

Review Paper on Design of Multistage Three-Roller Pipe Bending Machine for C. B. Industry, Nagpur

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ABSTRACT

Three roller pipe bending machine is used in an industry for bending pipes of different materials. Today, the pipe bending machines that are available in market are able to bend only one pipe at a time. As the demand is increasing the production also needs to be increased. So the requirement of industry is to bend more than one pipe at a time. We can also use multiple pipe bending machines to increase the production rate. But this will also increase the manpower required for the task and overall cost of production. This paper deals with studying and identifying the problem for a solution. The multistage pipe bending machine needs to be developed for increasing the production rate to fulfill the customer demands. The paper aims at review of literature in regard to pipe bending operation, different machines, design approach and process, different type of pipe bending machines, three roller bending operation. The crucial study of various literature related to this topic is discussed in this paper. This will help the future researchers working in this area to have a consolidated literature study.

Keywords: Pipe Bending, Bending Operation, Single And Multistage Bending Machine, Three Roller Bending Machine.

I. INTRODUCTION

Sheet or pipe bending operation are very commonly used for development of cylinders, cones, furniture, pipe profile, etc. The industry in general is presently using a three roller pipe bending machine. This type of machine have 3 rollers in which 1 roller is fixed and the other 2 rollers are adjustable. The adjustable roller can be moved manually. The metal pipe is fed into the machine in the roller and then taken back from the other end. The pipe need to be passed through machine for number of times. The products that can be produced with this machine are various curves, structural elements, automobile parts etc.

The common product of roll bending machine are tube bending, plate bending and a coil. All modern roll bending machine is power driven and some of the

bending machine equipped with electronic control. The pyramided style roll benders have one moving roller, usually the top roll. Double pinch type roll benders have to adjustable rolls, usually the bottom rolls, and a fixed top roll this method of bending causes very little deformation in the cross section of the pipe.

The conventional pipe bending machine is shown in figure 1 and 2. Figure 2 shows the bending operation. The sheet or pipe is feed to the rollers or pulley type rollers. The angle of bending depends on the motion of idler roller.

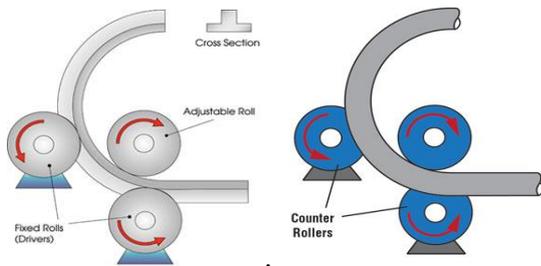


Figure 1. Position and Rotational Direction of Roller



Figure 2. Pipe bending machine

II. LITERATURE REVIEW

The available literature on net, printed literature, literature papers, technology magazines, design engineering books, design data book, industrial literature, etc. was reviewed between years 2016 to 2017. Total fifteen papers, articles, books, were studied for this. The some of the important papers, details related to various methods, machines and design procedures is discussed below.

Deformation And Fracture Properties Of Steel Pipe Bend With Internal Pressure Subjected To In-Plane Bending [1]

In this paper, the ultimate strength of steel pipe bend is carried out for gas transportation use. And also tests of both closing and opening mode bending are carried out. Their aim is to optimize the allowable design strain or deformation of steel pipe bend subjected to permanent ground displacement induced by liquefaction due to a great earthquake. Ultimate strength of steel pipe bends is studied with respect to crack initiation. Experiments and numerical analysis were carried out to determine the effects of materials, dimensions and geometry shape on ultimate strength of steel pipe bend.

Steel pipe bends largely deformed up to occurrence of a wrinkle before crack initiation. The ultimate strength of steel pipe bend was evaluated at least 30% as a local strain independent of materials.

In this study, closing mode and opening mode bending tests for various steel pipe bend specimen were carried out and also a numerical simulation by using elasto-plastic finite element technique was also performed.

