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Research Article

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Design and Fabrication of Pneumatic MS Rod Bending Machine

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Abstract Now in this world the use of bending machine is increased. The construction sites are the most basic type of example is for bending machine. The main objective of this project 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 tools in the sheet metal workshop. It is primarily designed for bending. The bend has been made with the help of punch which exerts a large force on the work clamped on the die. The bending machine is designed in such a way that, it works manually. 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.

Keywords Bending machine, Hydraulic rod, Pneumatic cylinder, Air pipe, Hinges

1. Introduction

Earlier the bending machines were operated , but nowadays in industries especially in the automobile and other sector operated by machines. Now the technique of bending operation of the component is changed. 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. In this project the bending machine is a manual bending machine, in which the loading and unloading of the component is done manually and the bending of the rod is done pneumatically. .I Muhammed, et.al. Design and fabrication of hydraulic rod bending machine, April 2014. Worked on design and fabrication of rod bending machine and they concluded that Each and every work of human is reduced by a machine, but few areas like construction the usage of machines for bending rods for stirrups, which are used to withstand loads in beams and columns are not done by machine because the cost of machine is high and need skilled labours to operate it. So this project is aimed to do bending operation for stirrups using hydraulics and named as hydraulic rod bending machine. The main objective of our project is to implement the hydraulic rod bending machine in the construction sites with less cost compared to the existing bending machines, and increasing the productivity of the stirrups. Vilas et.al. Design and fabrication of hydraulic stirrup making machine. They worked on Design and Fabrication of Hydraulic Stirrups Making Machine and they concluded that since testing the stirrup making machine it is observed that how much time is required to make a single piece of stirrup by effectively working. The detail description is given as below: Loading and unloading combining clamping the bar to fixture it almost takes only 5 to 6 seconds. The time required to forward and backward stroke is about 10 to 11 seconds during which stirrup is made. Considering machine ergonomics that is the interaction of human operator with machine, it is very easy to operate it because the operating switch is

provided at suitable place of the machine. Again, loading and unloading is not complicated since not very specialized tooling is used, it is a very simple structure.

1.1. Objectives of the Project

a) To make a bending machine to bend a metal bar up to 10mm.
b) Analytical design of pneumatic MS rod bending machine.
c) Modeling and simulation of pneumatic MS rod bending machine.
d) Preparation of prototype samples of pneumatic MS rod bending machine.
e) Experimental workout of pneumatic MS rod bending machine.
f) The Study of comparative result of pneumatic MS rod bending machine.

1.2. Aim of Project

Pneumatic MS rod bending machine will reduce the manual efforts of the user as shown in figure 1. Pneumatic MS rod bending machine will be useful to the user to manage. It will reduce the time compare to manually doing.

2. Description of Components

a) Pneumatic double acting cylinder
b) 3/2 Direction Control Valve
c) Air Compressor
d) Air Pipe
e) Pneumatic fittings
f) Hinges
g) Caster wheel

