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Design and Manufacturing of Automatic Bar Feeding and Clamping Mechanism

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ABSTRACT - To reduce human effort for repetitive work of metal cutting as well as for providing a convenient fixture to support and hold the rod during cutting. The subject is undertaken as a part of project for B. E. Mechanical Engineering. The feeding and clamping of a bar is automated by using rollers and pneumatic cylinder. It has potential to reduce a huge amount of human efforts, increases efficiency and productivity. The primary concern of this system is to carry out two operations – Feeding and Clamping. For feeding of rod, a motor is used which is connected to a pulley which is further connected to a shorter pulley with the help of a belt. Pulley is connected to rollers, which starts moving along with it and thus, the rod is fed. Limit switch is used to stop the movement of rollers, as desired. Pneumatic cylinder is used for the clamping purpose, which also holds the rod tight for the purpose of reducing human effort for repetitive work. This is done by solenoid operated DCV. An Arduino module is used for automation and to control the various actions which are required for feeding and clamping of the bar. Time required is less when compared to manual cutting. This work provides the desired output.

Keywords: Pneumatic Vice, Motor, Rectangular Frame, Rollers, limit switch

I. INTRODUCTION

Figure 1: Original Machine W/O automatic bar feed mechanism

In the recent period of automation where it essentially requires a mechanical power as a replacement of manual effort in all areas of automation. This project is aimed at achieving the accuracy while cutting MS bar of varying shapes and sizes and for ease while feeding. In automation the advantage is it helps in saving labor; importantly, additionally it is used to save energy as well as materials and to improve accuracy, precision and quality. Conventionally bar is measured of required length as per the application manually using tape or any other measuring instrument. As per the requirement of the length of the bar it is cut after mounting the bar on the cutting machine. This is time consuming process and requires effort for loading and unloading the bar on the cutting machine. Also, the marking done by the operator helps in deciding the accuracy of the metal bar which may vary. Recently for the use in a floor different types of electrically operated power-hacksaw machines of various industries are available. These machines are so precise that they can cut metal bars made up of different materials with minimum time, but they have one major disadvantage that they are not able to cut at faster rate as well as these require manual intervention for every operation of bar to be cut and also these machines are of high cost. Thus, a system has to be created which handles the operation of bar cutting efficiently such a way that it requires low mechanical effort to carry out the bar feeding as well as cutting operation automatically. To overcome these advantages, this project involves designing and manufacturing of automatic bar feeding and clamping mechanism, which not only saves the time but is also accurate as it is computerized.

1.1. Problem Statement

Design and manufacturing of automatic Feeding and Clamping mechanism incorporating the use of Pneumatic Vice for clamping purpose pair of rollers for feeding which are driven by a D.C. motor.

