanism, to convert the regenerated electric energy into thermal energy during braking process of the electric motors.

2.4.1 BRAKING RESISTOR FUNCTIONS

2.4.1.1Protect VFD

Due to inertia effect, it will produce lots regenerative electric energy in the motor's fast braking process. It will affect the DC control part of VFDs if those electric energy can't be consumed in time, it leads to fault of VFDs, even worse, the VFDs would be broken. Thanks to the brake resistor solves this problem well enough to protect electric motors away from regenerative energy damage.

2.4.1.2. Protect power supply line

The brake resistor converts regenerated electric energy into thermal energy and absorbs it during braking process, so it won't feed back to the power supply lines and harm it, therefore to protect power supply in stable running state.

2.5 HUMAN-MACHINE INTERFACE

Human-machine interface (HMI) is a component of certain devices that are capable of handling human-machine interactions. The interface consists of hardware and software that allow user inputs to be translated as signals for machines that, in turn, provide the required result to the user. Human-machine interface technology has been used in different industries like electronics, entertainment, military, medical. Human-machine interfaces help in integrating humans into complex technological systems. Human-machine interface is also known as Man-Machine Interface (MMI), computer-human interface or human-computer interface.

2.6 CONTACTOR

A contactor is an electrically-controlled switch used for switching an electrical power circuit. A contactor is typically controlled by a circuit, which has a much lower power level than the switched circuit, such as a 24-volt coil electromagnet controlling a 230-volt motor switch. Unlike general-purpose relays, contactors are designed to be

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directly connected to high-current load devices. Relays tend to be of lower capacity and are usually designed for both normally closed and normally open applications. Devices switching more than 15 amperes or in circuits rated more than a few kilowatts are usually called contactors. Apart from optional auxiliary low-current contacts, contactors are almost exclusively fitted with normally open ("form A") contacts. Unlike relays, contactors are designed with features to control and suppress the arc produced when interrupting heavy motor currents.

2.7 RELAY

Relay is one of the most important electromechanical devices highly used in industrial applications specifically in automation. A relay is used for electronic to electrical interfacing i.e. it is used to switch on or off electrical circuits operating at high AC voltage using a low DC control voltage. A relay generally has two parts, a coil which operates at the rated DC voltage and a mechanically movable switch. The electronic and electrical circuits are electrically isolated but magnetically connected to each other, hence any fault on either side does not affects the other side. .relay are available in different operating voltages like 6V, 12V, 24V etc. The rest of the three terminals are used to connect the high voltage AC circuit. The terminals are called Common, Normally Open (NO) and Normally Closed (NC).

2.8 MCB

Miniature Circuit Breakers are electromechanical devices which protect an electrical circuit from an over current. The over current, in an electrical circuit, may result from short circuit, overload or faulty design. An MCB is a better alternative to a Fuse since it does not require replacement once an overload is detected. Unlike fuse, an MCB can be easily reset and thus offers improved operational safety and greater convenience without incurring large operating cost.

2.9 SERVO MOTOR

There are some special types of application of electric motor where rotation of the motor is required for just a certain angle. For these applications, we require some special types of motor with some special arrangement which makes the motor to rotate a certain angle for a given electrical input (signal). For this purpose servo motor comes into picture. The servo motor is usually a DC motor controlled for specific angular rotation with the help of additional servomechanism (a typical closed-loop feedback control system). Now day's servo system has large industrial applications. Servo motor are also application commonly seen in remote-controlled toy cars for controlling the direction of motion, and it is also very widely used as the motor which moves the tray of a CD or DVD player. Besides these, there are other hundreds of servo motor applications we see in our daily life. The main reason behind using a servo is that it provides angular precision, i.e. it will only rotate as much we want and then stop and wait for next signal to take further action. The servo motor is unlike a standard electric motor which starts turning as when we apply power to it, and the rotation continues until we switch off the power. We cannot control the rotational progress of electrical motor, but we can only control the speed of rotation and can turn it ON and OFF. Servo motor is a special type of motor which is automatically operated up to a certain limit for a given command with the help of error-sensing feedback to correct the performance.

2.10 PROGRAMMABLE LOGIC CONTROLLER

It is an industrial digital computer which has been ruggedized and adapted for the control of manufacturing processes, such as assembly lines, or robotic devices, or any activity that requires high reliability control and ease of programming and process fault diagnosis. They were first developed in the automobile manufacturing industry to provide flexible, ruggedized and easily programmable controllers to replace hard-wired relays, timers and sequencers. Since then they have been widely adopted as high-reliability automation controllers suitable for harsh environments. A PLC is an example of a "hard" real time system since output results must be produced in response to input conditions within a limited time, otherwise unintended operation will result.

