Automated Tube Bending Machine

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Abstract— Now a day the world is focusing into automation. This project is aimed to do bending operation for tube by using automation and named as automatic tube bending machine. The main objective of project is to implement the automatic tube bending machine for bending with less cost compared to the existing bending machines, and increasing the productivity of the bend tubs. Automatic bending machine consist of bending die, pulleys, chuck, bed, linear motion lead screw, timing belt, base frame, micro controller, sensor, computer. The tube is bent by the pulleys with holding the tube in the bending die. The main advantage of our project is the tube can bend at any angle in any plane continuously without repositioning the tube in the machine.
Key words: Automation, Bend, Tube, Angle

I. INTRODUCTION

The aim of this chapter is to provide all the basic information about project background. This chapter includes the theoretical and technical framework necessary for understanding the work done during the dissertation in the form of problem statement, objective, scope of work and methodology opted.

In this modern era tubes are having wide range of applications fields like aerospace, structures, trusses, and automobile industries etc. So the accuracy in machining and forming of these tubes needs to be good.

II. PROBLEM STATEMENT

While bending the tubes outside part of the cylinder will be under tension and inside portion will be under compression and will lead to the wrinkle formation, to avoid this one should heat the tubes and then go for the forming process. But heating of the tube will lead to hardening of the material which will alter the strength and property of the materials, so there is an immense need for the machine which can bend the tubes without any wrinkles as well as thinning in a required angle & plane.

III. LITERATURE REVIEW

A. Experimental Design and Fabrication of a Portable Hydraulic Pipe Bending Machine

1) Description

This paper stated that, the horizontal press brake was first introduced by SIMASV in1957, are particularly distinguished by their flexibility and versatility. User-friendly and easy to maintain, the horizontal press brakes can be fitted with countless tools. The horizontal bending press fits any small to medium-sized industry when machinery for large-scale production must necessarily make way for machinery with distinctly lower production costs. The hydraulic pipe bending consists of two series of horizontal press brakes, the standard series and the super series. Both series have gone through decades of improvements. One of our biggest improvements was placing the Hydraulic Jack below the table. After years of producing machines with the cylinder above the table (which we still produce today upon request) we standardized on machines with the cylinder below, offering the greatest working environment, and the most bend accuracy due to less deflection in the table.

The horizontal machine has the following features:

- Cylinder under work table allowing for better accuracy and more work surface.
- User performs operation in front of the machine instead of the side of the machine making it easier to produce quality products, and frontal position on our press brakes is protected and practical position for the operator.
- Our patented conical pins with lock-on bayonet fittings eliminate all mechanical slack as far as tolerance is concerned, providing maximum rigidity with minimal flexing of work table. This patented feature is why no other horizontal bending press is as accurate
- Our super series stroke control is by means of hydraulically controlled stroke end devices that allows for greater accuracy (compared to limit switch stroke end control) allowing for continuous movement under pressure, achieving maximum accuracy and repeatability in position; and much more.

Twenty-five tons is the proper tonnage for approximately 50 % of all applications out there. The horizontal press brake the operator should start with a machine no lower than 25 tons if they want to capitalize on a greater amount of profitable work that can be shifted to the machine. The unique cylinder is under the table allowing for the perfect flat open work table environment that will bring more profit to the end user.

This series is a simple series where the operator controls the stroke in and the stroke back by two hand wheels. Simplicity means profit. The 45 ton machine is the proper tonnage for 90% of all applications for a horizontal press brake. For many people who buy or 25 ton machine soon wish they would have made the small extra investment, because the 45 ton machine covers the biggest spectrum of profitable jobs. The most profitable machine in line up for the investment made.

B. Manually Operated Pipe Bending Machine

1) Description

This paper stated about the pipe bending machine is power and manually both operated. But, the manually operated pipe bending machine has less accuracy at high prize. Therefore, their objective is to increase accuracy at low prize without affecting the pipe bending productivity.

They take a pipe of correct size of 19 mm outer diameter and 17 mm inner diameter Mild Steel.Hold this pipe between the grooved pulley and rail with the help of fixing element. Apply a considering force at the end of

lever. In this machine when the force is applied by the lever, roller transmits this force to the rail. The rail can slide over the face of pulley. So, rail tends to bend the pipe in the groove, the compressive stress is generated at the inner side surface of pipe and tensile stress is generated at the outer surface of pipe. Due to these stresses, the pipe will bend without failure.

