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Design and fabrication of pipe bending machine

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ABSTRACT

As we know that pipe bends are used in various household and industry things therefore it is necessary to build an economical pipe bending machine. It is also used in designing of various machine components, without this bending device a machine can't work properly. As far as industrial application is concerned it is used for piping purpose. The reason to design a bending machine is because there is no proper bending machine to bend a hallow pipe for small scale. Pipe bending machines are typically human powered, pneumatic powered, hydraulic assisted or electric servo motor. In the pipe bending operation the tube may be supported internally or externally to preserve the cross section of the pipe. In this study, manually operated pipe bending machine is fabricated. This machine is used to bend pipes into circular shape. The size of machine is very convenient for portable work. It is fully made by mild steel. Moreover, it is very easy to be carried and used at any time and any place.

Keywords— *Roller, Benging, Pipe, Tube*

1. INTRODUCTION

In three rollers pipe bending machine pipe is bend with the help of load acting on upper roller which is movable. 3 roller pipe bending machine mainly consist of following parts: 3 rollers (upper roller and 2 bottom rollers) power screw, and frame. Bending operation is done by applying load (force) with the help of upper roller, which is movable. It can be moved by adjusting the power screw manually. Two bottom rollers are fixe which acts as a support for holding the metal pipe. When upper roller moves in a clockwise direction, bottom rollers simultaneously move in anticlockwise direction. Square threaded power screw is used to change the position of upper roller. This operation is totally manual. Frame is fixed rigid support used for supporting the assembly and also prevent machine from vibrations. The rolling process is usually performed by a three roll bending machine often called as pyramid type, because of the peculiar arrangement of the three rollers.

i) Static bending, ii) Forward rolling, iii) Backward rolling, iv) Unloading,

1.1 Functions of Bending Machine

- To bend a pipe having thickness up to 5 mm in required angular shape.
- To provide curvature shape to pipe.
- Machine is convenient for portable work.
- The machine is power operated to archive maximum accuracy in less time.

2. LITERATURE REVIEW

As so many industries and house hold applications require bending the pipes for different purposes. This pipe bending machine simple in construction easily portable and very useful.

Himanshu et al. [1] has done bend ability analysis for bending of steel plates on heavy duty 3- roller bending machine. In this experiment they found out the equivalent thickness, equivalent width and maximum width analytically& based on power law material model. The 3-roller plate bending machine are widely used in heavy engineering industries for the manufacturing of skeleton of oil and gas rigs, the construction of tunnels, cylindrical tanks, boiler equipment's, fuel tanks for launch vehicle in space application, industrial buildings, pressure vessel, heat exchangers, tall towers, rectors, etc.

Jong Gye Shine et al. [2] has developed a logical procedure to determine the roller displacement, in the three-roll bending process, which is required in the fabrication of curved rectangular plates with a desired curvature. To this end, the mechanics of the process was analysed by both analytical and finite element approaches. Comparisons of the results reveal that a simple analytical procedure, based on the beam theory, yields a reasonably accurate relationship between the centre roller displacement and residual curvature. With further development and refinement, the procedure proposed in this work has great promise for practical application, particularly for the automation of the process.

2. MAJOR COMPONENTS

(a) Frame
(b) H-section
(c) Square rod
(d) Bearing
(e) Shafts
(f) Pulleys
(g) Nuts
(h) Allen screws
(i) 3-phase motor

2.1 Frame

The frame provides support to the entire machine components and is a mild steel metal plate having 2×1 square feet dimension. In this metal plates are 2 in no. The frame is designed to give maximum stability, minimizing the risks of sideways movement or skidding across floors, making operation as easy and effective as possible. To remove unwanted material from the plate the following operations are made. They are gas cutting and grinding.

Fig. 1: Frame

2.2 Gas Cutting

In this oxy acetylene flame is used for cutting the metal and separating the material from the plates and getting the required shape. For producing the required shape on the metal first wooden pattern is produced with the same dimensions. By using this wooden pattern drawn a line on the metal plate along this line cutting is takes place. In this process unwanted material is separated from the plate by melting small amount of material between the required and unwanted portions.

2.3 Square Threaded Rod

The square thread form is a common screw thread form, used in high load applications such as lead screws and jack screws. It gets its name from the square cross-section of the thread. It is the lowest friction and most efficient thread form, but it is difficult to fabricate. The greatest advantage of square threads is that they have a much higher intrinsic efficiency than trapezoidal threads (Acme or metric trapezoidal). Due to the lack of a thread angle there is no radial pressure, or bursting pressure, on the nut. This also increases the nut life.

2.4 Ball Bearings

Ball bearing is used primarily to support rotating shafts in mechanical equipment. They can be found in everything from personal computers to passenger cars. They are of simple design and can be precision made in mass production quantities. They can support heavy loads over a wide speed range and do it virtually friction free. They come in many different sizes and shapes, are relatively inexpensive, and require little or no maintenance. They have predictable design lives and operating characteristics and are truly a valuable asset to the rotating equipment industry of today.

A ball bearing consists of an inner ring (IR), an outer ring (OR), a complement of balls, and a separator to contain the balls. The outer diameter of the inner ring (IROD) and the inner called the path way. The raised surfaces on each side of the pathway are called the shoulders. The balls are held equally spaced around the annulus of the bearing by the separator. The basic dimensions of the bearing are the bore (B), outside diameter (OD), and the width (W). In this project 6205z bearing. It`s half sectional view.

