

Automated Shaft Bending Machine

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Abstract— Nowadays the world is focusing into automation. This project is aimed to do bending operation in shaft by using automation and named as automatic shaft bending machine. The main aim of project is to implement the automatic shaft bending equipment for bending with less cost compared to the existing once, and increasing the productivity of the bend shaft. Automatic bending machine consist of bending die, pulleys, chuck, bed, lead screw, timing belts, base frame, micro controller, sensor, computer. The shaft is bent by the pulleys with holding the shaft in the bending die. The advantage of our project is that the shaft can bend at any angle in any plane continuously without repositioning the shaft in the machine.

Key words: Automation, Bend, Shaft, Angle

I. INTRODUCTION

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

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

II. PROBLEM IDENTIFICATION

While bending the shaft 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 shaft and then the forming process. But heating of the shaft will lead to hardening of the material which will replace the strength and property of the materials, so there is an immense need for the machine which can bend the shaft 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

In this paper says, the horizontal bending machine on the press brake mechanism was introduced by SIMASV in 1957, are particularly renowned by their stretch ability and versatility. Eco-friendly and easy to maintain, the horizontal press brakes can be fitted with countless tools. The horizontal bending machine is a press fits any bottom to medium scale industry when machinery for large-scale fabrication, must necessarily make a way of machinery within definitely lower production costs. The hydraulic pipe bending consists of two types of series on horizontal press brakes, the standard series and the super series. Both series have gone through decades of improvements on the production. One of our major

development was placing the Hydraulic Jack under the table. After years of producing machines with the cylinder overhead the table (which we still produce today upon request) we standardized on machines with the cylinder under, offering the greatest working atmosphere, and the most bend accuracy due to less deflection.

The horizontal machine has the following character:

- Cylinder below 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 high quality products, and frontal side on our press brakes is protected and practical position.
- Our patented conical pins with lock-on bayonet fittings abolish all mechanical slack as far as tolerance is concerned, providing high rigidity with minimal flexing of work table. This patented feature is why no other horizontal bending press is as correct.
- Super series stroke control is by means of hydraulically controlled stroke end instrument that follows high accuracy (compared to limit switch stroke end control) allowing for ongoing movement under pressure, attain more accuracy and repeatability in position.

Twenty-five tons is the proper tonnage for approximately 50 % of all applications out there. The horizontal press brake the operation must pick up on the machine no less than 25 tons if they want to capacity on a large amount of used work that can be shifted the operation. The unique cylinder is below the table allowing for the absolute flat open work table atmosphere that will bring high profit to the customer.

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 operated. But, the manually operated pipe bending machine has less accuracy and less flexibility at high prize. Therefore, their objective is to increase accuracy and flexibility at low prize without affecting the pipe bending productivity.

They take a pipe of correct size of 20 mm outer diameter and 18.2 mm inner diameter Mild Steel. Hold this pipe between the grooved pulley and rail within the help of fixing element. Try to considering force at the end of lever. In this pipe bending 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 in the machine. So, that the pipe is bend in the required groove, the compressive stress is generated at the inner side surface of pipe layer and tensile stress is generated at the outer surface of pipe layer. Due to stresses, the pipe will bend without failure.

IV. METHODOLOGY

This machine is a semi-automatic machine. It is mainly based on automation energy. This can bend the shaft efficiently and repeatedly. The main objective of the machine is to obtain shaft bends at any angle in any plane without wrinkle and thinning. The machine can bend the shaft at desired angle of bent with the gradual & continues application of the pressure on the shaft such that shaft bends are obtained.

To option this machine the work proposed here by following steps,

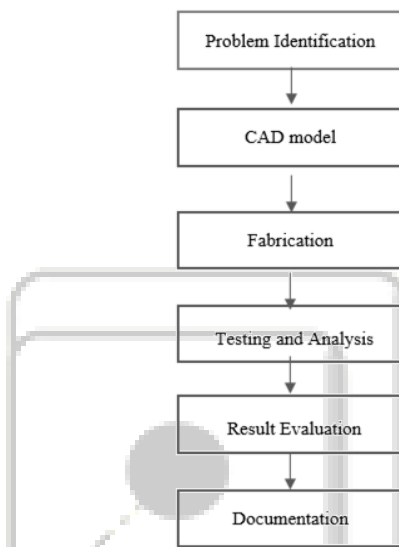


Fig. 1: Flow chart

1	Frame
2	Guides
3	Lead Screw
4	Pulley
5	Vice
6	Disk plate
7	Timing belt pulley
8	Gear arrangement
9	Motor A
10	Motor B
11	Motor C

Table 1: Machine Parts

A. Details of Parts of Machine

1) Frame

The frame is a rectangular shaped member of angles. It is a bed of machine. The bending system is mounted over this frame, such as chuck mounting, motor mounting, disk mounting, guides, lead screw, belt pulley mounting, etc.