IV. METHODOLOGY

This machine is semi-automatic machine. It is mainly based on automation power. This can bend the tubes efficiently and repeatedly. The main Moto of the machine is to obtain tube bends at any angle in any plane without wrinkle and thinning. The machine can bend the tubes at desired angle of bent with the gradual & continues application of the pressure on the tube such way the tube bends are obtained.
Current status of this project is completed till "Fabrication of Machine".
To opted this machine the work proposed here by following five steps,

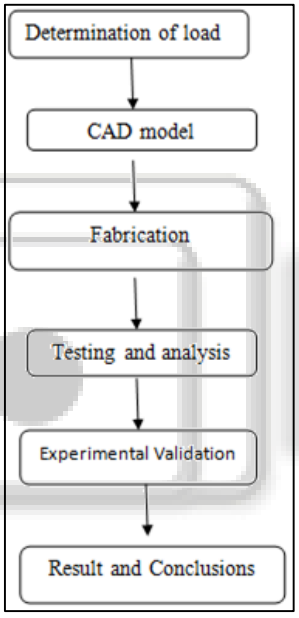

Fig. 1:

1) List of the components

1	Frame
2	Guides
3	Lead Screw
4	Pulley
5	Vice
6	Disk
7	Timing belt pulley
8	Gear mechanism
9	Motor1
10	Motor2
11	Motor3

Table 1:

2) Details of Components of Machine

- Frame:- The frame is a rectangular shaped frame of angles. It is a base of machine. The overall bending system is mounted over this frame, such as chuck mounting, motor mounting, disk mounting, guides, lead screw etc.
- Guides:- the guides are fixed between two end of frame. These are simply round shaft provided to guide and support the chuck during travelling.
- Lead screw:- The power screw is used to travel the chuck during bending process with the help of motor. It is located between two end of frame.
- Pulley:- The pulley is placed on a disk at the centre. The pulley behaves as stopper and also guides the tube which is to be bend.
- Vice:-The vice is used to hold the tube and it rotate with respect to pulley and disk during bending.
- Disk:-The disk is a circular shape plate , on which a pulley and a vice is placed. The disk rotate with the help of gear mechanism provide below it.
- Timing belt pulley:- to rotate chuck in required plane, chuck is connected to motor by timing belt pulley.
- Gear Mechanism:-The gear mechanism is providing below the disk to rotate it with the help of motor.
- Motor1:-Motor 1 is used to travel a chuck.
- Motor2:-Motor2 is used to rotate chuck for changing plane.
- Motor3:- Motor 3 is used to rotate disk for bending process

V. ANALYTICAL RESULT

- Platform
  Section modulus, Zc =1164.12 mm^2
  so, we choose section of (35X35X4).
- Frame
  Critical load of column, Pcr=102283 N > F =686N
  so, design is safe.
- Plate
  Allowable bending stress, σb = 31 N/ mm^2
  Since std σb = 138.6 N/ mm^2> σb = 31 N/ mm^2
  so, design is safe.
- Disk
  Allowable bending stress, σb = 0.0194 N/ mm^2
  Since std σb = 138.6 N/mm^2 > σb = 0.0194 N/mm^2
  so design is safe.
- Guides (Shaft)
  Dia of shaft,d=24mm
- Gear Mechanism
  Face width = b= 56mm
  PCD of pinion = Dp = 60mm
  PCD of gear = Dg = 240mm
- Power Screw
  Outer dia (d) = 10 mm
  Core dia (d1) = 8 mm
  Pitch (p) = 1 mm

VI. WORKING

- Tube bending as a process starts with loading a tube into a chuck and clamping it into tube holding die & check the tub is axially align.
- Programming is done on a PC equipped with dedicated software, which is part of the machine. For generating a new program provide engineering data with the help of mouse and keyboard. The software asks for all necessary values and checks all figures. Inputs can be corrected at any time and minimum distances are

checked instantly to guard against improper inputs & the part is shown on a screen.

- The power supply is on.
- The chuck frame moves forward with the help of motor and lead screw.
- The machine having two guide pulleys which guides the tube, the bending die rotated in the direction of pulley with the help of sub assembly provide in the machine.
- The machine run according to the instructions provide in computer and after completing the all instruction machine stop automatically.
- The "Automated Tube Bending Machine" obtained the bends by following the above process.

A. 3D Model

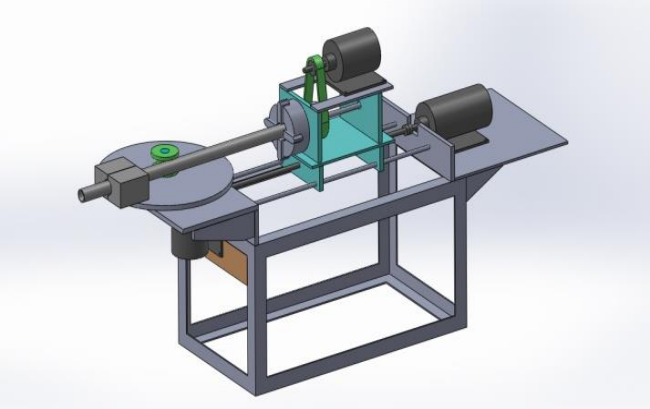

Fig. 2: 3D Model

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