2.11 VARIABLE-FREQUENCY DRIVE

It is also known as adjustable-frequency drive (AFD), variable-voltage/variable-frequency (VVVF) drive, variable speed drive, AC drive, micro drive or inverter drive is a type of adjustable speed drive used in electro mechanical drive systems to control AC MOTOR SPEED and torque by varying motor input frequency and voltage. VFDs are used in applications ranging from small appliances to large compressors. About 25% of the world's electrical energy is consumed by electric motors in industrial applications, which can be more efficient when using VFDs in centrifugal load service; however, the global market generation for all applications of VFDs is relatively small . It is also known as adjustable-frequency drive (AFD), variable-voltage/variable-frequency (VVVF) drive, variable speed drive, AC drive, micro drive or inverter drive is a type of adjustable speed drive used in electro mechanical drive systems to control AC MOTOR SPEED and torque by varying motor input frequency and voltage VFDs are used in applications ranging from small appliances to large compressors. About 25% of the world's electrical

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energy is consumed by electric motors in industrial applications, which can be more efficient when using VFDs in centrifugal load service; however, the global market generation for all applications of VFDs is relatively small.

III. CONTROL PANEL

The use of control panel is based to solve automation problems is essential to manufacturing automation today. These works describe the design and implementation of control system for the operation of a mechatronics hydraulic press machine. The overall operation and control is based on a programmable logic unit and a sensory system .the functionality of the control system is analyzed through qualitative simulation models and validated with physical experiments prior to the implantation. These overall control design and operation produces applied have enabled the reduction of sensor failures and machine manufacturing.

3.1 Operation of control panel

The supply is given to the control panel with help of push button and all the components in the control panel will receive the signal. Initially The MPCB will be operating and its output is given as the input to the current transformer which is connected to the bus-bar. Next the MCB and its corresponding contactor and motor will be operating.

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Fig3.1 hardware of control panel

