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# Implementation of PLC Control Panel for 500 Ton Hydraulic Deep Drawing Press

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**ABSTRACT:** This project presents a design and implementation of monitor and control system for 500ton deep drawing press based on programmable logic controller (PLC). Here fuel tank is manufactured, which is used in the automobiles for safety purpose. To manufacture the deep drawing press having accurate shape and size automatically programmable logic controller is used. The PLC kit is placed in the control panel along with the device like MCB, SMPS, MCCB, MPCB, relays, and transformer to protect the deep drawing press. The PLC used in this project is micro PLC of the SIEMENS Company's ET200S SIEMANTIC. The inputs and outputs of PLC differ from one to another and it completely based on the program developed inside the PLC. Circuit connection can be changed simply by changing the program as per the requirement of the user with respective number of inputs and outputs. HMI is the Human Machine Interface which interfaces the between the human and machine through codes. In HMI the current position of the deep drawing press is viewed through display panel. The deep drawing press is a hydraulic machine with fluted rollers or with dies, for deep drawing ruffles, leather, iron, etc. For controlling this deep drawing process, we are making a control panel programmed with the PLC. By using this control panel we can control the hydraulic machine (deep drawing machine) operation and control. The existing system involves a presence of more human power which makes the time consumption very high and leads to the wastage of more power. To avoid such issues a control panel is designed and manufactured for an automatic process and this panel makes the machines to interface with the PLC. This proposed system can reduce the human effort and also it can save the time and power usage, for monitoring the panel and also the working movement of the machine, HMI is used here.

**KEYWORDS:** Sheets, Hydraulic deep drawing, Tooling.

## I.INTRODCUTION

Industry has begun to recognize the need for quality improvement and increase in productivity in the sixties and seventies. Flexibility also a major concern which is the ability to change a process quickly became very important in order to satisfy consumer needs. Try to imagine automated industrial production in sixties and seventies. There was always a huge electrical board for system controls and not infrequently it covered an entire wall. Within this board there were a great number of interconnected electro-mechanical relays to make the whole system work. By word "connected" it was understood that electrician had to connect all relays manually using wires. An engineer would design for a system and it would receive a schematic outline of logic that had to implement with relays. These relay schemes often contained hundreds of relays. The plan that was given was called "ladder schematics". Ladder displayed all switches, sensor, valves, relays, etc... Found in the system. One of the problems with this type of control was that it was based on mechanical relays. Mechanical instrument were usually the weakest connection in the system due to their movable parts that could wear out. If one relay stopped working, it would have to examine an entire system and it would be out until a cause of the problem was found and corrected. The other problem with this type of control was in the system break period when a system had to be turned off, so connections could be made on electrical board. If a firm decided to change the order of operation or to make even a small change it could turn out to be a major expense and loss of production time until a system functional again. The machine is entirely controlled and operated by PLC (Programmable Logic Controller). In control panel PLC kit, relays, MCB, MPCB, and SMPS are used to operate the crimper machine. In existing, there is no automatic system to view the current position of the crimper machine. Here HMI (Human Machine Interface) is used to view the current status and the position of the machine. For manufacturing

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the airbag, we can give pressure up to 200ton. A circuit called PLC, which consists of the entire logic controller programs. The model used in this program is Siemens somatic ES200. In PLC there are 10 modules used.