2) Guides

The guides are fixed motion between two ends of frame. These are simply round shaft provided to guide and support the chuck during oscillation.

3) Lead screw

The lead screw is used to travel the chuck during bending process with the help of motor. It is located between two ends of frame member.

4) Pulley

The pulley is placed on a disk at the center point. The pulley behaves as stopper and also guides the shaft which is to be bend.

5) Vice

The vice is used to hold the shaft and it rotate with respect to pulley and disk during bending process.

6) Disk

The disk is the circular shape plate, on which a pulley and vice is placed. The disk rotate with the help of gear arrangement provide on the machine.

7) Timing belt pulley

To rotate chuck in required plane, chuck is couple to the motor by timing belt pulley.

8) Gear Mechanism

The gear mechanism is providing below the disk to rotate it with the help of motor system. Motor A is used to travel a chuck. Motor B:-Motor B is used to rotate chuck for changing plane motion. Motor C: - Motor C is used to rotate disk for bending process.

V. WORKING

- Shaft bending as a process starts with loading a Shaft into a chuck and clamping it into shaft holding die & check the hub is axially align.
- Programming is done on a computer equipped with different software, which is a part of the machine. For generating a new program provide engineering information with the help of computer. The software asks for all data values and checks all figure.
- The power supply is ON the machine.
- The chuck frame moves onwards with the help of motor and lead screw.
- The machine having two guide pulleys which guides the shaft, 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 commands provide in computer and after completing the all commands machine stop automatically.

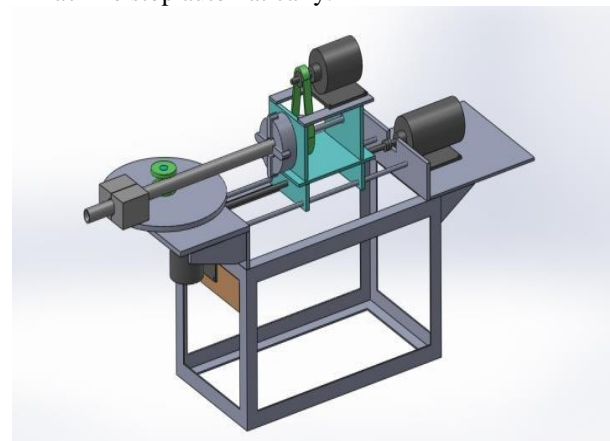


Fig. 2: 3D Model

VI. ANALYTICAL RESULT

A. Platform

Section modulus, $Z_c = 1123.12 \text{ mm}^3$.
So, we choose section of (30X30X4).

B. Frame

Critical load of column, $P_{cr} = 102351 \text{ N} > F = 686 \text{ N}$.
So, design is safe.

C. Plate

Allowable bending stress, $\sigma_b = 31 \text{ N/mm}^2$.
Since $\sigma_b = 136.6 \text{ N/mm}^2 > \sigma_b = 31 \text{ N/mm}^2$. So, design is safe.

D. Disk

Allowable bending stress, $\sigma_b = 0.0194 \text{ N/mm}^2$.
Since $\sigma_b = 136.6 \text{ N/mm}^2 > \sigma_b = 0.0194 \text{ N/mm}^2$. So design is safe.

E. Guides (Shaft)

Dia of shaft, $d = 20 \text{ mm}$
Gear Mechanism
Face width = $b = 56 \text{ mm}$
PCD of pinion = $D_p = 60 \text{ mm}$
PCD of gear = $D_g = 240 \text{ mm}$

F. Lead Screw

Outer diameter (d) = 10 mm
Core diameter (d_1) = 8 mm
Pitch (p) = 1 mm .

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