

Design and Fabrication of Machine to Perform Cutting, Drilling and Grinding Operations

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Abstract— In today's world, there is very high competition in the market. It is very hard to survive in today's market. Everyone is getting better and better day-by-day. So, every industry wants to be successful. Industries want to increase the efficiency and production rate. Also, industry wants to increase quality of the products and to decrease cost & time of the production. Today, every task has been made quicker and faster due to technology advancement but this technology needs high investment and expenditure. In an industry, a considerable portion of investment is being made for machinery installation. So, in this project a machine is proposed which can perform operations like cutting, drilling and grinding at different working centres simultaneously which can be done by using single motor which implies that industrialist have not to pay for each separate machine performing above tasks separately. As the aim of the project is to perform operations such as cutting, drilling and grinding in a single machine, a project work is carried out to fabricate such a machine which is capable of performing all of these operations simultaneously.

Keywords: Drill, Cutting, Single Motor, Efficiency

I. INTRODUCTION

During the survey, various industries have been visited and according to the survey the conclusion made was that for many processes like cutting, drilling and grinding are done on different machines and cost of each machine is higher. Then decision was taken to make a project by which all this kind of operation can be done on a single machine which can be run on a single motor. In search of this project idea, various fabricators and machine shops were visited to get their opinion about this idea. And this project idea was searched in different research papers and reference books after which various ideas were obtained about how to manufacture this project. By visiting various industries and according to the survey for many processes like cutting, drilling and grinding are done on separate machines and cost of each machine is higher. There is a huge need of a machine that would perform all the operations in fabrication, carpentry shop & in other shops, so to the decision was taken to make a project by which all these operations can be done on a single machine which can be run on a single motor. A multitool is that which combines few individual functions in single unit. The advantage of multitools is to save weight and space over a set of individual tools to perform the same functions. Specialized multitools may be used for cutting, drilling and other similar functions. So, machine that would operate tools like drill bit by using gear arrangement that will run on a single-phase motor was proposed. The machine is operated by giving a drive through a motor to the main shaft to which bevel gear

and pinion gear are meshed at 90° to run the various tools to perform their perspective operations.

According to the survey, in different industries there was a lack of a machine which can perform various operations like cutting, drilling, grinding simultaneously at the same time with required speed. So, the decision was taken to make a machine which would perform these operations simultaneously or as per the requirement which would run on a motor with the help of electrical current. The model of multi-purpose machine can be used in different fabrication industries as well as for domestic purpose which can perform mechanical operations like cutting and drilling of a metal sheet or rod or wood.

II. OBJECTIVES OF THE STUDY

Following are the objectives of this research work:

- 1) To fabricate a machine which can perform cutting, drilling, grinding operations simultaneously.
- 2) To fabricate such a machine with more efficiency.
- 3) To reduce production time.
- 4) To perform various operations on thin metallic as well as wooden workpiece.
- 5) To reduce the area required.
- 6) To conserve electricity.

III. LITERATURE REVIEW

Before starting of our work, we have undergone through many research papers. Those research papers were focused on problems faced by the production-based industries. Some research papers provided us the idea of such a machine which may give solution to the problems faced and those papers are as follows:

A. Kumar Penumuru, Dorababu, Suresh, P. Kumar Babu:

This model facilitates to complete three operations simultaneously with a single power source. The machine is useful particularly for small scale industries. The project aims at designing and developing a multipurpose machine tool which is capable of performing multiple tasks simultaneously. The grinding wheel is directly connected to the motor shaft. This model facilitates to complete three operations simultaneously with a single power source.

B. Vikrant R. Kaveri, Dr. D.S. More:

This paper was presented on work named as "DESIGN AND DEVELOPMENT OF MULTI-FUNCTION OPERATING MACHINE TOOL" which is mainly carried out for heavy production-based industries. So, in this paper we have a proposed a machine tool which can perform operations like drilling, grinding, cutting, punching etc. In today's world, every task has been made rapid and faster due to technology

enhancement but this advancement also requires huge investments and expenditure, every industry wants to make high productivity rate maintaining the quality and standard of the product in less cost. In this work, the model of a machine tool which would be capable of performing different operation simultaneously is developed, and it should be economically efficient. The objective behind development of this model is to conserve electricity, reduction in cost increase in productivity, reduced space, reduced production time, reduction of human resources.

C. *Abhilash A.Aher, Prof. Satish D. Shewale:*

This paper was presented on project work of the machine called multi-operational mechanical system mainly carried out for production-based organizations. All industries want high productivity by consuming less time and at minimum cost. The main advantages of this system are that it is easy to rectify the fault and increase the productivity of the system with less input electricity used.

