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Design of Manual Pipe Bending Mechanism

Manish Giripunje[1], Aman Shrivastava[2], Aditya Arun[3], Nikhil Kondlekar[4], Saloni Bagwani[5], Rutija Wadighare[6], Chaitali Doijad[7]

[1]*Assistant Professor,* [2, 3, 4, 5, 6, 7]*Under Graduate Scholars, Department of Mechanical Engineering, Priyadarshini College of Engineering, Nagpur, India.*

Abstract: ***Rotary draw bending an ongoing process. It's an at-hand service proffered within the current market. However, each draw bender features a divergent mechanism with its pros and cons, thanks to its main advantages; the rotary draw bender was selected. Pipe bending machines have progressed many enhancements and augmentations over the amount. The sort of pipe bending plays a critical role in industries, instruments, and transporting of fluids. The first concern is that the required bend angle that this pipe will bend on.***

The following report will include an outline of the accessibility of this machine. The crucial variables that ought to be accounted forwithin the pipe bending is bend radius bend angle, pipe diameter, and thickness. The concept of press bending is employed to hold outthe operation; thus, the specified force is administered with the help of a hydraulic jack. Also, other important variables are accounted for, like the bending force, bending torque, simulation outcomes about the work piece analysis, and eventually the machine design.

Moreover, a prototype that satisfies the specified constraints is manufactured and assembled. Being a manual bending machine means no use of electricity is required, leading to no power consumption. Additionally, this machine is favorable, feasible, affordable, low maintenance, and higher accuracy.

Keywords: Slider-Crank Mechanism, Cad Design, Spiral Bevel Gear, Linear Bearing, Knuckle Joint, Needle -Type Roller Bearing.

I. INTRODUCTION

For thousands of years, human beings have indulged themselves to find new ways to enhance their standard of livingand improve their lives. Since the very first civilization, they have invented tools in order to mitigate human efforts. The best examples are the invention of wheel, hunting tools and many more. Throughout the history, with the help of these inventions' men turned themselves from being cavemen to civilized people. Even now in 21st century the inventions are still going on. But the pace of inventions got boomed during the early 17th century till mid-18th century, the Industrial Revolution. This revolution resulted with the existence of all the functioning machines and their mechanisms, which we use today. Bending objects have always played a crucial role in the evolution of human race, first to make hunting tools,then to make houses and then to making machines and automotive. So, in the 1760's the first proper bending machine was invented and since then it has been prevalent in the industrial sector. We have many types of bending machines nowadays. Bending machines keeps on advancing. The main goal is to improve the bending mechanism by using analytical geometry and empirical techniques to achieve better shapes and designs. But each bending machine comes with its pros and cons. The overall goal is to minimize human efforts to achieve 3 desired geometric form with maximum accuracy and in less time. But as the automotive industries and pipe and pipeline industries flourished, the need for a pipe Bending objects have always played a crucial role in the evolution of human race, first to make hunting tools, thento make houses and then to making machines and automotive. So, in the 1760's the first proper bending machine was invented and since then it has been prevalent in the industrial sector. We have many types of bending machines nowadays. Bending machines keeps on advancing. The main goal is to improve the bending mechanism by using analytical geometry and empirical techniques to achieve better shapes and designs. But each bending machine comes with its pros and cons. The overall goal is to minimize human efforts to achieve desired geometric form with maximumaccuracy and in less time. But as the automotive industries and pipe and pipeline industries flourished, the need for a pipe bending machine increased. Thus, the manual pipe bender was invented in 1950's by Jerry Huth. Before inventionof pipe benders, fitting exhaust pipes was a difficult job which every shop couldn't do it. The mechanic had to cut and weld the pipe section while making small bends manually. Therefore, Huth's automotive pipe bender gained popularityin no time. Around 1960 Huth was providing pipe benders to every shop in the country. His bending machine continues to lead the field even after 50 years. It has continuously modified to meet the needs of the changing industry.