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II. DESIGN WORK CARRIED OUT

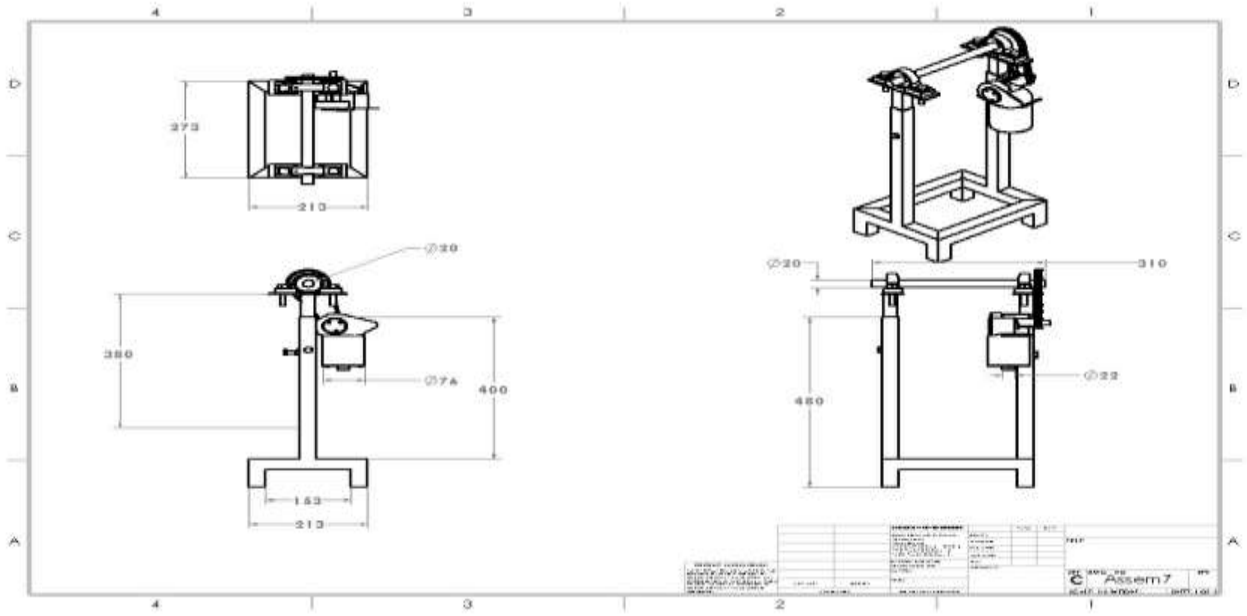

Figure 2: SolidWorks Drawing of the Feeding Mechanism

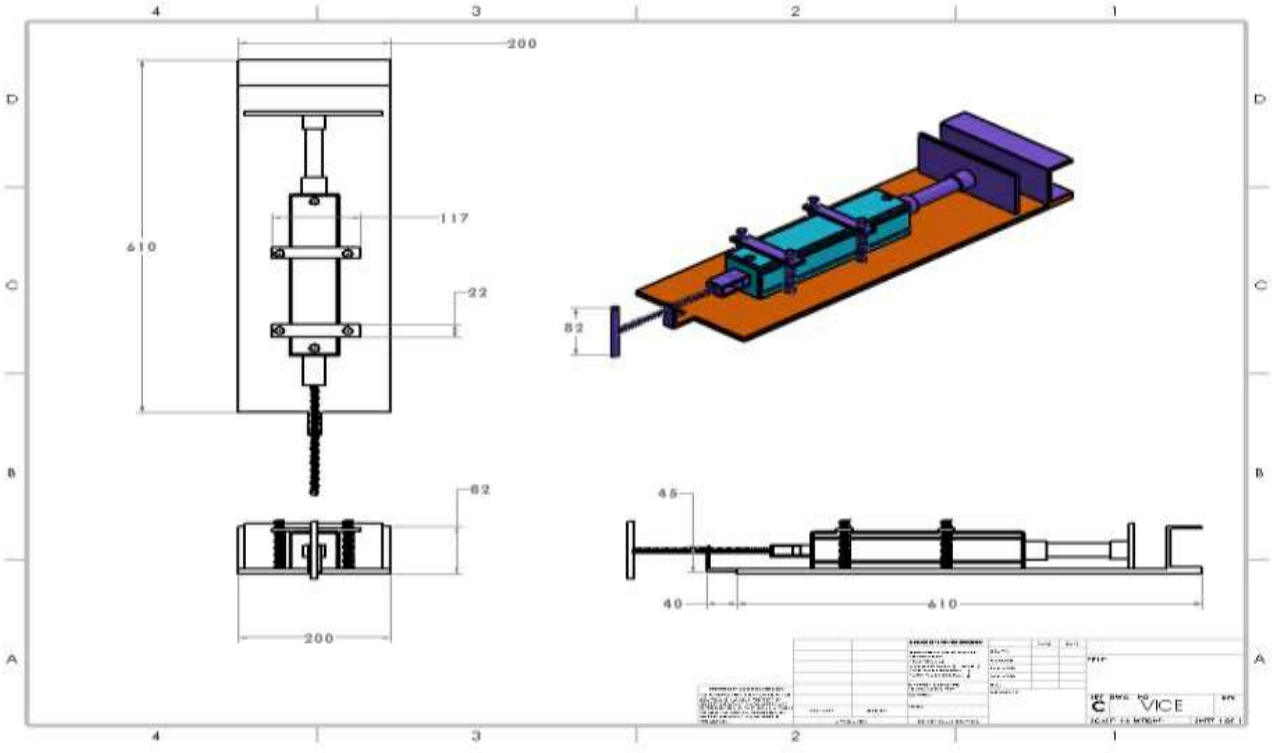

Figure 3: SolidWorks Drawing of the Clamping Mechanism

III. WORKING METHODOLOGY

3.1. Principle

The automatic bar feeding and clamping mechanism is an Arduino controlled metal cutting machine tool designed to feed and clamp the metal bar in a continuous manner. With the help of belt drive, the metal bar moves over the roller till it comes in contact with the limit switch which is placed as per the required length of the bar. Upon touching the limit switch, Arduino provides signal to motor to come at rest and simultaneously clamps the work piece. After cutting of the metal bar as soon as the contact between bar and limit switch is over the clamp return to the original position and motor will operate again.