D. *Sharad Srivastava & Shivam Srivastava:*

This paper was presented on the concept of “Multi-Function Operating Machine” mainly carried out for production-based industries. Every industry wants production of useful goods at low production cost, machinery cost and low inventory cost. Now-a-days, all of the tasks have been made faster because use of the latest technologies but this technology demands high investments and expenditure. A conceptual model of a machine is developed which would be capable of performing different operation simultaneously, and it should be economically efficient.

E. *Perumalla Ravi Teja, K. Sudhakar:*

This paper was presented on the project work which was named as “Design and Analysis of Multi-Purpose Power Tools Combination of Drilling, Cutting and 11 Grinding Operations”. Now a day mechanical work is modernized but still we are using separate tools for separate operations this is also time consuming and power consuming because we using separate motors for separate operation so it requires lot of space as well and maintenance. The first requirement was to design a physical model of mechanical tools those were drilling, cutting, grinding. The second requirement was analysis of control the motion of the constructed by method such as following a track which consists of straight lines and curves.

IV. METHODOLOGY



V. RESULTS AND DISCUSSIONS

A. Result for Cutting:

$$\begin{aligned} \text{Cutting Force} &= F \text{ Shear stress} = (\tau_{\max}) = F/A \\ &= F/1570.79 \text{ F} \\ &= 314.55 \text{ N} \end{aligned}$$

$$\begin{aligned} \text{Torque (T)} &= F \times (D-d)/2 \text{ T} \\ &= (314.55 \times 10) \text{ T} \\ &= 31455 \text{ N mm T} \\ &= 3.1455 \text{ Nm} \end{aligned}$$

$$\begin{aligned} \text{Power (P)} &= (2\pi NT) / (60) \text{ P} \\ &= 0.5289 \text{ KW P} \\ &= 0.7090 \text{ HP} \end{aligned}$$

Workpiece Material	Cutting Speed in m/s
Mild Steel	0.75
Cast Iron	0.50
Brass/Aluminium	1.5
Bronze	1.25
Thin section (pipes and tubes)	1.5

B. Result For Drilling:

Ultimate point stress= 400 MPa

Maximum Shear Stress($\tau_{\max}$) = 400/2 = 200 MPa

Thickness of plate: 30 mm (assumed)

Speed of rotation (N) = 900 rpm

Diameter of Drill beat (D) = 8 mm

Area of cross section = (A) = πDT

$$\text{Cutting Force} = F \text{ Shear stress} = (\tau_{\max}) \\ = F/A$$

$$200 = F/(\pi \times 8 \times 30)$$

$$F = 150\text{N}$$

$$\text{Torque (T)} = F \times D/2$$

$$= (150 \times 4) T$$

$$= 600 \text{ N mm}$$

$$T = 0.6 \text{ Nm}$$

$$\text{Power (P)} = (2\pi NT) / (60)$$

$$P = 0.1016 \text{ KW}$$

$$P = 0.1362 \text{ HP}$$

$$\text{Cutting Speed} = (\pi \times \text{Drill Diameter} \times \text{Spindle Speed}) / (1000)$$

$$= (\pi \times d \times n) / (1000)$$

$$= (\pi \times 7 \times 750) / (1000) \dots (n=900\text{-losses})$$

$$= 18.84 \text{ m/min}$$

$$\text{Feed per Revolution} = (\text{Table Feed}) / (\text{Spindle Speed})$$

$$Fr = (10) / (750)$$

$$Fr = 0.013 \text{ mm}$$

C. Result For Drilling:

As in multioperation mechanical system, grinding wheel is fixed to the shaft of dual shaft motor. So, the speed of motor is the speed of grinding wheel so the speed of motor is 800 rpm because of that theoretical speed of grinding wheel is 800 rpm for grinding operation. But using tachometer, the speed of grinding wheel measured as 840 rpm.



Fig. 1: Top View of Fabricated Machine



Fig. 2: Front View of Fabricated Machine

VI. CONCLUSIONS

Based on the study, the following conclusions are drawn:

- While making this project, the main function of multi-purpose and the process of operation of this machine is known. This project is useful in many different industries like not only in fabrication other than that we can use in plumbing machine shop only by changing tools.
- All the production-based industries want low production cost and high work rate which is possible through the utilization of multipurpose machine which will require less power as well as less time, since this machine provides working at different centers it really will reduce the time consumption up to appreciable limit. In an industry a considerable portion of investment is being made for machinery installation. So, in this project, it can be concluded that proposed system which can able to perform operations like drilling, sawing, grinding and polishing at different working centers simultaneously which implies that industrialists have not to pay for machine performing above tasks individually for operating operation simultaneously. This efficiently reduces the size of the system because of the use of dual shaft motor. Due to the combining of systems, maintenance cost of the system also reduces. The main advantages of these 52 systems are that it is easy to rectify the fault and increase the productivity of the system with less input electricity used.

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