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II. LITERATURE STUDY

The available literature on Google, printed literature, research papers, technology journals, design engineering books, design data booklet, industrial literature, etc. were reviewed between years 2016 to 2021. Total eighteen papers, articles,books, were studied. This literature is about the importance of designing a rotary draw bender to bend a pipe. A bendingmay be a process of bending a metal. The metal is often a sheet, tubes, square hollow, rod, and iron angle. This sort of metal has its own thickness. The draw bender designer will take into consideration variety of things including sort of metal, sort of the draw bender, power driven or manual and therefore the size of the draw bender. The number of the important papers, details associated with various methods, machines and style procedures is discussed below

A. Deformation and Fracture Properties of Steel Pipe Bend with Internal Pressure Subjected To In-Plane Bending

In this paper, the ultimate strength of steel pipe bend is used to transport gas and also tests of both opening and closingmode bending are carried out.

Their aim is to optimize the permissible design strain or deformation of steel pipe bend subjected to permanent ground displacement induced by liquefaction because great earthquake. Ultimate strength of steel pipe bends is studied with reference to crack initiation. Experiments and numerical analysis were administered to work out the consequences12 of materials, dimensions and geometry shape on ultimate strength of steel pipe bend. Steel pipe bends are largely deformed till occurrence of a wrinkle before crack initiation

B. Automated Tube Bending Machine

This paper is aimed to fabricate an automatic tube bending machine. The target of paper is to form this machine whichcan be less expensive comparatively increasing the productivity of the bend tubs. Automatic bending machine containsbending die, pulleys, chuck, bed, linear motion lead screw, timing belt, base frame, micro controller, sensor and computer. The tube is bent by the pulleys with holding the tube within the bending die. The most advantage of this machine is that the tube can bend at any angle in any plane continuously without repositioning the tube within the machine.

C. Development of A Hydraulically Operated Pipe Bending Machine

In this paper, a hydraulic operated pipe bending machine designed and developed for bending pipes of various diameters. The machine contains the machine are frame, housing, flaps, rollers, pins, ram and hydraulic jack. The lifting capacity of jack is 5 tones. This machine is in a position to bend to pipes having different diameters. They tested the machine for 25 mm and 12.5 mm pipes. Working of the machine is extremely simple. The upper flap is opened while the pipe to be bent is positioned within the groove on the 2 rollers and therefore the ram.

D. Final Working of Rolling Pipe Bending Machine

In this paper, they talked about the idea of a movable pipe bender. They designed the machine for pipe bending withgears, pulleys, motor, a screw, etc. the mechanism is quite simple. This machine can bend a pipe in 3 to 4 minutes. Thispipe design increases the accuracy of the operation by giving the exact location of the work piece.

Provisions are also made so as to minimize the vibrations and to eliminate any 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 issues at the inner curve, wall thinning (cracking) at the outer curve, spring back phenomenon, cross-section deformation, forming limit and process/tooling design/optimization.

E. Justifying Selecting and Implementing Tube Bending Methods

In this study, author is discussing about the bending methods and various sorts of bending machines which are available in market. they need discussed the physical and technical characteristics required for bending like outside diameter, wall thickness, material, bend quality required, etc. they need defined the bending data as angle, feed and rotation.

They discussed about manual bending, semiautomatic bending, and CNC 14 bending, special application bending intimately. They need given the tactic of every sort of bending with its advantages and drawbacks. Applications of every sort of bending are given within the paper.

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F. Research Paper of Manually Operated Pipe Bending Machine

In this paper, an operated by hand pipe bending machine is meant with increased accuracy. Pipes which are bended by chair manufacturer are having wrinkles. Since the accuracy of operated by hand pipe bending machine is a smaller amount, they wanted to extend accuracy in order that it can provides a perfect bend to the pipe. A case study of pipe bending machine is completed for accuracy. During this machine, pipes having 19 as outer diameter and 17 as inner diameter is often bend easily.