## II.BLOCK DIAGRAM OF 500 TON DEEP DRAWING PRESS

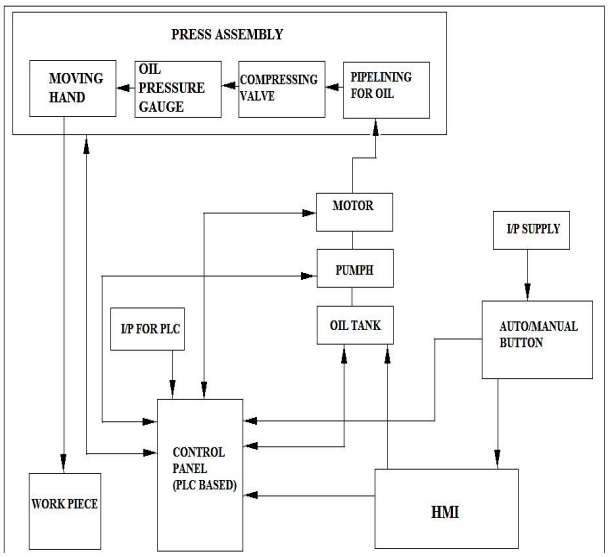


**Fig.2.1 Block diagram of 200 ton crimper press machine**

## III.BLOCK DIAGRAM OF CONTROL UNIT

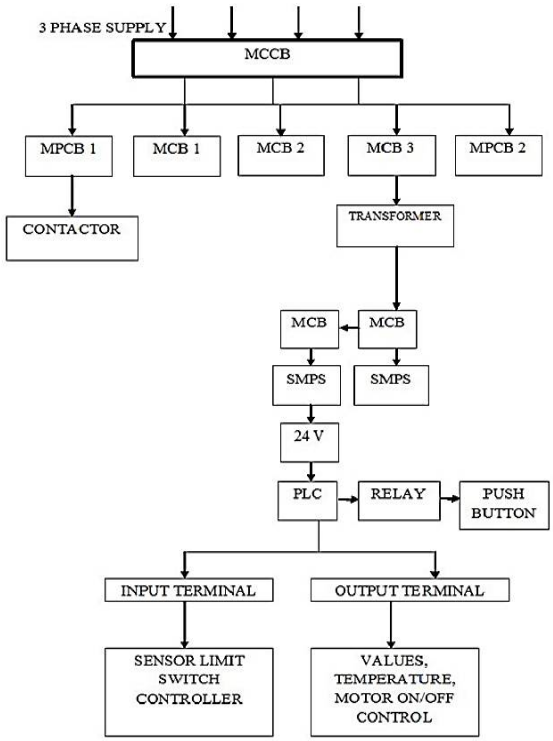


**Fig.3.1 Block diagram of control unit**

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***A.POWER SUPPLY***

Power supply is device to an output of group of loads is called a power supply unit or PSU. The term is most commonly applied to electrical energy supplies, less often to mechanical ones, and rarely to others. The input power supply for the system would be about 3 phase, 415 volts, 10 amps and 50 HZ.

**B.*SMPS***

A SMPS is an electronic power supply in corporate a switching regulators to convert electric powereffectively like power an SMPS transfer power from the source, like mains power to load voltage and current characteristics. Unlike a linear power supply, the pass transistor of switching mode power supply continually switches between low dissipation full of states and spend very little time in high dissipation transistor which minimize wasted energy ideally, a SMPS dissipates no power voltage regulation by achieved by varying the ratio of On –to –Off time in construct a linear power supply regulators the output voltage by continually dissipating the power in the pass transistor. The higher power conversion efficiency is an important advantage of SMPS. SMPS supplies may also be sustained smaller and lighter than a linear supply due to smaller transformer size and weight. The SMPS supply for the PLC, the input is about 87-130 V AC and the output is 24 V DC / 6AMPS.

***C.TRANSFOMER***

Transformers convert AC electricity from one voltage to another with little loss of power. Transformers work only with AC and this is one of the reasons why mains electricity is AC. Step-transformer increases voltage, step-down transformer reduces the voltage. Most power supplies use a step down to reduce the dangerously high mains voltage (230V in UK) to a safer low voltage. Transformers waste have very little power so the power out is (almost) equal to the power in. Note that as a voltage is stepped down current is stepped up. The ratio of number of turns on each coil, called the turn's ratio, determines the ratio of the voltages. A step-down transformer has large number of turns on its primary (input) coil which is connected to the high voltage mains supply, and a small number of turns on its secondary (output) coil to low output voltage. The transformer would be step down transformer and the input will be 440V AC and the output will be 220V AC.