Automated Tube Bending Machine [2]

This paper is aimed to fabricate a tube bending machine which will operate automatically. The objective of paper is to make this machine which will be less costly comparatively increasing the productivity of the bend tubes. 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 this machine is that the tube can bend at any angle in any plane continuously without repositioning the tube in the machine.

Study Of Portable 3 Roller Pipe Bending Machine [3]

In this paper they discussed the idea of developing a pipe bending machine which is portable so that it can be used to bend a pipe in workshop. This paper provides information for designing and constructing a portable pipe bending machine. The material used for the machine is steel. The machine is very portable and reduces human effort. Skilled operator are not required for the machine. Semiskilled operators can also operate the machine. They are designing manually operated pipe bending machine with use of pulley, motors, gears and support (frame).

This machine can bend up-to 4- 5mm thickness of pipe. They designed the machine according to the size of the machine so that it can be used in small workshops. They designed the machine and calculated all the stresses and dimensions of the machine.

A New Model in Design and Manufacturing of Mobile Hydraulic Pipe Bending Machine in Industry [4]

This paper discuss about the advantages of hydraulic pipe bending machine and disadvantages of heat treatment of pipe bending. It gives the information about operation and construction of hydraulic pipe bending machine. The method of pipe bending is also discussed in the paper. They discussed the different types of pipe bending methods such as press bending, rotary draw tube bending, etc. Different calculations are also done for example bend allowance, section modulus, etc.

Final Working of Rolling Pipe Bending Machine [5]

In this paper, they discussed about the idea of a mobile pipe bending machine. They designed the machine for pipe bending using gears, pulleys, motor, a screw, etc. the mechanism is very simple. This machine can bend a pipe in 3 to 4 minutes.

This pipe design provides the precise location of the work piece, thereby increasing the accuracy of the operations Provisions are also made so as to reduce the Vibrations and eliminate damage to the work piece via the analysis of bending characteristics and multiple defects, advances on exploring the common issues in tube bending are summarized regarding wrinkling instability at the intrados, wall thinning (cracking) at the extrados, spring back phenomenon, cross-section deformation, forming limit and process/tooling design/optimization. The material used for the components of the machine is mild steel, which is of considerable strength as well as of low cost.

Experimental Design And Fabrication Of A Portable Hydraulic Pipe Bending Machine [6]

This paper discuss about the design and fabrication of a hydraulic bending machine. They compared the conventional bending machine with hydraulic bending machine. They discussed the fabrication of the hydraulically operated pipe bending machine. They modified the conventional hydraulic bending

machine for multipurpose. The machine can be adjusted according to the need of the industry. Thus if we want to perform any press operations using die and punch, than a table having a provision to hold a die can be used and corresponding punch can be fixed to the ram end. So likewise the machine can be used for multiple operation.

Development Of A Hydraulically Operated Pipe Bending Machine [7]

In this paper, a hydraulic operated pipe bending machine designed and developed for bending pipes of different diameters. The machine consist of the machine are frame, housing, flaps, rollers, pins, ram and hydraulic jack. The lifting capacity of jack is 5 tonnes. This machine is able to bend to pipes having different diameters. They tested the machine for 25 mm and 12.5 mm pipes. Working of the machine is very simple. The upper flap is opened up while the pipe to be bent is positioned in the groove on the two rollers and the ram. The upper flap is then closed and secured with the two pins at both ends. With the aid of the hydraulic jack's handle, non-return valve is locked so that the ram moves against the two rollers to bend the pipes as its actuates up to the calibrations on the lower flap, which shows angle 90o and 120o respectively by the reciprocating movement of the jack handle. The close-coiled helical spring incorporated, enables the piston on which the ram is attached to return to its initial position.