IV. COMPONENTS

4.1. Components Used for Feeding Purpose

4.1.1. Rollers

Rollers are used for the purpose of moving the metal bar so that bar can be moved forward with less power achieving the friction less movement.

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Figure 4: Rollers for support of bar feeding.

4.1.2. P.M.D.C. Motor

Motors take electrical energy and produce mechanical energy. PMDC is a compact size and economically priced rugged right angle worm gear motor. We are making the use of motor for moving the rollers in forward direction. The rod will further move on rollers and strike the limit switch and indeed it will give signal to stop the motor and the cutting action will take place.

Figure 5: PMDC Motor 25 RPM

Specification of Motor:

1. Power of motor = 30 Nm /s
2. RPM of motor = 25 rpm

4.1.3. Rectangular Frame

For the rectangular frame, the hollow pipes of square shape are selected of mild steel material. As per the requirement of the size the pipes are cut using cutting machine. For the proper welding the square pipe ends are grinded so that it became smooth. The welding is done on the square pipes to form a rectangular frame.

Figure 6: Frame for holding Support Rollers

4.1.4. Battery

The battery is a device which converts chemical energy into the electrical energy. The battery supplies the current for operating the cranking motor and other units. For this purpose the lead acid battery is used which is rechargeable.

Figure 7: Battery pack for Electrical Units

Specification of Battery:

1. Voltage = 12V
2. Current = 7.2 Ah

4.2. Components Used for Clamping Purpose

4.2.1. Pneumatic Vice

Figure 8: Pneumatic Vice

Figure 9: Pneumatic Vice as placed in machine

Pneumatic cylinder is a device which uses compressed air/gas supplied by the compressor to produce linear reciprocating motion which generates force to clamp the work piece/component. Pneumatic Cylinder with stroke length 110m is used. It is readily available in market. Cylinder is further connected to the movable vice. A scale is attached to the base which is connected to the limit switch. Operator can vary the length of bar to be cut according to his need.

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4.2.2. Arduino

Specifications:

1. Microcontroller = Atmega328
2. Operating Voltage = 5V
3. Input Voltage = 7 to 12V

Figure 10: Arduino Uno R3 Module

V. MACHINING OPERATIONS CARRIED OUT

4.3. Abrasive Cutting machine

An abrasive saw which is however known as a cut-off saw or metal chop saw, is used to cut hard materials such as metals which functions as a power tool. An abrasive disc is used for the cutting action which is similar to a thin grinding wheel.

Figure 11: Abrasive Saw

4.4. Drilling

Drilling is a cutting process which is used in solid materials to cut or enlarge a hole of circular cross section using a drill bit. The drill bit which is often multipoint is a rotary cutting tool. The drill bit is rotated at high revolutions and pressed against the workpiece to achieve a circular hole.

4.5. Welding

Welding is a process in which permanent joint is produced by heating the material up to suitable temperature with or without application of filler material and it is distinct from the processes of brazing and soldering, which do not melt the base material. Different materials can be welded and it can be done everywhere.

4.6. Threading Operation

Threading is a process which is used to create screw threads using tools such as taps and dies. Many are cutting tools; others are forming tools. For the formation of the female portion of the mating pair a tap is used (e.g., a nut), while to form the male portion a die is used (e.g., a bolt).

4.7. Tapping

Tapping is a process of forming or cutting threads using a tap.

Figure 12: Taps used for this project

4.8. Grinding Operation

Grinding is truly a metal cutting process which is a subset of cutting. Grinding practice is carried out at a very large scale for manufacturing and tool making. Accurate dimensions and smooth finishes can be obtained and yet it can wear out workpiece in production of large volumes of metal quite rapidly.

Figure 13: Grinding Operation in action

VI. PERFORMANCE ANALYSIS

When manually operated power hacksaw machine was automated, improvement in the overall performance of the machine was observed. Improvements in the major parameters are explained as follows:

- The efficiency of the operation is increased.
- The rate of production is relatively increased.
- Increase in accuracy and quality of the component.
- Reduced human efforts, work load and labor cost.
- The process is controlled by arduino which enables to run the operation in a continuous manner.
- Human intervention is minimized.
- Time required to produce large number of jobs is minimized.