***D.MOUDEDCASE CIRCUIT BREAKER***

Motor Protection Circuit Breaker which can withstand up to 100A. By this Circuit breaker, we can change the Ampere rating according to the required function. Motor Protection Circuit Breaker integrates function of a MCCB and thermal overload relay into highly compact. Electrical motors have plenty of application and are used to drive mechanical devices of all times so it is very important to protect the adequately with MPCB's. MPCB can be considering a sub type of thermal magnetic circuit breaker, but with additional function that are specially designed to protect electrical motor. MCCB is available with the special future making. It is suitable for protection or motor circuit when used in conjunction with the separate over load protection device. In the application, they are referred to as circuit breaker protector. This protects the both 50Hz and 60Hz. The main distinction between molded-case and miniature circuit breaker are that the MCCB can have current rating of up to 2500A, and its trip settings are normally adjustable.

**E.*RELAY***

A simple electrometrical switch made up of an electromagnet and a set of contact. Here we are using coil type and transistor relay. They are used to isolate one voltage level from another. Coil type relay is used for on/off state of motor. Transistor type relay is used for frequent on/off state. This can withstand up to 10A.

***F.HUMAN MACHIE INTERFACE***

Human Machine Interface is the controller operating panel. The panel comprises numeric keypad and a LED screen that displays text. We can operate manually in this we can find the current situation of the crimper machine.

***G.THREE POLE MCB***

A three pole breaker is used when there is need for three live conductors to be interrupted when any combination of poles is tripped, and are externally ganged together to ensure this happening e.g. if you fed a 220v mechanism with two single-pole breakers instead of one double pole breaker, It's possible that a short to one of the hot

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wires would trip only one breaker, leaving the other energized. From the operational power, if any single pole fed mechanism works safely only if other single-pole mechanisms are operating properly,

***H.TWO POLE MCB***

Double-pole circuit breakers are used as a safely device to protect the circuit wiring from drawing too much power. If the breaker senses excessive amperage draw, it shuts the circuits off by tripping the breaker. If too much amperage flows through a wire that is not rated for that amount of current, overheating of the wire is the result. This in turn can lead to an electrical fire in your home.

***I.ONE POLE MCB***

The standard for circuit breaker panels is either single or double pole circuit breakers. Single-pole breakers are an important part of electrical distribution as a safe way to manage branch circuits from a circuit breakers panel. Single-pole circuit breakers supply 120-volt power to breakers come in a wide range of amperage ratings, with 15-, 20-, and 30- amp circuit breakers being the most commonly used in most household installations.

***J.CONTACTOR***

A contactor is an electrically controlled switch used for switching a power circuit, similar to a relay expect with higher current ratings. A contactor is controlled by a circuit which as a much lower power level then the switched circuit. The contactor is same as that of a Relay, Which is used for heavy load applications.

***K.MPCB***

A motor protection circuit breaker, or MPCB, is a specialized electromechanical device that can be used with motor circuits of both 60 Hz and 50 Hz. It has several functions that allow it to provide a safe electrical supply for motors: Protection against electrical faults such as short circuits, line-to-ground faults and line-to-line faults. The MPCB can interrupt any electrical fault that is below its breaking capacity. Motor overload protection, when a motor draws electric current above its nameplate value for an extended period of time. Overload protection is normally adjustable in MPCBs. Protection against phase unbalance and phase loss. Both conditions can severely damage a three-phase motor, so the MPCB will disconnect the motor in either case as soon as the fault is detected. Thermal delay to prevent the motor from being turned back on immediately after an overload, giving the motor time to cool down. An overheated motor can be permanently damaged if it is turned back on.

***L.PLC***

A programmable Logic Controller or PLC is a digital computer used for automation of typically industrial electromechanical processes, such as control of machinery on factory assembly lines. PLCS are used in many industries and machines. PLCs are designed for multiple analogue and digital inputs and output arrangements, extended temperature ranges, immunity to electrical noise, and resistance to vibration and impact. Programs to control machine operations are typically stored in non-volatile memory

Before the PLC, control, sequencing, and safety interlock logic for manufacturing automobiles was mainly composed of relays, cam timers, drum sequencers, and dedicated closed-loop controllers, Since these could number in the hundreds or even thousands, the process for updating such facilities was very time consuming and expensive, as it is needed to individually rewire the relays to change their operational characteristics

***M.INPUT MODULE***

Input devices can consist of digital or analog devices. A digital input card handles discrete devices which give a signal that is either on or off such as a pushbutton, limit switch, sensors nor selector switches. An analog input card converts a voltage or current, where a signal that can be anywhere from 0 to 20mA into a digitally equivalent number that can be understood by the CPU. Some of analog devices are pressure transducers, flow meters and thermocouples for temperature readings.