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

This paper discusses 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.

H. A New Model in Design and Manufacturing of Mobile Hydraulic Pipe Bending Machine in Industry

This paper discusses about the benefits of hydraulic pipe bending machine and drawbacks of warmth treatment of pipe bending. It gives the knowledge about operation and construction of hydraulic pipe bending machine. the tactic ofpipe bending is additionally discussed within the paper. They discussed the various sorts of pipe bending methods like press bending, rotary draw tube bending, etc. Different calculations also are finished example bend allowance, section modulus, etc.

I. Study of Portable 3 Roller Pipe Bending Machine

In this paper they discussed the thought of developing a pipe bending machine which is portable in order that it is often wont to bend a pipe in workshop. This paper provides information for designing and constructing a transportable pipe bending machine. The fabric used for the machine is steel. The machine is extremely portable and reduces human effort. Skilled operator isn't required for the machine. Semiskilled operators also can operate the machine.

III. OBJECTIVE OF PROJECT

The specific objectives of the study can be summarized as follows.

A. To engineer a manual pipe bending machine with rotary draw bending mechanism.
B. The machine should be able to bend a pipe of OD 5cm with thickness 5mm with a bend curvature of 10 cm and bend angle ranging from 0 to 180 degrees.
C. The manual labor force shouldn't go beyond 100N.
D. To avoid deformation in the bend.
E. To design a cost efficient, portable compact and low maintenance machine.
F. To improve the rate of bending in order to reduce time consumed and manual labor.
G. To take into consideration the current pandemic situation and make it cheap and easily accessible to unskilled workers and cottage industries

IV. COMPONENTS

Sr No.	Resource used	Specification	Material used
1.	Bend die	Outer Diameter: 70mm	Mild steel
2.	Lever	200 x 25 x 40 mm (length x breath x thickness)	Mild steel
3.	Base	90 x 90 x 15mm (length x breath x thickness)	Mild steel
4.	Guide	42.5 x 30 x 20 mm (length x breath x thickness)	Mild steel
5.	Clamp	42.5 x 20 x 10 mm (length x breath x thickness)	Mild steel

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6	Die nut	Length: 58.95mm Diameter:20mm	Mild steel
7	Nut	Diameter:10mm	Mild steel
8	Bolt	Diameter:25.98mm Thickness:10mm	Mild steel

Table I: Specification of components

V. WORKING

The mechanism works on the basis of draw bending, this method is used from a very old time for bending pipe.The main components of the manual bending mechanism are as bellow:

A. Bend die

Bend die is mounted on the base plate using nut and bolts. The pipe is clamped tangentially to the bend die to draw the pipe in desired angle of bend and required radius of bend. Radius of bend is the factor at which bends are specified.

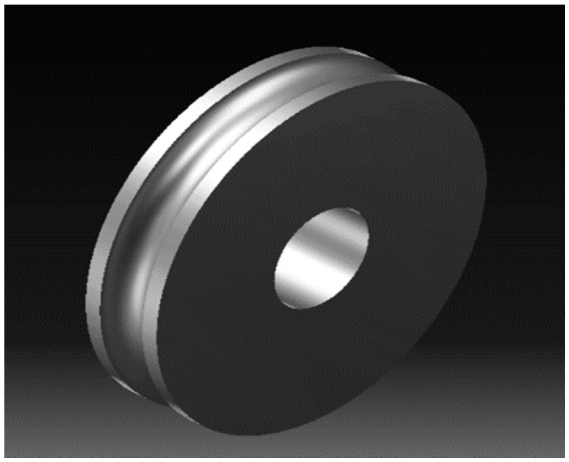

Fig. 1 Bend die

B. Wiper die

Wiper die is joined with the pressure die and lever (handle), the wiper die is in contact of the job in a tangential line so as the pipe undergoes bending the bend does not form wrinkles on job surface.

