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Automatic Bar Bending Machine using Pneumatic System

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Abstract: ***The main intention of this project is to automate the bar bending process using pneumatic system to reduce the cost and enhance the productivity. Conventional Methodologies involve major labour work, layout setup, high cost etc. Hence to reduce labour cost, Automation is preferred. Existing hydraulic system are cost high enough, so to make cost effective, Pneumatic bar bending system is proposed here. Sample bar is taken about 8mm and pressurized with a compressor of about 25-30mm. Entire test setup size assembled is 2*2 square feet. This project discuss about the construction and process of pneumatic based bar bending system, also the associated practical implications during implementation.***

Keywords: Piston, Bar Bending, Pneumatic Cylinder.

I. INTRODUCTION

Conventionally, labour work has essential role in constructions including mixing coarse aggregate-sand water-cement, cutting rod in required length, rod bending and pouring the mixture of concrete in columns and beams. Currently, due to development in technology there are lots of available resources to reduce the work of labours. Conventional method is not suppose to reduce the construction time and building process as fast as possible. So, Automation in construction system is required. This project helps to replace the manual work and reduce time for bending by designing an alternative machine. This project deals with the automatic bending of rod using pneumatics. The hardware consists of pneumatic cylinder constructed with steel, pressure guage and rod.

II. LITERATURE REVIEW

Mohammed, S.Ravivishwanth, N.Saravanan style and fabrication of hydraulic rod bending machine. This project minimizes the human effect but in case of stirrups making, it involves the manual effort because of cost efficient and labour work is involved to some extent.

P. S. Thakare Productivity Analysis of Manually Operated Bar Bending Machine, Author told in later year's bar bending machine is used in industry and domestic purpose of bending the stirrups under the required edges and angles.

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This bending machines have a disadvantages like operation time is very high and productivity is low. Because of labour operated the process is not fast and continuous.

P. Sureshkumar style and fabrication of stirrups bending machine.The hydraulic load delivers high power compare to the gas and electrical system.

III. EXISTING METHOD OF PROPOSED SYSTEM

In manual operation, labours used the bar bending bench on that robus nails square measure mounted and GI pipes with appropriate lengths to bend the bars. The stirrups usually wraps round the bottom and high bars of the beams. A designer ought to specify the dimensions, spacing and length.

Fig 3.1 Manual Bar Bending System

IV. PROPOSED METHODOLOGY

The main objective of our project is to develop an automatic bar bending machine pneumatic system. In the construction sites bar is bent manually by the bar bender. So, to scale back the work of the labour this machine is developed with less initial value and maintenance value. The accuracy of the machine is perfect and productivity is high. The hardware consists of pneumatic cylinder, dc motor mounted with shaft, arduino controller, relay and rod for bending purpose. The figure 4.1 shows the block diagram of proposed methodology.

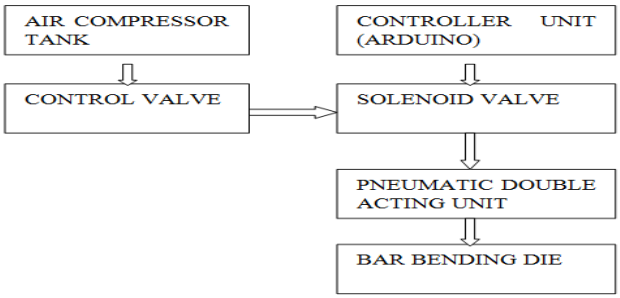

Fig 4.1 Block Diagram of Bar Bending Machine

V. CONTROLLER UNIT

Arduino Uno is a microcontroller ATmega 328. It has 14 digital input/output pins, 6 analog inputs, a 16 MHz crystal oscillator. Power supply is provided by an AC- DC adapter 12V and 1Amp. It control and receives signals from various parts such as Pneumatic cylinder, relay switches, Dc motor.

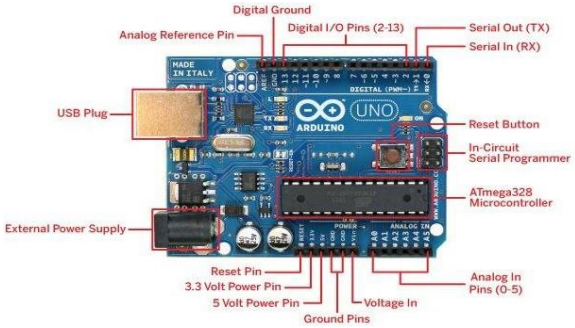

Fig 5.1 Arduino Uno Board-ATMEGA328P

VI. BLUETOOTH CONNECTION

The Vcc and Gnd of the module goes to Vcc and Gnd of Arduino. The TXD pin goes to RXD pin of Arduino and RXD pin goes to TXD pin of Arduino i.e. (digital pin zero and 1).The user can use the on board led. Then led is connected to pin 12 externally for better convenience.