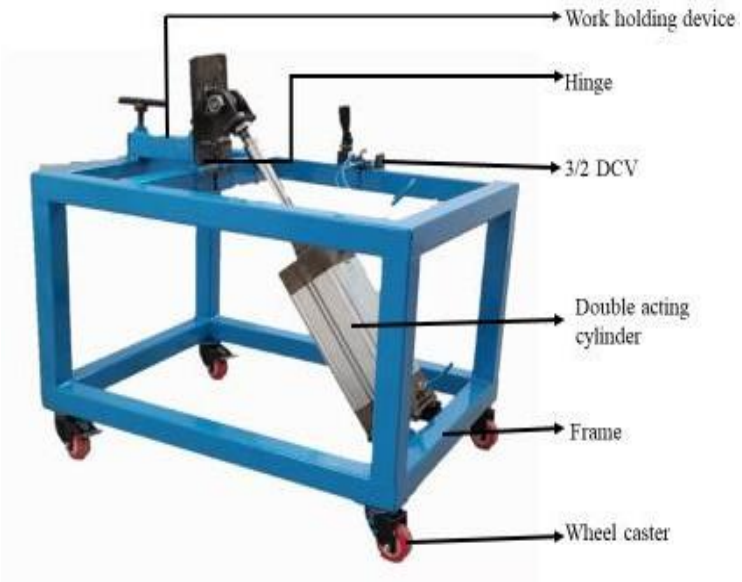

Figure 1: Pneumatic MS rod bending machine

a. Pneumatic double acting 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 as shown in figure 2. 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, leaking from a pneumatic cylinder will not drip out and contaminate the surroundings, making pneumatics more desirable where cleanliness is a requirement.

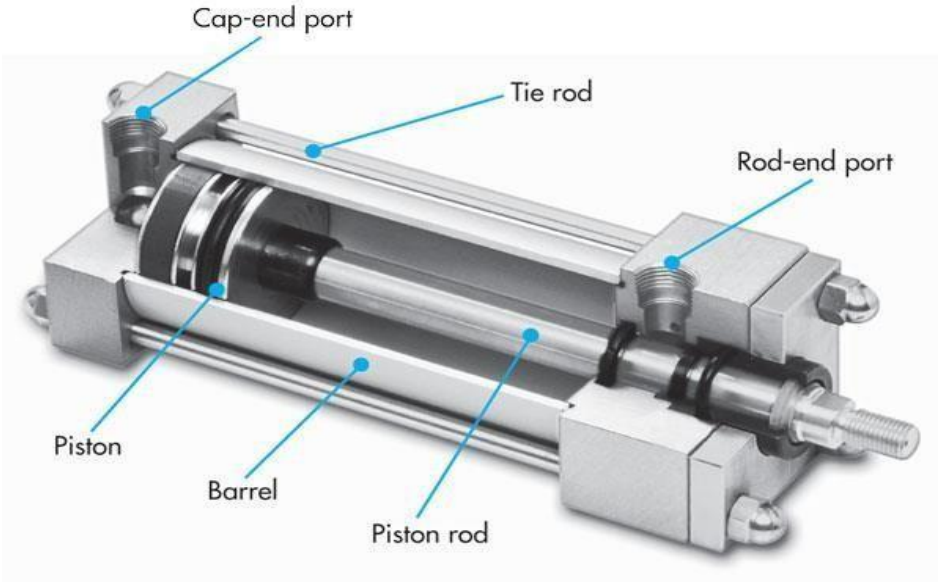

Figure 2: Pneumatic double acting cylinder

Specification: Pneumatic Cylinder

Type-Double acting cylinder

Max. Supplying pressure = 5bar Max.

Operating pressure = 10bar

b. 3/2 Direction Control Valve

The 3/2 DCV pneumatic valve has three way and two position as shown in figure 3. The three ports are:

a) inlet (P, 1),
b) outlet (A, 2)
c) exhaust (R, 3)

Figure 3: 3/2 Direction Control Valve

The two states of the valve are open and closed. When the valve is open, air flows from the inlet (P, 1) to the outlet (A, 2). When the valve is closed, air flows from the outlet (A, 2) to the exhaust (R, 3). A valve that is closed in non- actuated state is normally closed (N.C.), the opposite is called normally open (N.O.).3/2-way valves can be actuated by different means such as:

a) pneumatically

b) manually
c) mechanically
d) electrically (solenoid valve)

Furthermore, the valves can be direct operated or indirect operated. With indirect operation, the valve uses the inlet pressure to help switching the valve state.

Design

3/2-way valves are available in several designs. The sealing mechanism of the valves can be a poppet or a spool. The valve's main parts are the following: housing, seals, poppet (or spool) and an actuator With direct operated valves, the spool or poppet is moved directly by the actuator. Several types of actuators are possible:

1. Solenoid (coil),
2. Push button,
3. Lever,
4. Foot pedal, etc.

Specification

Max. Supplying pressure =5bar
Max. Operating pressure =1.5-8bar

c. 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) as shown in figure 4. 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. 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).The energy contained in the compressed air can be used for a variety of applications, utilizing the kinetic energy of the air as it is released and the tank depressurizes.