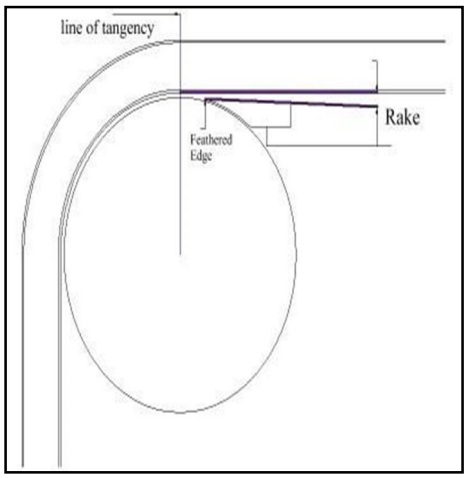

Fig. 2 Wiper die

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C. Pressure die

Pressure die is joined with the lever (handle) therefore while applying force on the lever starts formation of bend on the pipe. The pressure die applies force on the tangency of the pipe.

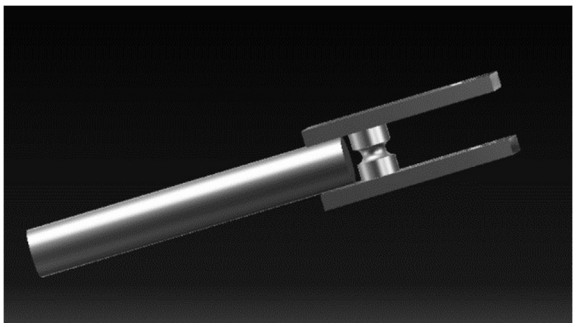

Fig. 3 Wiper die

D. Lever/handle

Lever is mounted in the pressure die , using lever one can apply force to the pressure die. Lever can be suspended more than300KN of force. The length of the lever is 600mm, as the length of lever is long the force can be applied more easily.

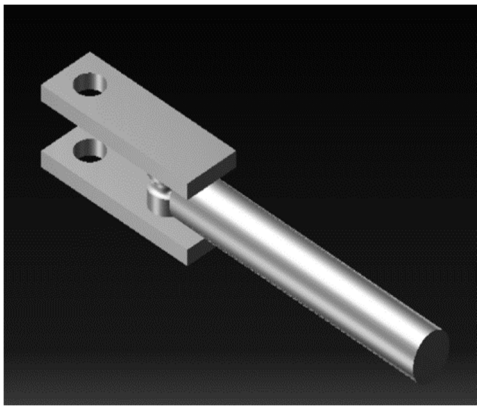

Fig. 4 Lever

E. Clamp/fixture

A clamp is mounted on the base of the manual bending mechanism. The clamp is needed to hold the workpiece rigidly, while performing bending operation the workpiece should be rigidly held for the accuracy of the bend.

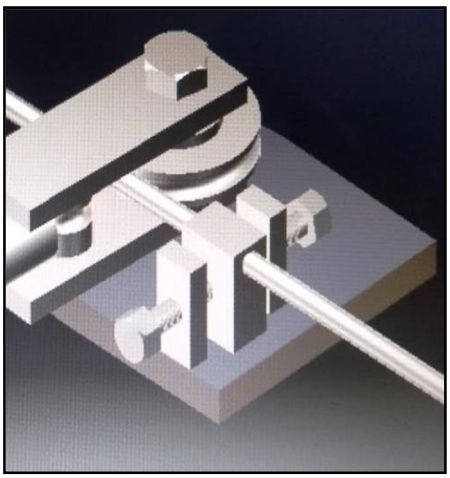

Fig. 5 Clamping arrangement

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F. Base

Base of the manual bending mechanism holds the bend die, wiper die, pressure die, clamp and the lever.