***N.OUTPUT MODULE***

Output devices can also consist of digital or analog types. A digital output card either turns a device on or off such as lights, LED, small motors, and relays. An analog output card will convert a digital number sent by the CPU to

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real world voltage or current. Typically outputs signals can range from 0-10 VDC or 4-20mA and are used to drive mass flow controllers, pressure regulators and positions controls.

***O.CENTRAL PROCESSING UNIT (CPU)***

The brain of the whole PLC is the CPU module. This module typically lives in the slot beside the power supply. The CPU consist of a microprocessor, memory chip and other integrated circuits with interface adapters to control logic, monitoring and communications which is shown in figure 1.2

## IV.CONTROL PANEL PICTURE

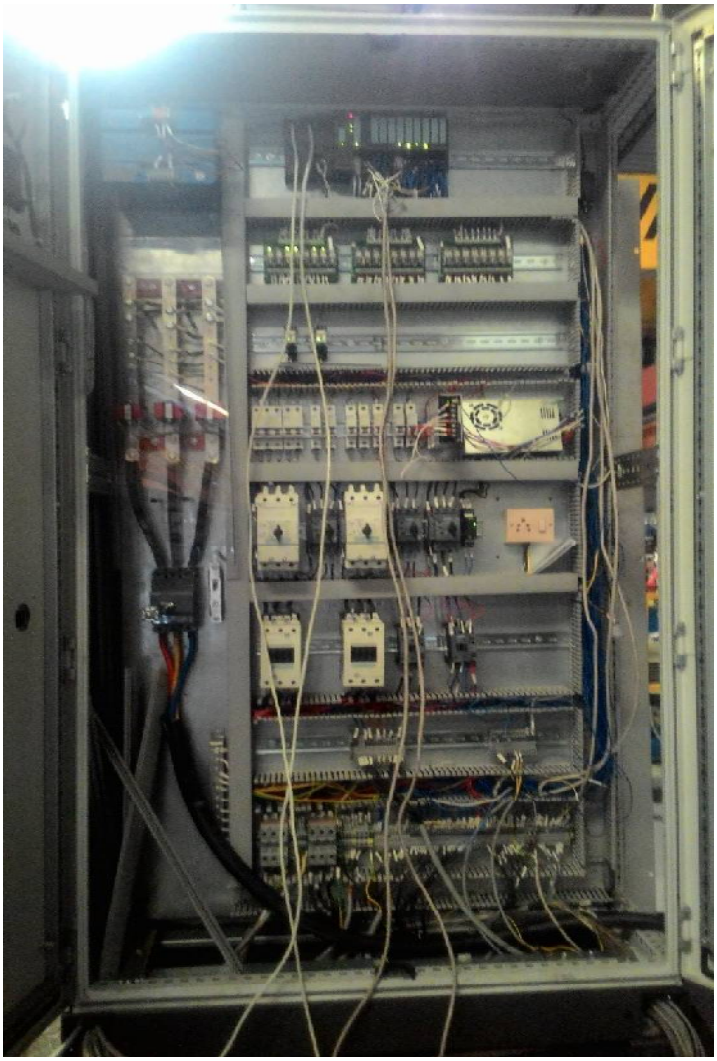

**Fig.4.1 control panel connection picture**

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## V.FLOW CHART

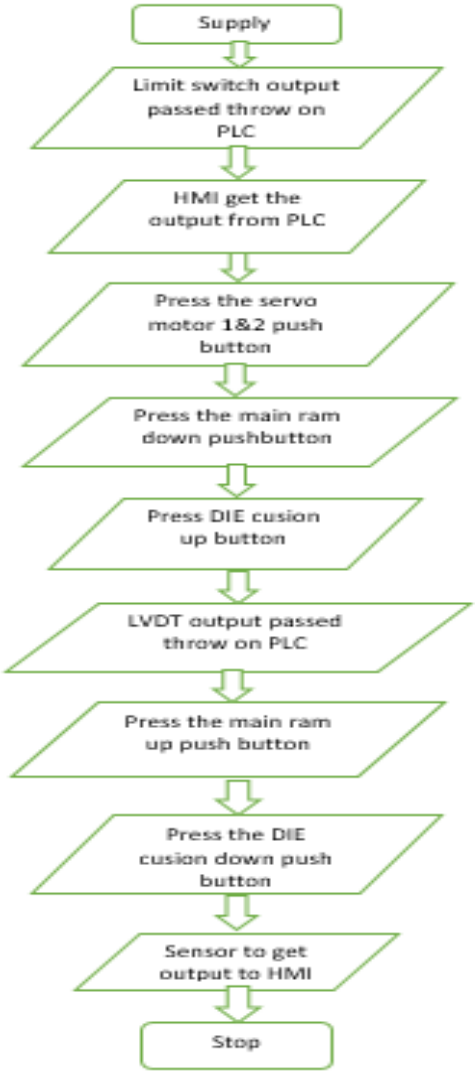


**Fig.5.1 flow chart of control process**

The deep drawing press is used to manufacture the fuel tank. The material is first weighed for the given specification. Then it is filled in the appropriate place in the press. When the main push buttons are operated, the main ram moves downwards slowly. When a certain limit is reached, it moves faster and approaches bed where the material is placed. It presses the material for some duration and decompresses for a while.

The process of decompressing and providing air space for the material for specified interval is called vent. Next the compressed material is subjected for curing. Curing is the process of maintaining a specified temperature around the compressed material for a small duration of time. After curing, the main ram decompresses the material and moves back to its original position.The steps involved in the fuel tank manufacturing are given below:

### *A.WEIGHING*

The material is test whether it has withstand capability and placed in the press. Then the push button is pressed. When this push button is pressed, the PLC checks the status of press. When the machine is ready, it is shown in the HMI.

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***B.MAIN RAM DOWN***

When the machine is ready for the cycle, the two push buttons in the machine is pressed. So that the main ram starts to move down slowly. On reaching the limit switch mounted on the machine, the signal is sent to the PLC so that it makes the ram to move down faster. Now the ram starts pressing the material at the specified pressure after receiving signal from limit switch. The pressure can be up to 160 bars.