When tank pressure reaches its lower limit, the air compressor turns on again and re-pressurizes the tank. The most common types of air compressors are: electric or gas/diesel powered compressors. The power of a compressor is measured in HP (Horsepower) and CFM (cubic feet of air per minute). The gallon size of the tank tells you how much compressed air "in reserve" is available.

Figure 4: Air compressor

Specification:

Max. Supplying pressure = 5bar
Max. Operating pressure = 5bar

d. Air pipe

A pipe is a tubular section or hollow cylinder, usually but not necessarily of circular cross 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 as shown in figure 5.

Figure 5: Air pipe

e. Pneumatic fittings

Fittings provide the essential link between components in any pneumatic system. Pneumocyte's extensive offering of miniature pneumatic fittings accommodates numerous connector and tubing requirements as shown in figure 6.

Figure 6: Pneumatic fittings

f. Hinges

A hinge is a type of joint that attaches two things together while allowing for limited movement. A door hinge fastens the door to the wall, Metal and lets the door swing open. A hinge is a joint that holds two pieces of something together while allowing one piece to move in a swinging motion as shown in figure 7.

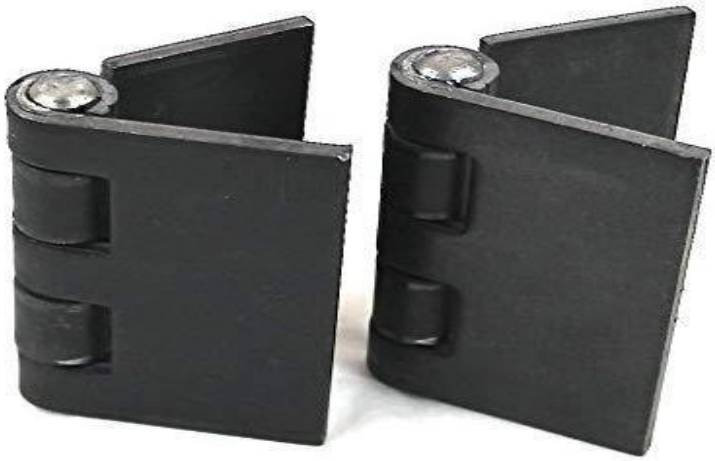

Figure 7: Hinges

g. Caster wheel

A caster (or castor) is an undriven, single, double, or the compound wheel that is designed to be attached to the bottom of a larger object (the "vehicle") to enable that object to be moved(as shown in figure 8). They are available in various sizes, and are commonly made of rubber, plastic, nylon, aluminum, or stainless steel.

Casters are used in numerous applications, including shopping carts, office chairs, hospital beds, and material handling equipment. High capacity, heavy duty casters is used in many industrial applications, such as platform trucks, carts, assemblies, and two lines in plants. Generally, casters operate well on smooth and flat surfaces. Five types of caster wheel; Rigid casters, Swivel casters, Industrial casters, Braking & locking casters and Kingpin less caster.

Figure 8: Caster wheel

3. Working Principle

The bending machine works with the help of pneumatic double acting cylinder. The piston is connected to the moving hinge plate bending tool. It is used to bend the small size of the MS Rod. The machine is portable in size, so easily transportable. The compressed air from the compressor is used as the force medium for this operation. There are pneumatic Double acting cylinders 3/2 directional control valve used. The controlled air from the gate control valve enters to the directional control valve. The 3/2 DCV is used. In one position air enters to the cylinder and pushes the piston so that the bending stroke is obtained. The next position air enters to the other side of the cylinder and pushes the piston returns back, so that the releasing stroke is obtained. Project deals with the semi-automatic bending of rod. The hardware consists of pneumatic cylinder constructed with steel and rod. A rod which is to be bent is taken. The length of the rod is around 300 mm. As our project is semi-automatic, human interference is needed. The rod is placed on the pneumatic cylinder machine. When the rod is placed, the point where it should be bent is marked on it. With 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 as shown in figure 9. The completed (fabricated) view of pneumatic bending machine is shown in figure10.