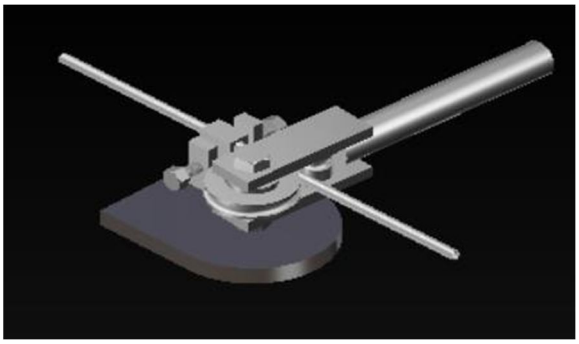

Fig. 6 Base with assembly

VI. CAD DESINGS

(All the dimensions are in mm)

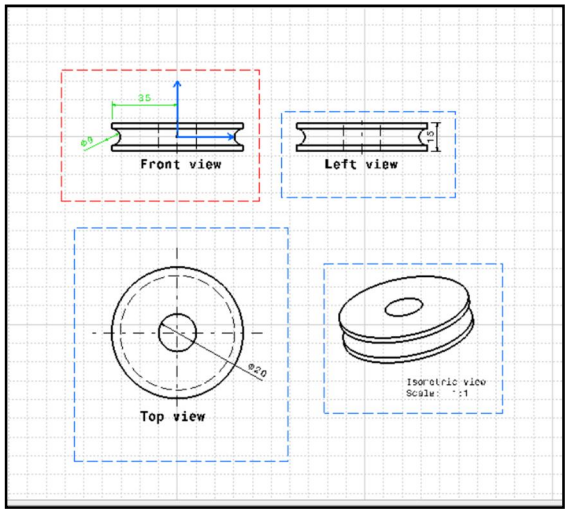

Fig. 7 Bend die

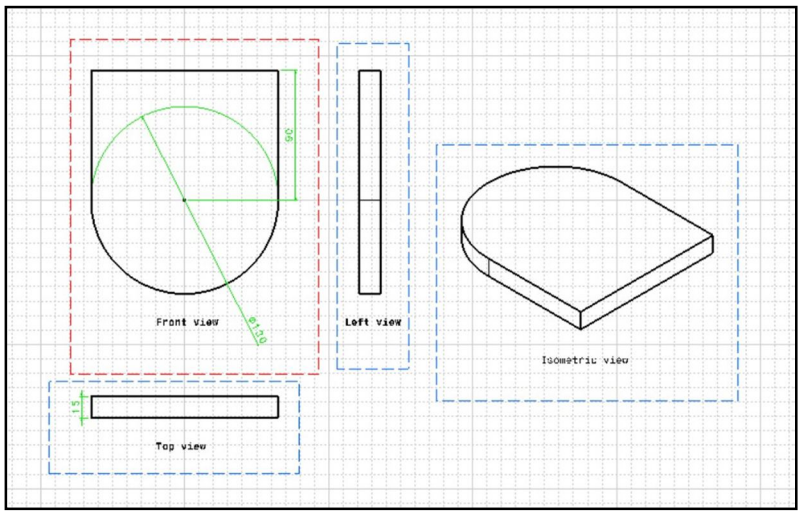

