

# Study of PLC Based Automatic Pipe Bending Machine

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## ABSTRACT

Nowadays in industries especially in automobile and other industries the automatic plate bending machines are widely used. Earlier the bending machines were operated manually. So the output of machine was very less. PLC based hydraulic bending machine operated manually or automatically. This machine used to bending the pipes at different angles. PLC based hydraulic bending machine in which PLC program are saved and it can be change as per customer requirements. In this machine manual operation can be done by using HMI (Human Machine Interface). PLC programmed are saved and easily changes the degree and doing the automatic process. This machine is used for long life and having more accuracy by using encoder. Because the movement of ram was done manually by rotating the screw. Now the technique of bending operation of the component is changed. Once the plate is loaded the operator should not only use once push button to start the machine. But he has operated two push buttons so that both the hands of the operator are engaged.

This arrangement is made in order to avoid injuries to operators. The main aim of this project is to have the complete know how of pneumatic devices, sensors etc. by which the manually operated press or any machine can be converted into a semi or fully automatic unit. In this project the bending machine is a semi-automatic bending machine, in which the loading and unloading of the component is done manually and the bending of the plate is done automatically.

**Keywords**— PLC, HMI, Encoder, Cost Analysis, Hydraulic Motor

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## I. INTRODUCTION

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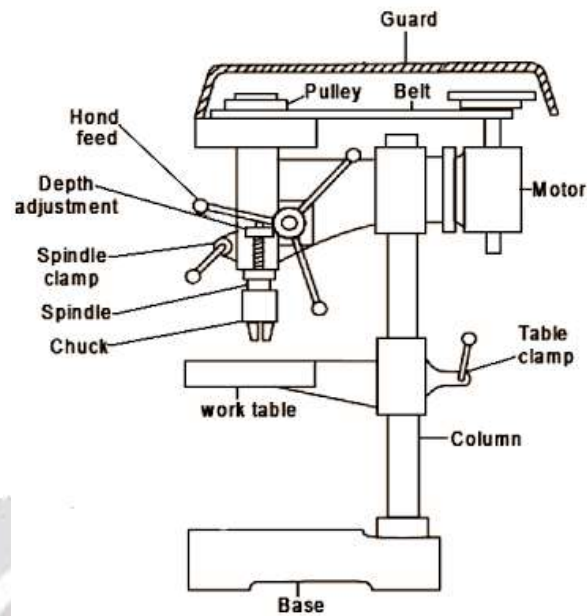


Fig.1-Automatic Pipe Bending Machine

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A general definition of the word "Press", as used for the purposes with which we are concerned in this treatise, might be written as follows: A machine in which a bed or anvil is approached by a ram or hammer, having a reciprocating motion in a line approximately at right angles to said bed, and the said ram being suitably guided in the framework of the machine so that it may always move in the same path. Black Smith's anvil and hammer or of the still more primitive large stone and small stone used by the predecessors.

### A. Types of press

The presses are broadly classified into the following two groups according to the source of power.

- Manually operated: Hand press, Ball press or fly press.
- Power Press: Mechanical press, Hydraulic press.

## II. DESCRIPTION OF PLC COMPONENTS

### A. Push Button

1. Actuator: The part of the switch to which an external force is Applied to operate the switch.
  2. Alternate Action (Push-Push) Switch: A switch in which the operable position is maintained after the first actuation, and then disengaged with the second operation.
  3. Break-Before-Make Switch (BBM): A double throw switch in which the moving contact breaks the connection with the first circuit before making contact with the second; also called non-shorting switch.
  4. Double Throw Switch: A switch which has a normally open as well as a normally closed circuit per pole.
  5. N.C., Normally Closed: Switch in which the circuit is closed without actuation (with actuator in the "normal" position).
  6. N.O., Normally Open: Switch in which the circuit is open without actuation (with actuator in the "normal" position).
- Over travel: The distance or angle between the operating position and the extreme position to which the actuator may be moved.

### B. MPCB (Motor Protection Circuit Breaker)

We introduce latest range of TC MPCB (Motor protection circuit breakers) offering wide range up to 100A & high breaking capacity up to 100Ka. TC MPCBs are most suitable for switching & protection three- phase induction motors up to 45KW at 415VAC and for loads up to 100A. Its compact design saves size of a panel by having both functions of MCCB and Thermal Overload Relay. The interrupt ratings are the world's best level. Trip ratings is designed according to IS 13947/IEC 60947-1, 2, 4 / UL508 standard. TC MPCB is designed to satisfy coordination with TC Magnetic Contactor.

TC MPCB is available in three frame sizes: 32AF, 63AF & 100AF. 32AF is available both with rotary & toggle knobs whereas 63AF & 100AF are available with rotary handles. TC MPCB delivers more efficiency through various functions & compact design such as:

- Protection of group installation
- Protection of circuits
- Starter protection
- Wide range of ambient temperature compensation

TC MPCB offers excellent features for ease of both end users & panel makers such as:

Compact width in three sizes: 32AF: 45mm, 63AF: 55mm & 100AF: 70mm

- Distinct three position: ON-TRIP-OFF
- Locking of handle in OFF position
- Class 10 overload trip characteristics
- Trip test facility
- Finger proof terminals
- DIN rail & Screw mounting



Fig..3. MPCB Switches

**C. 4-pole Double Throw Relay**

The 4 Pole Double Throw Relay, Model 4PDR, is a 24 Volt, AC, multi-purpose control relay. The 4PDR is a plastic DIN rail or flush mounted socket and plug-in- relay. The 4 Pole, Double Throw action provides four separate single pole double throw contacts that can be used for a variety of applications. The most common use of the 4PDR is a slave damper control relay to control more than one damper from a single switch or zone on a control panel. The 4 contacts allow up to 4 separate dampers to be control by a single switch or control. The two screws directly under the plug-in-relay are the relay coil, terminals 13 and 14. The bottom row of terminals are the common for each switch and the top row of terminals #1, 2, 3 and 4 are the normally closed contacts and the second row of terminals #5, 6, 7 and 8 are the normally open contacts. The plug-in relay is easily replaceable and is the Model PIRR.