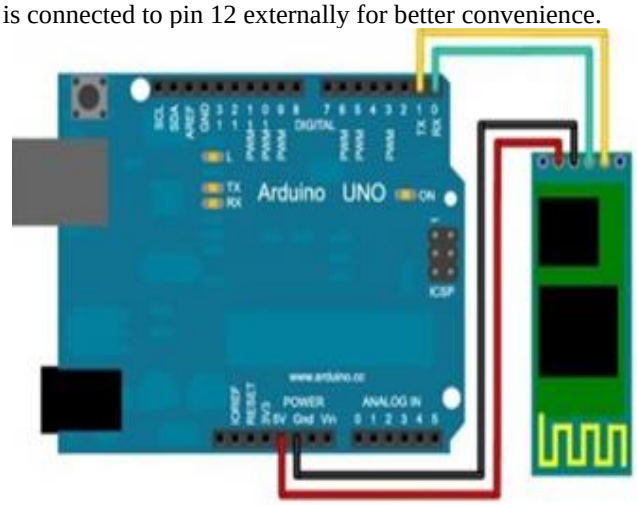

Fig 6.1 Bluetooth Connection to Arduino

VII. HARDWARE DESCRIPTIONDC GEAR MOTOR

A DC motor with gear arrangement for clockwise rotation and another dc motor for anticlockwise rotation are accompanied with relay circuit to achieve the defined position of bar. A gear motor is a specific type of electrical motor that is designed to produce high torque while maintaining a low horsepower, or low speed, motor output. Gear motors are primarily used to reduce speed in a series of gears, which in turn creates more torque and thus it uses the basic principles of speed reduction to increase torque or force. Thus the high torque is completely necessary for the holding back the bar.

Fig 7.1 Dc Gear Motor

1. PNEUMATIC CYLINDER

Pneumatic cylinder(s) (sometimes known as air cylinders) is a mechanical device which uses the power of compressed gas to produce a force in a reciprocating linear motion. The piston is a disc or cylinder, and the piston rod transfers the force it develops to the object to be moved.

Fig 7.2 Pneumatic Cylinder

2. SOLENOID VALVE

The are unit several valve style variations. Standard valves will have several ports and fluid ways. A 2-way valve fluid ways as an example, has a pair of ports; if the valve is open, then the 2 ports area unit connected and fluid could flow between the ports; if the valve is closed, then ports area unit isolated.

Fig 7.3 Solenoid Valve

3. 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).

Fig 7.4 Air Compressor

4. TMT ROD SPECIFICATION

Thermo-mechanical processing, also known as thermo-mechanical processed bars (TMT), is a metallurgical process which combines processes of forging, rolling and bending. TMT tolerance is based on the standard IS 1786-2008. Rods are set vertically and diagonally. This is to avoid the shear failure that is normally diagonal in the case of beam fractures, and also to prevent buckling.

Table 7.1 Specifications of Rod

DATA	SPECIFICATION
Length	100mm
Diameter	Up to 8mm
Tolerance	± 7%
Material Grade	Fe 500
Yield Strength	550 N/square mm

VIII. OPERATION OF THE PROJECT

Project deals with the following automatic bending of rod using automation system.

- 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 100m.
- The rod is placed on the pneumatic cylinder machine which consist of bed assembly.
- Pressure is set in the pressure gauge
- 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.

IX. TORQUE CALCULATION

Pneumatic cylinder in employed to provide the force required for bending the rod from stirrups. As bending of three rods is to be done, the force required is more. Also bending of different diameter is required as per the application.

Calculation

Force, F = π/4×D2×P2 ⟶ 1
F=π/4×102×4 **=314.15 N**
Tensile stress =314.5÷ πr2 ⟶ 2
=314.5÷π × (2.5)2
=15.99 N/cm2
Shear stress, max =VQ/I b ⟶ 3
I =πr4/4
Q =Ay =πr2/2 × 4r/3π
Q=2r3/3
τ max = V(2r3/3) ÷(πr4/4)(2r) ⟶4
= 4×5026.54/3×π × (2.5)2 = **341.36 Nm**

The obtained torque is about nearly 290Nm. Because, when the piston strokes, the entire setup gets trembled. So the required force is not achieved. The length of the piston increases torque reduces.

X. HARDWARE SETUP OF THE PROJECT

Fig1.9 Hardware of the Proposed Work

XI. RESULT ANALYSIS

The Bar bending machine using pneumatic was modeled. From this machine, the rod is bend about 90 degree. It is modeled as the cost economical one. It greatly reduces the labour effort and increases the productivity. As it is an automated one, it can be easily controlled. The productivity and cost of the hydraulics is higher when compared to the other methods but the cost compared with other systems the pneumatics is very low. The comparison of the electric, hydraulic, pneumatic and manually operated systems are compared for 8mm is shown in below table.

XII. COMPARISION TABLE

Table 13.1 Performance Comparision of Various Bar Bending System

Parameters	Manual	Hydraulic	Electric	Pneumatic
Productivity/hr	50	135	160	140
Pressure	Applied Pressure	103 kg/m^2	≥ 100 bar	Up to 75 bar
Cost	500/day	78,000	60,000	32,000

XIII. CONCLUSION

It is observed that more time is required to make single piece of rod to bend by effective working. The manually controlled rod bending mechanism is converted into automatic machine by which maximum operating time will be saved. Here the model is made for the 8mm bar. Therefore the efficiency will be high. To conclude, this project is made keeping in mind that any manually operated machine can be converted to programmable machines by using gear, pneumatic, electrical and electronic devices.

FUTURE SCOPE

The bar size can be increased further. Modifying the bending machine to bend tubes and pipes by adjusting the pressure capacity of the piston. Here, the cutting of the bar can also be performed. Further, more varieties and more flexibility to add or replace any part according to the requirements can be done to improve its use and increase field of usage and to make it more universal or flexible.

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