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4 OVERALL BLOCK DIAGRAM

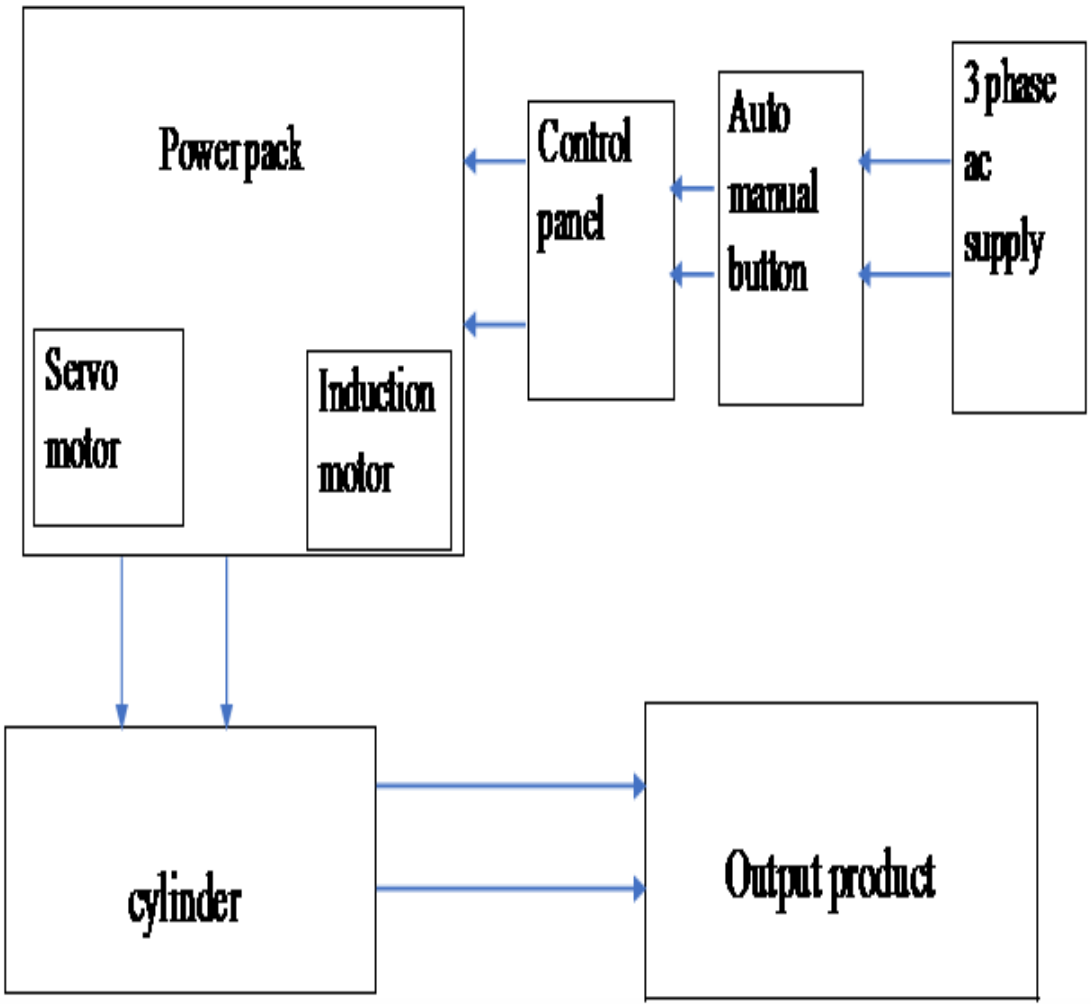

Fig: 4 over all block diagram

IV. OVERALL OPERATION

T he three phase supply is given to the auto manual button and this passes the supply to the control panel which consists of various components .The PLC(S71500 IPN) is programmed according to the clients condition and it is placed inside the top of the control panel .Once the control panel received the supply the plc checks the various position of the hydraulic machine (such as the position and dimension of intake material ,oil level and valve condition).It indicates the machine is ready to operate .Now the servo motor makes the oil to flow inside the pump and it makes the cylinder (dia 750) to move down with the pressure of 250 bar.Thus the main ram moves up and with the help of die cushion cylinder the product(wheel rim)is taken out.

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4.1 PROCESS OF WHOLE MACHINE

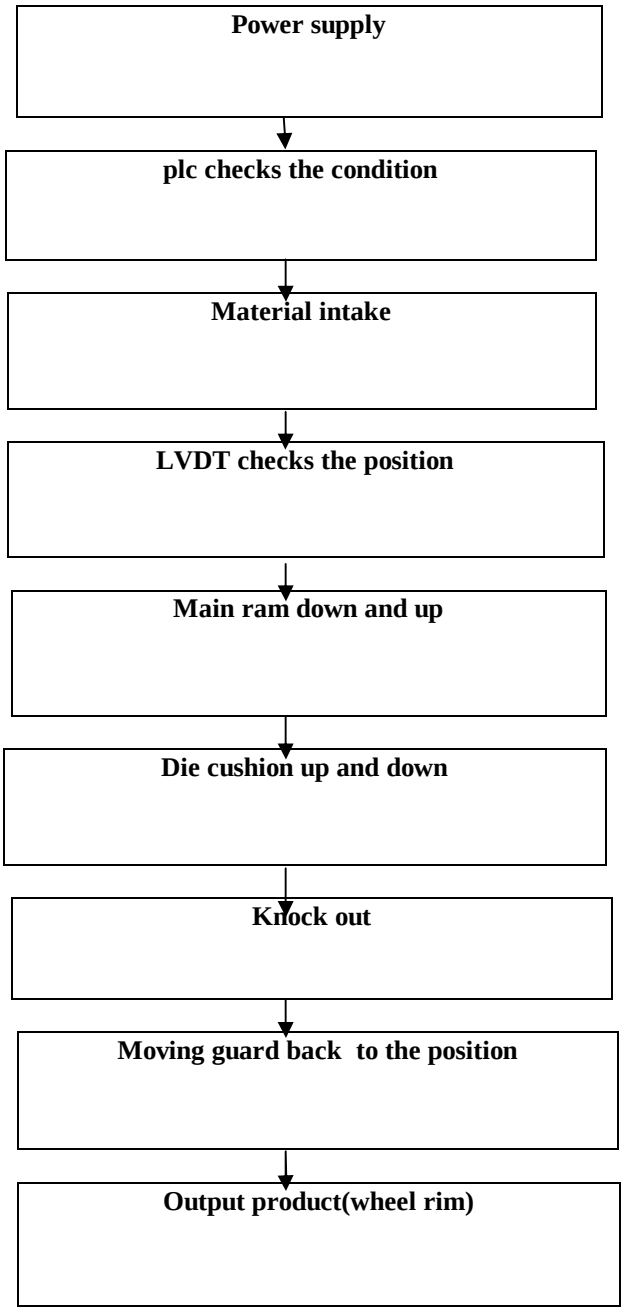

Fig: 4.2 flow chart for whole process

V. CONCLUSION

In all the industries the product manufacturing operation is done by manual which cause the accident due to his lack of concentration. To overcome this machines are introduced to perform the operation automatically. Here the

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machines are monitor by the way of PLC program. The PLC operation involves the operation with SCADA which is very easy to operate from the PC itself. Thus the operating time is get reduced with high production and saving of electricity up to 30% by using servo motor in the place of induction motor. The wiring complexity is reduced by connecting the relay. PLC program was designed for controlling the machine automatically .thus the PLC proved to be a versatile and sufficient control tool in industrial electric drives application .today industrial software requirements include capability to implement application involving widely distributed devices, high reuse of software components formal verification that specification are fulfilled .

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