

Design And Development of A Multi-Function Machine

Arularasan R¹, Pavankumar A H², Nazar R³, Pradeep S⁴, Rajkumar A⁵

^{1,2,3,4,5} Department of Mechanical Engineering

^{1,2,3,4,5} University College of Engineering Arni

Abstract- This work present the design and development of a Multi-purpose machine with lesser effort to make simultaneous cutting, drilling and grinding of PVC pipes, metals, wood and other work pieces.

The model developed in this work suggests a conversion of rotary motion of crank to reciprocating motion of hacksaw blades, which is done by using Crank Slider Mechanism and using bevel gears, the motion transmitted perpendicularly to driller. Through this model we can operate Hacksaw, Grinding and Drilling at simultaneously. This model make nearly 45% of cost saving and overcome the traditional individual operating machines

Keywords- Bevel Gear, Crank Slider, cutting, drilling, grinding, multi-function

I. INTRODUCTION

There are many industrial needs for the transformation of round rod into a square rod. Also We require many machining operations[1] on different machines to make mass production of different machinery components.

In mass production industries, it is necessary to perform multiple operations with high rate of productivity[2]. They need the improvement in technology and design of conventional machines.

This paper describe the prototype model development of a Multi-Purpose machine which is to perform multi operations simultaneously without any jerk and minimum vibrations.

The Multi-Purpose machine proposed is basically to perform three operations concurrently to conserve machining time and other efforts.

Intended Multi-Purpose machine contain fitted tools viz. hacksaw for cutting material, grinding wheel to ground the material and a driller to drills the material.

This model overcomes the limitations of conventional machines and it can perform operations at a time. It is able to cut different materials at the same time and will be helpful in many industrial needs.

In this model a Slider-crank mechanism is used to transform rotational motion into translational motion by means of a rotating driving beam, a connection rod and a sliding body.

In this case, a flexible body is used for the connection rod. The sliding mass is not allowed to rotate and three revolute joints are used to connect the bodies. While each body has six degrees of freedom in space, the kinematical conditions lead to one degree of freedom for the whole system.

The operation of the unit is simplified to a few simple operations involving a motor, cam mechanism and bevel gears. Different tools for cutting, drilling and grinding machine are selected and fitted to perform operations simultaneously by adopting cam and bevel gear mechanisms. The machine is exclusively intended for mass production and they characterize the faster and more efficient way to machine a material.

We introduce a single machine for multiple operations. The main function of this machine is to perform multiple operations at a time for thin and soft metals by motor power.

- The main objective of this project is to reduce the human effort for machining various materials.
- The basic principles of hacksaw is crank-slider mechanism and driller is bevel gear mechanism.
- The objective of this project is to save man power and time in cutting materials in order to achieve high productivity.

II. WORKING_PRINCIPLE

Our work is to automate and to modify the conventional machine in order to achieve high productivity of

work-pieces than the conventional machine using cam mechanism.

Hence the machine is fabricated with a motorized high speed two way hacksaw machine with drilling and grinding tools.

III. CONSTRUCTIONAL DETAILS

The machine has a rigid frame on which the hacksaw blades, grinder wheel and drilling chuck are mounted. The hacksaw blades are mounted on the two sides of the frame and the grinder wheel connected in the main shaft and driller chuck is connected in the sub-shaft.

The circular cam plate is mounted in the center of the frame which is operated by the main shaft. Connecting rods are used to connect the cam wheel and the hacksaw blades. The cam Mechanism is used to convert the rotary motion into the reciprocating motion.

The Grinder wheel[3] is connected in the main shaft. Whenever the main shaft is rotated, the grinder wheel is rotated. The main shaft is connected to the motor by pulley with V-belt.

when the motor is switched on, the power from the motor is delivered to the pulley. It will transmit the power from pulley to cam disc, grinding wheel and bevel gears.

The work pieces are mounted on the special vice firmly and the entire system is switched on. Thus the two work pieces are cut simultaneously[4] using the motor and the cam mechanism and the work-piece is drilled by driller.

This machine is built with the two hacksaw machines such that all the machines are operated simultaneously with the help of cam mechanism and bevel[5] gears.

All the Two hacksaw blades are connected with the cam in such a way that when the motor is switched on, all the blades receive power[6] and cut the materials according to the requirement.

This model consists a single phase vertical electric motor rigidly placed at the bottom right of metallic frame. The circular disc is mounted on the shaft, the power from the motor is transmitted to disc through the belt and pulley arrangement.

The eccentric point on the plane of disc effects the desired cutting stroke. One end of each connecting rod is pivoted at this eccentric point by the use of suitable bearing.

Another end of each rod is connected to the hacksaw blade frame with the help of universal joint to get vertical and horizontal degrees of Freedom of rotation for the proper cutting operation.

The hacksaw frame slides on the guide ways. When motor is switched-on then the disc start rotating. Rotation of the Disc effect the to the reciprocating motion of hacksaw frame and hence the material is cut which is fixed in the vice.

Bevel gear and the grinding wheel is connected in the same disc-shaft. Grinding wheel simultaneously functions whenever the disc shaft rotates.

To achieve the simultaneous drilling operation, a pinion wheel is engaged perpendicularly with bevel gear. The pinion wheel drives another shaft where the driller chuck is attached. Various Main Parts of Machine include:

- Hack saw
- Cam Disc
- Grinder wheel
- Drill chuck
- Bevel gears

HACK SAW

Figure.1 show the Hacksaw blade which is made of Bi-metallic. In hacksaw like most frame saws, the blade can be mounted with the teeth facing toward or away from the handle, resulting in cutting.



