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Pneumatic TMT Bending Machine

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Abstract:

The main objective of this paper is to implement the Pneumatic rod bending machine in the construction sites with less cost compared to the existing bending machines, and increasing the productivity of the stirrups. 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.

I. INTRODUCTION:

Now-a-days 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. 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 rod is done pneumatically.

Hardware Modules:

Thermo-mechanical processing, also known as thermo-mechanical treated bars' (TMT), is a metallurgical process that integrates forging, rolling and/or work hardening withheat-treatment into a single process.

Components:

- Pneumatic cylinder
- Solenoid valve

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- Air compressor
- Air pipe
- Rods
- Pressure gauge

Pneumatic cylinder:

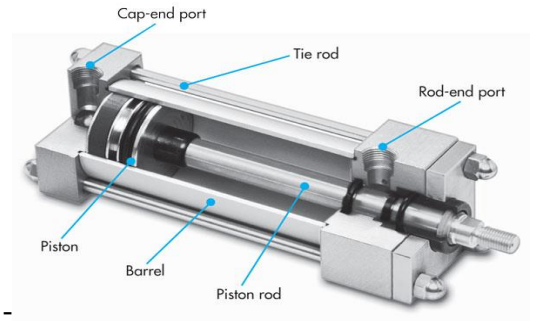

Fig 1: Pneumatic cylinder

Pneumatic cylinder(s) (sometimes known as air cylinders) are mechanical devices which use the power of compressed gas to produce a force in a reciprocating linear motion. Like hydraulic cylinders, something forces a piston to move in the desired direction. The piston is a disc or cylinder, and the piston rod transfers the force it develops to the object to be moved. Engineers sometimes prefer to use pneumatics because they are quieter, cleaner, and do not require large amounts of space for fluid storage.Because the operating fluid is a gas, leakage from a pneumatic cylinder will not drip out and contaminate the surroundings, making pneumatics more desirable where cleanliness is a requirement.

Solenoid valve

Fig 2: Solenoid valve

A solenoid
valve is an electromechanically operated valve.

The valve is controlled by an electric current through a solenoid. In the case of a two-port valve the flow is switched on or off; in the case of a three-port valve, the outflow is switched between the two outlet ports. Multiple solenoid valves can be placed together on a manifold.Solenoid valves are the most frequently used control elements in fluidics. Their tasks are to shut off, release, dose, distribute or mix fluids. They are found in many application areas. Solenoids offer fast and safe switching, high reliability, long service life, good medium compatibility of the materials used, low control power and compact design

Air compressor:

An air compressor is a device that converts power (using an electric motor, diesel or gasoline engine, etc.) into potential energy stored in pressurized air (i.e., compressed air). By one of several methods, an air compressor forces more and more air into a storage tank, increasing the pressure. When tank pressure reaches its upper limit the air compressor shuts off. The compressed air, then, is held in the tank until called into use.

Fig 3: Air compressor

Air pipe:

Fig4: Air pipe

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A pipe is a tubular section or hollow cylinder, usually but not necessarily of circularcross section, used mainly to convey substances which can flow liquids and gases (fluids), slurries, powders, masses of small solids. It can also be used for structural applications; hollow pipe is far stiffer per unit weight than solid members.

Rod:

Thermo-mechanical processing, also known as thermo-mechanical treated bars' (TMT), is a metallurgical process that integrates forging, rolling and/or work hardening with heat-treatment into a single process.

Pressure gauge:

Fig 5: Pressure gauge

Pressure regulators, commonly called pressure-reducing valves, maintain constant output pressure in compressed-air systems regardless of variations in input pressure or output flow. Regulators are a special class of valve containing integral loading, sensing, actuating, and control components. Available in many configurations, they can be broadly classified as general purpose, special purpose, or precision.

Pneumatic fittings:

Fittings provide the essential link between components in any pneumatic system. Pneumadyne's extensive offering of miniature pneumatic fittings accommodates numerous connector and tubing requirements.

II. CYLINDERS:

Cylinders are linear actuators which convert fluid power into mechanical power.

They are also known as JACKS or RAMS. Hydraulic cylinders are used at high pressures and produce large forces and precise movement. For this reason they are constructed of strong materials such as steel and designed to withstand large forces. Because gas is an expansive substance, it is dangerous to use pneumatic cylinders at high pressures so they are limited to about 10 bar pressure. Consequently they are constructed from lighter materials such as aluminum and brass. Because gas is a compressible substance, the motion of a pneumatic cylinder is hard to control precisely. The basic theory for hydraulic and pneumatic cylinders is otherwise the same.

