Automation of Sheet Bending Machine Using Electro Pneumatic Devices

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Abstract— The bending machine is one of the most important machine tool in sheet metal work shop. It is primarily designed for bending. The bend has been made with the help of punch which exerts large force on the work clamped on the die. The bending machine is designed in such a way that, it works automatically. The automation strategy, when implemented is believed to result in reduced cycle time, costs and improved product quality. Other possible advantages are repeatability, increased productivity, reduced labor and integration of business systems. Automation is achieved with the help of Electro pneumatic system.

Index Terms— *Bending, Electro pneumatic, Machine tool, Sheet, Metal, Automated, Time.*

1 INTRODUCTION

Now a day in industries especially in automobile and other industries the automatic plate bending machines are widely used. Earlier the bending machines where operated manually. So the output of machine was very less. 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

1.1 Definition of press

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 frame work of the machine so that it may always move in the same path. It will thus be seen that the two important members in any ordinary press are the bed and the ram, and that they are only a more highly specialized form of the Black Smith's anvil and hammer or of the still more primitive large stone and small stone used by the predecessors.

1.2 A overview of conventional press

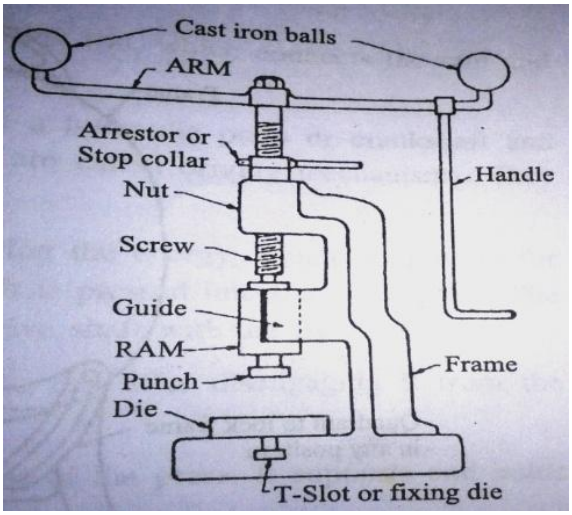


Fig.1 Conventional press

1.3 Types of presses

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

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

Tools of press

1. Punch
2. Die

Operations performed by the press

a. Shearing
b. Bending
c. Drawing
d. Squeezing

2 General Concepts on Design and Development of Pneumatic Systems

2.1 A Development of Pneumatic System

The solution to a control problem is worked out 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. Comprehensive documentation is required including most of the following

- Function diagram
- Circuit diagram
- Description of the operation of the system
- Technical data of the components.

Supplementary documentation comprising

- Parts list of all components in the system
- Maintenance and fault-finding information
- Spare parts list

The methodical design of a circuit diagram in accordance with prescribed rules and instructions.

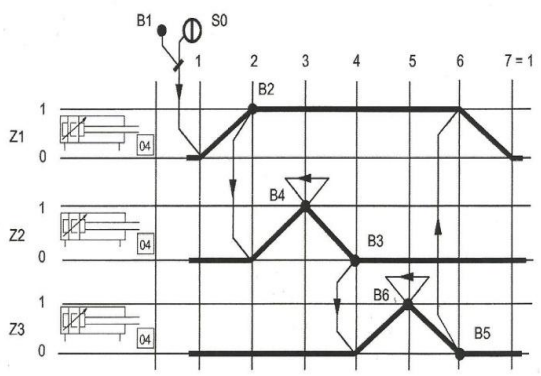
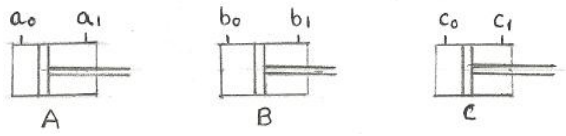


Fig. 2 Functional Diagram

In majority of the pneumatic applications more than one cylinder is used. The movement of these cylinders is coordinated as per the required sequence. The activation of the limit switches of different cylinders will provide set or reset signal to the final control valves for further controlling the movement of various cylinders.

The limit switches have to be arranged in the proper location with the help of motion diagram. In order to develop control circuitry for multi cylinder applications, it is necessary to draw the motion diagram to understand the sequence of actuation of various signal input switches-limit switches and sensors. Multi cylinder applications with three cylinders A, B and C. The status of the cylinder displacement and actuation of set and reset signals at double piloted directional control value is shown by functional diagram.

2.2 Sequence of Operation:



Stop pin Clamping Punching

Z_1 Z_2 Z_3

Fig.3 Sequence of Operation

Sequential motion of cylinders:

It is possible to have the following sequence of operation with three cylinder

A +	B	C	→	Clamping
A +	B +	C	→	Clamping bending
A +	B –	C +	→	clamping retracting bending
A –	B	C – retracting		→unclamping
A	B	C	->	Reset condition

3 Operational and Analysis

3.1 A Cost Analysis Of Manual And Automated Production Machine Press:

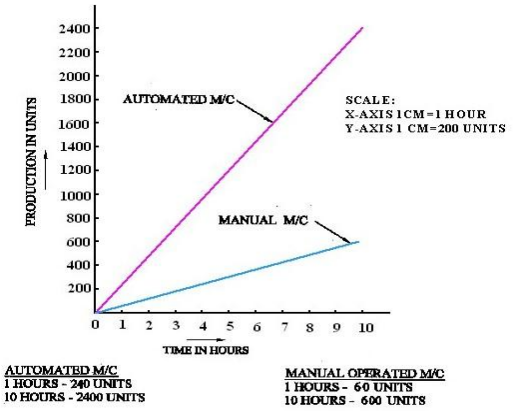
Depending upon the size of the machine the cost varies. Let us consider a minimum size of the machine and do the analysis. The machine taken is the press (bending). For manually operated press the cost of the minimum size machine for bending is approximately around Rs. 2,00,00/-. For automatically operated press the cost of a minimum machine for bending is approximately around Rs. 6,00,00/-. Lets 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.

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).

Automated Press:

The time needed to produce one fishplate on an automatic operated press is about 15 seconds. In 1 minute 4 fishplates are produced. In one hour 240 units , therefore in one day 2400 units are produced (total machining time taken in a day is 10 hours). To know the productivity of both the machines it can be understood from the graph.



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.

4 Conclusion

The manually controlled press is converted into automatic machine by which maximum operating time will be saved. Thus the output will be more. In this project the human intervention is for loading and unloading the plate. It may be called as semiautomatic machine. This machine can be converted into a fully automatic machine where loading and unloading of the plate can be done automatically.

To conclude, this project is made keeping in mind that any manually operated machine can be converted to automatic machines by using pneumatic, electrical and electronic devices. For these purpose one should have the full know how of the devices which are being used. By doing so the existing old machines 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 this area (automation).

Further in this project the wiring is very much complicated, if any troubleshoot occurs then the fault cannot be easily found, for this the interface with the PLC can be used, by which the wiring is minimized and the fault can be easily detected without waste of time.

Hence there is still wide scope in the automation are where lots of improvement can be made with the help of the latest technology.

5 References

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