Figure 1. Hacksaw Setup

DRILLING

Figure.2 show the Drilling setup where the process uses a drill bit to cut a hole of circular cross-section in solid

materials. The drill bit is usually a rotary cutting tool, often multipoint. The bit is pressed against the work piece and rotated at rates from hundreds to thousands of revolutions per minute. This forces the cutting edge against the work piece, cutting off chips (swarf) from the hole as it is drilled.



Figure 2. Drilling setup

GRINDING

Figure.3 show the grinding setup that carry an abrasive wheel as the cutting tool. Any grinding machine is a power tool or machine tool that use an abrasive wheel as the cutting tool. Each grain of abrasive on the wheel's surface cuts a small chip from the work piece via shear deformation.

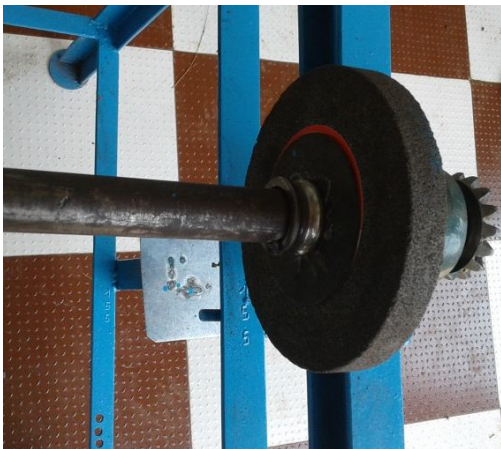


Figure 3. Grinding setup

CAM DISC

Figure.4 show the Cam disc arrangement. Acrylics disc in circular shape help to convert the rotary motion to linear movement



Figure 4. Cam disc arrangement

BEVEL GEARS

Figure.5 show the Bevel gear arranged for the power transmission to effect the drilling operations.

Figure.6 show the Multi-Functional Machine capable of performing simultaneous cutting, drilling and grinding operations.



Figure 5. Bevel Gear arrangement



Figure 6. Multi-Functional Machine

Details of different members in this machine are:

- Base frame height - 65 cm
- Cam disc diameter - 20cm
- Connecting rod length - 30cm
- Hacksaw blade length -30 cm

Centre shaft diameter	- 2cm
Motor capacity	- 0.25
HP Grinding wheel	- 6 inch
Driller bit	- 5 mm

IV. ANALYSIS

Table 1 and Table 2 show the cost incurred while performing the operations over individual machines and on a multi function machine. Large amount about 45% of cost saving is witnessed here while making a comparison of the cost incurred in both the cases and it is highlighting the value of a multi-function machine.

Table 1. Cost Analysis in Conventional Machines

Conventional Machines	
Drill Machine (Apprx.)	= Rs. 2000
Grinding Machine	= Rs. 2000
Cutting Machine	= Rs. 8000
Maintenance	= Rs. 2000
Total cost	= Rs. 14000

Table 2. Cost Analysis in Multipurpose Machine

Multipurpose Machine	
The total cutting, drilling, grinding operations and maintenance cost	= Rs. 7690

V. CONCLUSION

Comparing the time taken for performing the process by this machine with manually, this Multi-Purpose machine reduces the time and perform the process quickly. This Multi-Purpose Machine reduce the human effort and hence we don't need to spend too much time to cut, drill and grind the material logs.

The Conventional Machines cost near to Rs.15000. But this Multi-Purpose Machine cost around to Rs.8000. This Multi-Purpose Machine was designed to cater the needs of small industrial purposes. However with suitable modifications, it can be also be adopted for large industrial applications to achieve high productivity.

REFERENCES

- [1] Prof. Kshirsagar Prashant R en al, "Theoretical Analysis of Multi-Way Power Hacksaw Machine," International Journal of Research in Advent Technology, Vol.3, No.4, April 2015 E-ISSN: 2321-9637
- [2] Rishi Anand, Khomesh, ShrawanKumar, Prof. AlokVerma," Theoretical Analysis Of Four Way Hacksaw Blade Machine", International Journal of Advance Research and Innovative Ideas in Education, eISSN-2395-4396, Vol-2, Issue-2 ,April 2016
- [3] Prof. Nitinchandra R. Patel, Mohammad A. Vasanwala, BalkrushnaB.Jani, Miteshkumar D. Rathwa, Ravi A. Thakkar," Material Selection and Testing of Hacksaw Blade Based on Mechanical properties", International Journal of Innovative Research in Science, Engineering and Technology, ISSN: 2319-8753, volume 2, Issue6, June 2013.
- [4] D.V.Sabarinanda, V.Siddhartha, B. SushilKrishnana, T.Mohanraj , "Design and Fabrication of Automated Hacksaw Machine", International Journal of Innovative Research in Science, Engineering and Tech nology, ISSN (Online):2319-8753, volume 3, April 2014.
- [5] RakeshAmbade,AmitSartabe,MeghrajArekar,VaibhavKha chane,PrajaktaGawali," Design & Fabrication of Human Powered Multi-Purpose Machine", Int. Journal of advanced Technology in Engineering and Science, e-ISSN:2348-7550,Volume No 03,Special Issue No.01, April 2015.
- [6] Kshirsagar Prashant R, Rathod Nayan,,Halaye Prashant P,"Theoretical Analysis of Multi-way Power Hacksaw Machine",Int. Journal of Research in Advent Technology,E-ISSN:2321- 9637,Vol.3,No.4, April 2015.