Research Paper of Manually Operated Pipe Bending Machine [8]

In this paper, a manually operated pipe bending machine is designed with increased accuracy. Pipes which are bended by chair manufacturer are having wrinkles. Since the accuracy of manually operated pipe bending machine is less, they wanted to increase accuracy so that it can give a perfect bend to the pipe. A case study of pipe bending machine is done for accuracy. In this machine, pipes having 19 as outer diameter and 17 as inner diameter can be bend easily. Small industries can use this type of machine for pipe

bending easily. The pipes being bended are wrinkle free and also it is affordable for the user.

Justifying, Selecting and Implementing Tube Bending Methods [9]

In this study, author is discussing about the bending methods and various types of bending machines which are available in market. They have discussed the physical and technical characteristics required for bending such as outside diameter, wall thickness, material, bend quality required, etc. They have defined the bending data as angle, feed and rotation. They discussed about manual bending, semiautomatic bending, CNC bending, special application bending in detail. They have given the method of each type of bending with its advantages and disadvantages. Applications of each type of bending are given in the paper. Price, return on investment, production, change over time, scrap rate, accuracy and repeatability are some parameters which are given in this paper.

Selection criteria for selecting type of bending is discussed in the paper. The author classified it in two categories as features and purchase intangibles. All factors related to it are explained in the paper.

Observation of Literature Review

After studying all the literature related the pipe bending machine, certain observations are made.

- ✓ The first literature deals with the is to optimize the allowable design strain or deformation of steel pipe bend subjected to permanent ground displacement induced by liquefaction due to a great earthquake. In order to discuss the allowable value, ultimate strength of steel pipe bends is studied with respect to crack initiation.
- ✓ Second literature aimed to do bending operation for tube by using automation and named as automatic tube bending machine. It shows the implementation of automatic tube bending machine for bending with less cost compared to the existing bending machines, and increasing the productivity of the bend tubs.

- ✓ In third literature we studied the development a pipe bending machine which is useful to bend a pipe in workshop. This project is to design and construct a portable pipe bending machine. This machine is used to bend steel pipes into curve and the other curvature shapes. The size of machine is very convenient for portable work.
- ✓ A fourth literature based on the design and manufacturing of mobile pipe bending machine in industry.
- ✓ Fifth paper explains the design and development of automatic pipe bending machine which is used for Automobiles & Industrial. It's time consumption process. It reduces human effort and also required low less skill to operate this machine. They design automatic pipe bending machine with use of pulley, motor, gear & support (frame). Sixth paper the author works to replace the conventional machines by hydraulic pipe bending machine to reduce size, space occupied, cost employed etc.
- ✓ Seventh literature based on the features of pipe bending machine such as frame, housing, flaps, rollers, pins, ram and hydraulic jack. The lifting capacity of the jack was selected to be 5 tones. The maximum efficiency of 97% and a 3% level of ovality were obtained when tested with a pipe of diameter 12.5mm. When tested with a pipe of diameter 25 mm, 95% efficiency with 5 % level of ovality was obtained.
- ✓ Eighth paper deals with manufacturing of fixed die and lever operated manually tube bending machine. Especially discussions are made on bending project analysis of manually operated pipe bending machine with the bend of 19mm outer and 17mm inner diameter pipe at the angle of 90° to 180° without any wrinkles or defect. Ninth paper based on the investigation of some of the more popular options available for tube bending, their benefits, limitations, cost and applications.

III. PROBLEM IDENTIFICATION

Industries have simple three roller pipe bending machine for bending the pipe. On this machine they are able to bend one pipe at a time. If they have very high demand for the same, they would require a multistage pipe bending machine so that they will be capable of bending many pipes of different sizes easily. Due to which they can fulfill the need of customer within time. We can also use multiple pipe bending machines to increase the production rate. But this will also increase the manpower required for the task and overall cost of production. And, therefore we are developing the machine for multistage pipe bending so that they will be benefited with cost, manpower and time minimization.

IV. CONCLUSION

Thus, we studied the three roller pipe bending and its working. We also studied the literature related to the pipe bending including its different types, fabrication, stresses, different bending theories, etc. The existing machine is not satisfying the need of industries. So, the multistage pipe bending machine being proposed.

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