2.5 Shafts

A shaft is a rotating machine element which is used to transmit power from one place to another. The power is delivered to the shaft by some tangential force and the resultant torque (or twisting moment) set up within the shaft permits the power to be transferred to various machines linked up to the shaft. In order to transfer the power from one shaft to another, the various members such as pulleys, gears etc., are mounted on it. These members along with the forces exerted upon them cause the shaft to bending. In other words, we may say that a shaft is used for the transmission of torque and bending moment. The various members are mounted on the shaft by means of keys or splines.

(a) The shafts are usually cylindrical, but may be square or cross-shaped in section. They are solid in cross-section but sometimes hollow shafts are also used.

(b) An axle, though similar in shape to the shaft, is a stationary machine element and is used for the transmission of bending moment only. It simply acts as a support for some rotating body such as hoisting drum or a car wheel.

(c) A spindle is a short shaft that imparts motion either to a cutting tool (e.g. drill press spindles) or to a work piece (e.g. lathe spindle).

3. ASSEMBLY

All the individual parts of the machine are joined together and formed the complete machine with rigid construction. In this various screw and fastening methods are used to join the parts together. First two frames are joined by means of four axles with nuts on both sides of axle. The three parts of the h-section are joined together by using Allen screws and formed a complete h-section. Like this two h-sections are formed. These H-sections are inserted into frame at the space provide in the middle of the frame. One plate of thickness 25 mm is arranged to join two H-sections and make it as a single one. On the top of the frame a plate of thickness 25 mm is arranged. A square threaded rod is inserted through the frame top plate and H-section top plate. On the upper portion of square threaded rod, a small hole is provided to insert lever to apply force on H-section through the square threaded rod. In the H-section a big slot is provided to insert bearing into it. Through the holes provided in H-section a shaft is inserted and one side of it a pulley is mounted on it. The pulley is fixed to it by means of nut.

4. TUBE BENDING PROCESS

There are many ways by which a tube can be bent into the required radius. The main techniques by which tube can be bent into the desired shape are rotary draw tube bending, compression tube bending, roll bending and stretch bending. The selection of technique depends upon the following factors:

(a) The quality of the bend and production rate desired.

(b) Diameter, wall thickness and minimum bend radius desired.

4.1 Rotary Draw Tube bending

Rotary draw tube bending is the most flexible bending method and is used immensely in industry on account of its tooling and low cost. The tooling consists of a bend die, clamp die, pressure die and wiper die. In this bending technique the tube is securely clamped to the bend die by using the clamp die. The bend die rotates and draws the tube along with it. The pressure die prevents the tube from rotating along with the bend die. The pressure die may be stationary or it may move along with tube. The pressure die provides a boost pushes the material at the extrados of the tube to reduce the thinning of the tube and can be very helpful when the bending angle is large and the bending radius is small. A mandrel along with wiper die may be used to prevent the wrinkling and collapse of the tube. But the use of mandrel should be avoided if possible since it increases the production cost.

4.2 Compression Tube Bending

The tooling for the compression tube bending is similar to the rotary draw tube bending. It consists of the stationary bend die, a moving wiper shoe and a clamp. The only difference between the rotary draw bending and compression bending process is that in rotary draw tube bending the bend die is movable whereas in the compression tube bending the bend die is stationary. In compression tube bending the tube is clamped 4 to the bending die near the rear tangent point. The wiper shoe pushes the tube along the bending die as it rotates around it. Figures 4.2 (a) and (b) show the initial and final configuration of the compression tube bending.

4.3 Working of Pipe Bending Machine

Pipe bending machines are typically human powered, pneumatic powered, hydraulic assisted, or electric servo motor. In the pipe bending operation the tube may be supported internally or externally to preserve the cross section of the pipe. 3-roll bending is used for producing work pieces with large bending radii. The working roller and the two-stationary counter-rollers rotate, thus forming the bend. Normally there are 2 fixed rollers and one moving roller and the work piece is passed forward and backward through the rollers while gradually moving the working roller closer to the counter rollers which changes the bend radius in the pipe. This method of bending causes very little deformation in the cross section of the pipe.

In the first stage the pipe is kept between top roller and bottom rollers as shown in Figure and the top roller is given vertical displacement to get the required bend. In next stage the top roller is driven using hand in forward direction to get the roll bending of the pipe. Similarly, the rollers are driven in reverse direction to get better dimensional accuracy of the final product the steps in pipe bending process.

5. DISCUSSION AND RESULTS

In this project fabrication of manual operated pipe bending machine is successfully completed. By using this machine pipes can be bent circular shape with required diameter. By using this machine, we can bend pipes having the diameter up to 1½ inch. Pipes with different cross sections can be bending on this machine.

5.1 Advantages

Low initial cost, Low tolling cost, Easy, and quick setting user friendly Easy maintenance.

5.2 Applications

To bend the pipe into circular shape, Heat exchangers, Industrial purpose, Shops, office and hospitals furnishings, Equipment for food industry.

5.3 Result

- By using this pipe bending machine some of hallow pipes were bended after assembly.
- This result is accurate and precision. After bending there is no diameter varies, this is one of the major advantages of this machine.
- This machine can also straighten the bended pipes.

Fig. 2: Pipe bending machine

6. CONCLUSION

In this project, pipe bending machine is fabricated and a pipe is efficiently bend into circular shape without disturbing the actual size and shape of the pipe. By using this machine pipes of smaller diameter will be bending easily and if size of the machine increased it can produces bending of pipes with medium diameter. The defects in pipe bending is eliminated by taking some precautions while bending the pipe. For example, to avoid spring back moving the pipe to and fro over the pulleys under the application of pressure is needed. This bending tool is very useful in household application as it runs at very low cost and very efficient. In this project various pipe shape that is square, V-shape, channel bend, circular shape. With this machine pipes can also be bending up to required angle like an arc form.

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