Fig.8 Base

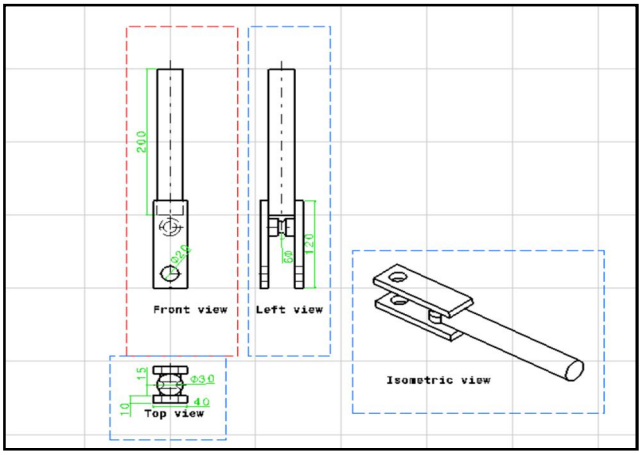

Fig.9 Lever

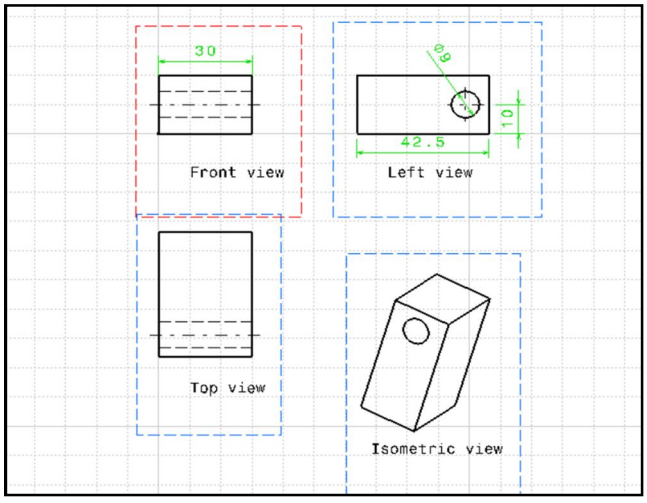

Fig.10 Clamp

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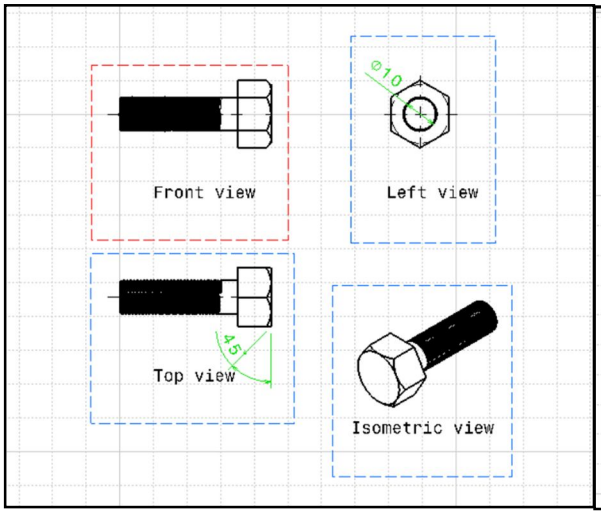