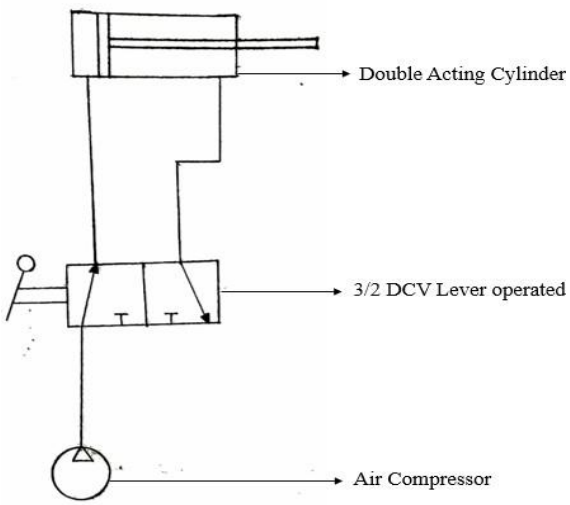

Figure 9: Block diagram of a pneumatic bending machine

3.1. Advantages:

a) High durability and reliability
b) Simple design
c) High adaptability to harsh environment
d) Pneumatic systems are safer than electromotive systems
e) Economical low cost
f) Less power
g) The pneumatic is more efficient in the technical field.
h) Quick response is achieved
i) Simple in construction
j) Easy maintenance and repair
k) Cost of unit is very less
l) No fire hazard problem due to overloading
m) Continuous operation is possible without stopping
n) Reduction of man power employed.
o) Increased safety
p) Easy handling & movement of machine.
q) Easy access to all areas

3.2. Disadvantages:

a) Silence must be used while compressing the air
b) High torque cannot be obtained
c) Load carrying capacity is low

3.3. Applications:

a) Angle Bending
b) Metal Bending
c) In Production
d) This Machine Is Very Useful For Small Scale Industries
e) All Industrial Application

Figure 10: Working diagram of a pneumatic bending machine

The Table 1 shows the List of Components

Table 1: List of Components

S. No.	Components	Quantity
1	Double acting cylinder	1
2	PU tube(6mmx4mm)	As required
3	3/2 DCV	1
4	Hinges	2
5	Compressor	1
6	Wheel caster with break	2
7	Wheel caster without break	2

4. Conclusion

From this project we conclude that Pneumatic bending machine is very cheap as compared to hydraulic bending machine. We can increase the bending thickness by arranging the high-pressure compressor. This machine can also be used where electricity problems occur. This type of bending machine uses compressed air. So, when an electrical problem occurs, we can change our electric compressor to IC-Engine installed compressor. This type of bending machine is very useful for small scale bending industries because they can't afford the expensive hydraulic bending machine. On this machine the manually controlled press is converted into automatic machine. So, we can save a maximum operating time and the output will also increase compared to manual. In this project the humans have to only load and unload the TMT bars. It can be also called as semi- automatic type bending machine. This machine can also be converted into a fully automatic machine so the loading and unloading will be done automatically. For making automatic one should have to be fully knowledgeable in this particular field. 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). We can achieve many types of shapes by using many types of fixtures in bed. This system easily handles by any worker. The worker doesn't have to be someone knowledgeable. Because of its cheap and simple design this machine can sell everywhere with ease. Advance bar bending machine use for mass production. By using advanced bar bending machine increases production rate and reduce labor cost. With the bending machine the manual usage and cycle time is reduced. They are compact in size and reliability.

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