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VII. RESULT

This works provides an alternative to the existing bar cutting machine, it provides automatic bar feeding into the cutting apparatus and clamping, eliminates power fluctuation and increase the work efficiency. Time consumption is less when compared to manual cutting, this work provides desired output. Thus, a system needs to be developed which can handle the operation of bar cutting effectively in such a way that it requires minimum mechanical effort and carry out the bar feeding as well cutting operation automatically. The Automatic Hacksaw machine can be used for different kind of industrial purpose that involve a bulk of shafts that have to be cut frequently. The range of size of size of work pieces that can be cut can be varied by changing the blade size.

VIII. CONCLUSION

The design and manufacturing of automatic bar feeding and clamping mechanism will be very useful for small scale industries, workshops, etc. We have used components for automation of this mechanism such as Pneumatic clamp, Arduino, PMDC motor, Limit switch, etc. The main aim of this machine is to reduce the human effort, time required for cutting, increase accuracy and neglect the time for measuring the workpiece. This aim is achieved by bringing the automation in the power hack saw machine. There are some machines which has been already designed, but we have introduced some new components and we also have different design which increases the efficiency of the process.

IX. LITERATUE REVIEW

1. AUTOMATIC BAR FEEDING MECHANISM FOR PIPE CUTTING MACHINE

Shital K.Sharma , Ashish V.Waghmare, Pranit S.Wakhare

Mechanical Engineering Department,G.S.Moze collage of Engineering,Pune,India

Methodology: - This work provides an alternative to the existing automatic PVC pipe cutting machine, in terms of automating the pipe entry into the cutting apparatus, eliminates power fluctuation and lesser initial investment.

Conclusion: -Eliminates power fluctuation. Time consumption is less compared to manual cutting.

2. AUTOMATIC BAR FEEDING AND CUTTING MACHINE

P. B. Patole , N. V. Gawade , A. R. Jagadale, G. A. Bugade , S. R. Bhopale, R. R. Devale, Professor, Mechanical Engineering, BVCOEK, Kolhapur, (India) Students, Mechanical Engineering, BVCOEK, Kolhapur, (India)

Methodology: -Proposed the model of multi way hack- saw machine for the bar of fixed (16 mm) shaft diameter. The bar is feed and cut with the use of PLC controller.

Conclusion: - Eliminates power fluctuation and lesser time consumption

3. AUTOMATIC BAR FEEDING MECHANISM FOR POWER HACKSAW MACHINE

Mr.N.A.Jadhav, Shubham Shinde, Pradip Thorwat ,Mechanical Department, Guru Gobind Singh Polytechnic, Nashik, Maharashtra,(India)

Methodology: - The automation mechanism regulates the MS round robin mechanism using electronic automation equipment. Regular intervals can be regulated by the Member States in the mechanism. The time interval can be set with a keypad connected to the control unit. The control unit controls the motor through the motor controller.

Conclusion: -Requires very less component than conventional machinery.

4. AUTOMATIC CLAMPING AND DECLAMPING USING SENSOR

Mr. Milind D. Dahiwale, Mr. Bhushan.S.Funde , Mr.Amit A. Waskar

Methodology: -Automatic clamping and declamping by using sensor. Job feeding takes place during return stroke of the machine there by reducing the idle time further.

Conclusion: -This project is a low-cost automation project and time consumption is less when compared to manual cutting.

5. DESIGN AND FABRICATION OF AUTOMATIC BAR FEEDING MECHANISM

Artralarasan , Pravin Joseph Rajkumar.S , Sivanesh.M , Selva Arasan.D

Methodology: -Designed a prototype model showing the concept of automated bar cutting machine incorporating the D.C. Motor for the required torque generation.

Conclusion: - This project is simple in construction, compact in size, Less Maintenance is required.

6. AUTOMATIC BAR FEEDING MECHANISM FOR CUTTING MACHINE IN WORKSHOP

Prof B.S.Shingate,Omkar Salunkhe,Aishwarya Kulkarni ,Ashish Deshmukh,Dharmesh Patel.

Methodology: - With this mechanism, they directly feed the bar or tube for cutting. It does not require human effort. a system that may be useful in most applications.

Conclusion: - By this machine the accuracy will increase drastically.

7. DESIGN AND AUTOMATION OF BAR CUTTING MACHINE

Prof G.S.Jagushte, Mayur Lanjekar, Rahul Hatiskar, Prasad Pednekar, Tejas Shinde Dept. Of Mechanical Engineering, RMCET, Ratnagiri, Maharashtra, India.

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Methodology: - The basic idea is to change the manual operation of cutting and holding of raw material on bar cutting machine by automatic feeding and clamping mechanism.

Conclusion: - Machine cuts three bars at time which increases their production and there is no requirement of a worker, once machines starts it works automatically. Machine has various applications in Production industries.

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