Force:

The fluid pushes against the face of the piston and produces a force. The force produced is given by the formula:

$F = pA$

p is the pressure in N/m^2 and A is the area the pressure acts on in m^2.

This assumes that the pressure on the other side of the piston is negligible. The diagram shows a double acting cylinder. In this case the pressure on the other side is usually atmospheric so if p is a gauge pressure we need not worry about the atmospheric pressure.

Let "A" be the full area of the piston and "a" be the cross sectional area of the rod. If the pressure is acting on the road side, then the area on which the pressure acts is (A - a).

$F = pA$ on the full area of piston.

This force acting on the load is often less because of friction between the seals and both the piston and piston rod.

III. PROJECT DESCRIPTION

Machine Diagram

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Fig 6: Machine diagram of a pneumatic bending machine

Project Working:

- Project deals with the semi-automatic bending of rod.
- The hardware consists of pneumatic cylinder constructed with steel, pressure guage, and rod.
- A rod which is to be bent is taken. The length of the rod is
- As our project is semi-automatic, human interference is needed.
- The rod is placed on the pneumatic cylinder machine.
- Pressure is set in the pressure gauge .The pressure can be
- The pressure gauge is operated by human.
- When the rod is placed, the point where it should be bent is marked on it.
- With the help of pressure gauge, the force is applied on the rod for bending.
- When the pressure is applied, the piston pushes the rod to the front side of the machine.
- Due to the pressure applied, the rod is bent per the human need.
- This is a semi-automatic project so both human and machine interference is needed.

Block Diagram

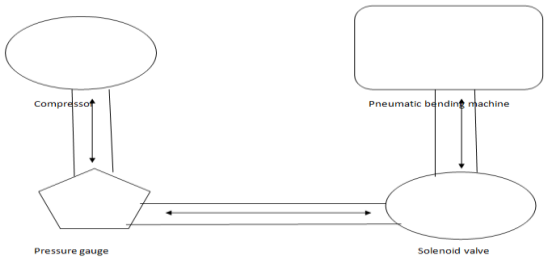

Fig 7: Block diagram of a pneumatic bending machine

Testing of a Machine:

Fig 8:Testing of a pneumatic bending machine

Fig 9: Before bending of a rod

Fig 10: After bending of a rod(45°)

Fig 11: Multi bending angles of a rod

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IV. COMPONENTS SPECIFICATIONS

Pneumatic cylinder

Fig 12: Pneumatic cylinder

Pneumatic cylinder

Type-Single acting cylinder
Diameter = bore diameter =25mm
L=stroke length = 100mm
Max. Supplying pressure = 10kgf/cm^2
Max.Operatingpressure = 5-8kgf/cm^2

TMT steel rod

Length of rod = 100mm
Diameter of the rod = 4-8mm

Pressure gauge

Fig 13: Pressure gauge

Max. Supplying pressure = 15kgf/cm^2
Max. Operating pressure = 9.9kgf/cm^2
Regulating range = 0.5-8.5kgf/cm^2
Ambient and media temperature = 5-60c

Solenoid valve

Fig 14: Solenoid valve

Max. Supplying pressure =10kgf/cm^2
Max. Operating pressure =5-8kgf/cm^2

Calculations

- Cylinder type – single acting
- Diameter of rod =10mm
- Piston rod diameter = 25mm
- Working pressure P =4 bar

Cylinder force forward stroke

$F = \pi/4 \times D^2 \times P^2$
$F = \pi/4 \times 10^2 \times 4$
F=314.15 N
Tensile stress $=314.5 \div \pi r^2$
$=314.5 \div \pi \times (2.5)^2$
$=15.99$ N/cm^2
Shear stress $\tau_{max} = VQ/I\ b$
$I = \pi r^4/4$
$Q = Ay = \pi r^2/2 \times 4r/3\pi$
$Q = 2r^3/3$
$\tau_{max} = V(2r^3/3) \div (\pi r^4/4)(2r)$
$=4V/3A$
$=4 \times 5026.54/3 \times \pi \times (2.5)^2$
=341.36

Advantages:

In this paper 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.

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- Fault can be detected.
- High durability and reliability
- Simple design
- High adaptability to harsh environment
- Pneumatic systems are safer than electromotive systems
- Environmental friendly
- Economical low cost
- Less power

Applications

- Angle bending
- Metal bending
- In construction fields
- In production

V. 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 study 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 knowledge on how the devices 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).

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