Fig.11 Die nut

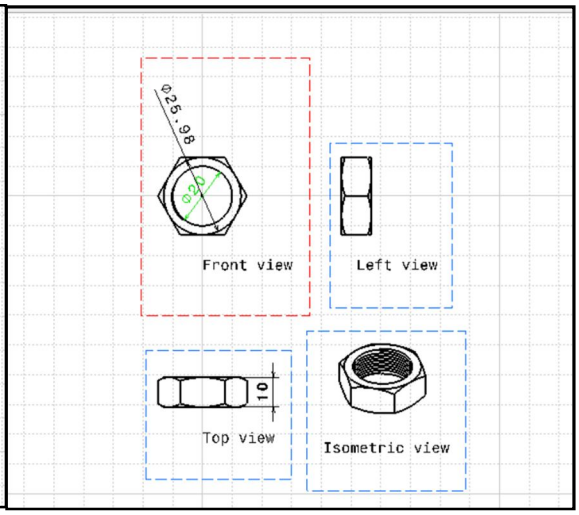

Fig.12 Bolt

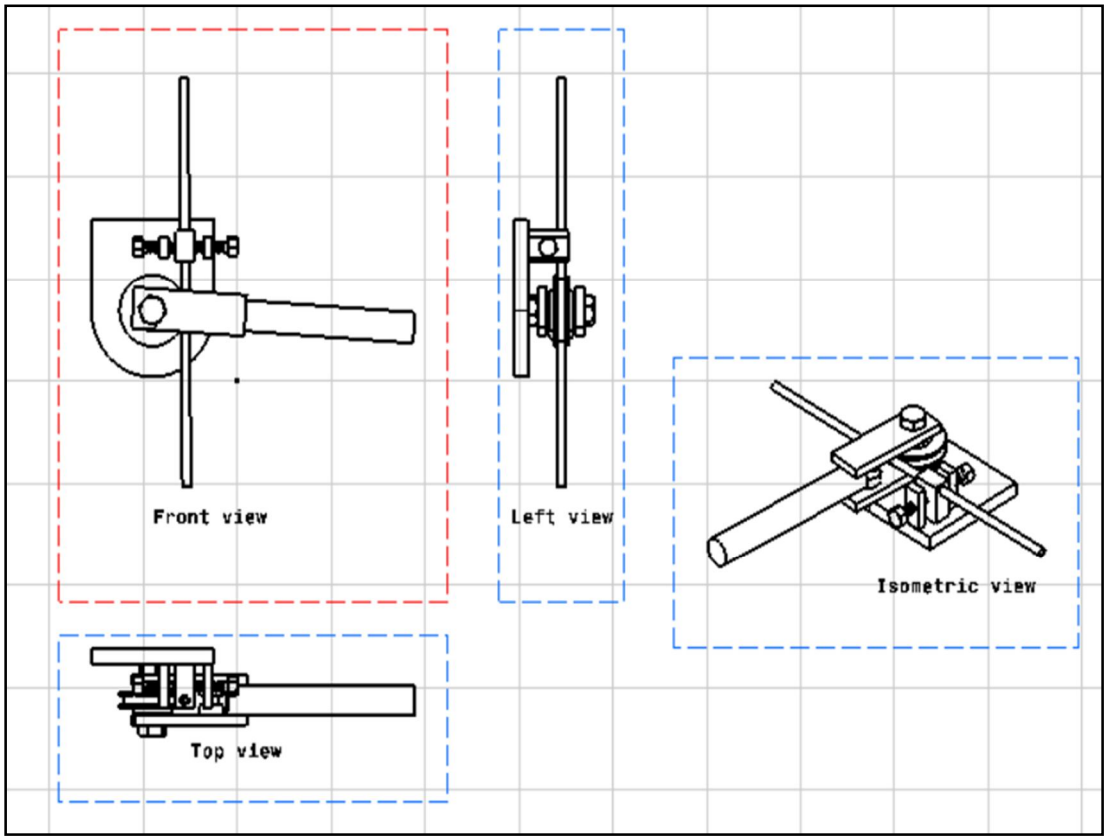

Fig.13 Assembly

VII. RESULTS AND DISCUSSION

The results of the study are presented and discussed regarding the aim of the study, which is Design of Manual Pipe Bending Mechanism without increasing the cost of the project. The developed mechanism will help citizens to start their own business at low initial cost

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VIII. CONCLUSION AND FUTURE SCOPE

A. *Conclusion*

Pipe bending process is used in automobile, power plant and industries etc. are pipe bending mechanism is manual. In this project, iron rod is efficiently brand using manpower. The various pipe bending machine consisting of various dies used for production industries are known in this project. This bending mechanism is very useful in industrial application as it turns at very low cost and very efficient. This project is made with planning that it provides flexibility in operation. This project “Manual Pipe Bending Mechanism" is designed with the hope that the workers who lost their job due to pandemic can start their own work as this project is much economical

B. *Future Scope*

In the next stage we are trying to make a pipe bending machine which will be helpful in easy bending of pipe. We have tried to make the system cost effective and also add some enhancement to make the system more efficient so that it may work around the year. Some following advance type of machine can be constructing and they should be increasing the future scope for pipe bending machine.

1) We can modify this machine into automatic machine by using electrical supply and pneumatic supply.
2) We can use this machine for different curve and different shape of pipe.