**D. Emergency Stop Switch**

Emergency stop switches, generally referred to as E-Stops, ensure the safety of persons and machinery and provide a consistent, predictable, failsafe con- 3 roll response. A wide range of electrical machinery must have these specialised switch controls for emergency shutdown to meet workplace safety and established international and U.S. regulatory requirements. E-Stops critical human machine interface (HMI) devices – differ from simple stop switches (that merely turn equipment off) in that they offer “fool proof” equipment shutdown. This is accomplished through advanced switch design that requires a twist, pull, or key to release electrical contacts to allow machinery restart.



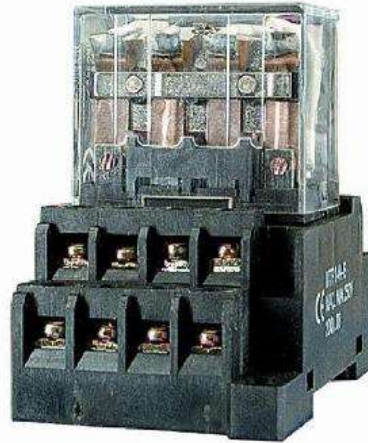


Fig.4: 4-Pole Relay

E-Stops are generally designed for failsafe operation so the stop command has priority over the sustaining function. This has led to innovative switch designs that prevent “blocking” (wanton or accidental obstruction of the actuator with foreign objects) and “teasing” (which could result in premature or unreliable action). Switch companies also are developing new solutions to problems that arise when contact block and actuator are improperly installed or separated because of vibration or other malfunction.

Safe emergency stopping According to international standards, the emergency stop function must be initiated by a single human action using a manually actuated control device. The E-Stop function must be operational at all times and designed to stop the machine without creating additional hazards. Resetting the electrical system can only be done by first releasing the E-Stop that was originally activated.

#### IV. COST ANALYSIS OF MANUAL AND AUTOMATED PRODUCTION MACHINE PRESS

##### A. Production Machine Press

Depending upon the size of the machine the cost varies. Let us consider a minimum size of the machine and do the analysis. The machine taken is the press (bending). For manually operated press the cost of the minimum size machine for bending is approximately around Rest. 2,00,00/-. For automatically operated press the cost of a minimum machine for bending is approximately around Rest. 6, 00, 00/-. Let's us consider a flash plate of a sheet metal with a minimum thickness (1.5mm). In which the two projected parts are to be bent.

##### B. Manually Operated Press

The time needed to produce (bend) one fishplate on a manually operated press is about 1 minute or 60 seconds. In 1 hour 60 units are produced .therefore in one day 600 units are produced (total machining time taken in a day is 10 hours).

##### C. Automated Press

The time needed to produce one fishplate on an automatic operated press is about 15 seconds. Graph shows the productivity of two machines: - As seen from the graph the rate of production is very high in case of the Automated press as compared with the manually operated machine. Hence the productivity is high on the automatic machines. A Development of Pneumatic System is to control problem according to a system with documentation playing an important role in communicating the final result. The circuit diagrams are drawn using standard symbols and labeling.

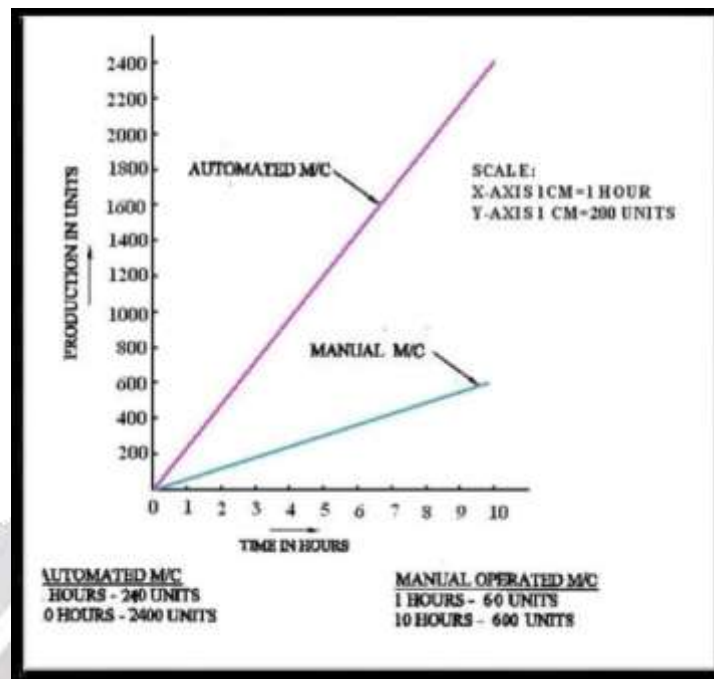


Fig.5: Cost Analysis

## VI. CONCLUSION

The manually controlled press is converted into automatic machine by which maximum operating time will be saved. The output will be more in the project the human intervention is for loading and unloading the pipe, it may be called as semi-automatic machine. This machine can be converted into a fully automatic machine where loading and unloading of the pipe can be done automatically. This project is made keeping in mind that any manually operated machine can be converted to automatic machines by using PLC, electrical and electronics devices. For these purposes one should have the full knowledge of the devices which are being used. By doing so the existing old machine can be modified and made automatic by which the initial cost, to procure new automatic machines may be minimized. Thus there is a lot of scope in automation.

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