***C.VENTING***

Pressing cannot be done at a stretch as it may not be effective. So decompression and vent are provided. The open stay time and close stay time are mentioned in the program for venting.

**D.*CURING***

This process is done to make the fuel tank. It is the process of heating the compressed material for a short duration of time. When the specified duration is reached, the heater is switched off automatically. When the half of the curing time is reached, then the material loading is done in the next press. This can be observed using the indication lamps mounted on the machine.

***E.DECOMPRESSION***

After the process of curing, the fuel tank is decompressed.

***F.MAIN RAM UP***

After the decompression process, the main ram is moved to its original position. It is confirmed by limit switch mounted on the machine.

## VI.CONCLUSION

The soft wiring advantage provided by programmable controllers is tremendous. In fact, it is one of the most important features of PLC's. Soft wiring makes change in the control system easy and cheap. If it want a device in a PLC system to behave or to control a different process elements, all have to do is change the control program. In a traditional system, making this type of change would involve physically changing the wiring between the devices, a costly and time-consuming endeavor. In future definitely PLC is dominant on all other controlling methods. Replacing the relay control system with PLC makes more efficient and effective control system. The very nature of PLC design as well as its application, Offers numerous benefits to industrial users to control and troubleshoot the faults. Testing of the tank insulators under certain pressure using PLC logic is possible, which decreases the complexity in operation compared to relay logic. So, PLC appears to be an excellent solution for many different problems which improves the status of production. Successful experimental results were obtained from the previously described scheme indicating that the PLC can be used in automated system with a servo motor. The monitoring control system of the servo motor driven by inverter and controlled by PLC proves its high accuracy in speed regulation at constant-speed-variable-load operation. Thus, the PLC proved to be a versatile and sufficient control tool in industrial electric drives applications. Today industrial automation software requirements include capability to implement application involving widely distributed devices, high reuse of software components, formal verification that specifications are fulfilled.

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