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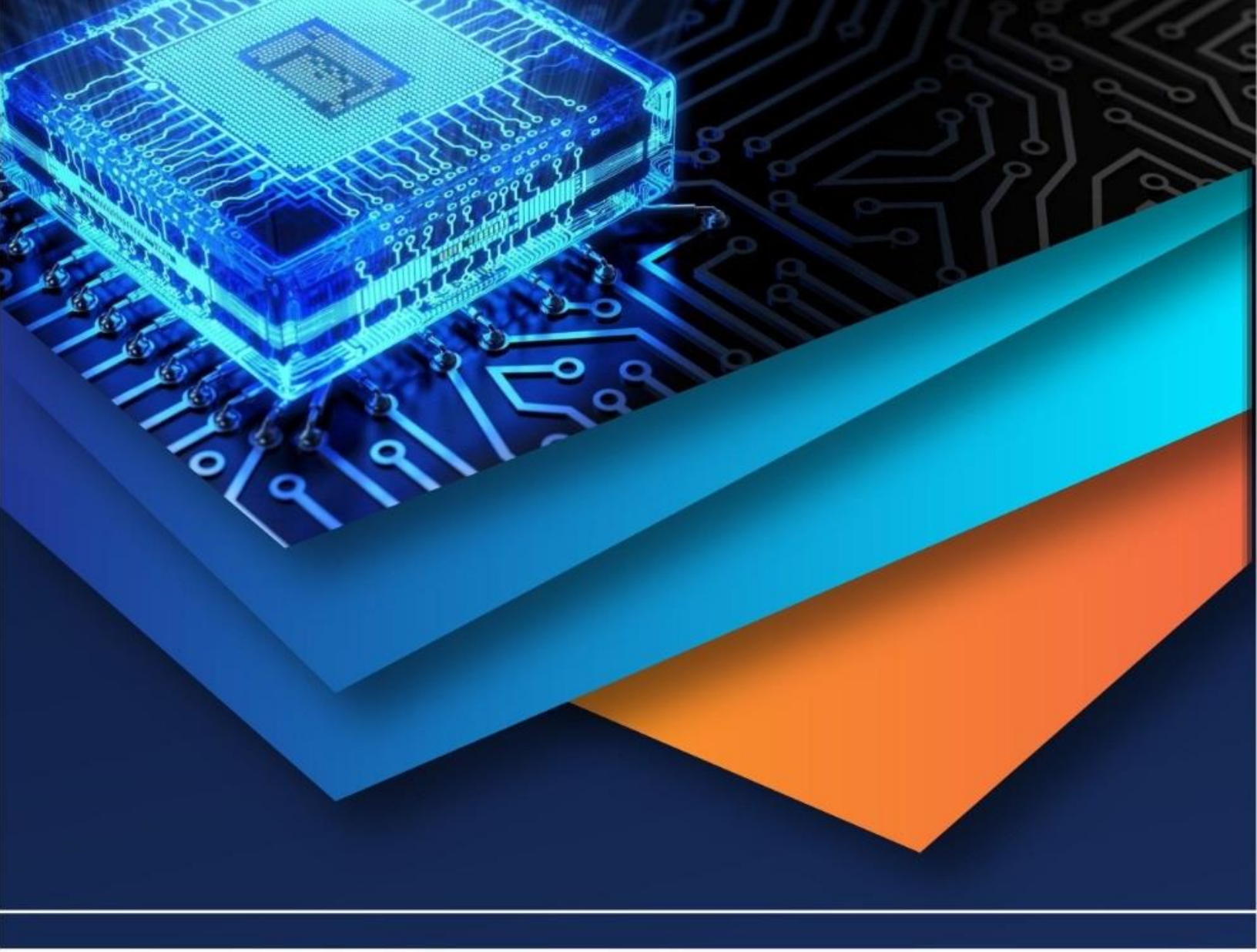

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