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Implementation and Development of Multi-Purpose Mechanical Machine

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***Abstract:** This is paper presents the concept of ''Multi-Purpose Mechanical Machine'' mainly carried out for production based industries. Industries are basically meant for Production of useful goods and services at low production cost, machinery cost and low inventory cost. Today in this world every task have been made quicker and fast due to technology advancement but this advancement also demands huge investments and expenditure, every industry desires to make high productivity rate maintaining the quality and standard of the product at low average cost. So in this project we have a proposed a machine which can perform operations like drilling, cutting, grinding some lathe operations at different working centers simultaneously which implies that industrialist have not to pay for machine performing above tasks individually for operating operation simultaneously. In this machine we are actually giving drive to the main shaft to which a bevel gear is attached, all four shafts have a bevel gear attached to each other to form a differential mechanism, and three of the four operations are both engageable and disengageable.*

***Keyword:** Multipurpose, Power transmission, Concurrent Engineering, FMS (Flexible Manufacturing System), Cutting.*

I. INTRODUCTION

Every industry desire to make high productivity rate maintaining the quality and standard of the product at low average cost .in an industry a considerable portion of investment is being made for machinery installation .so in this project work is propose where a machine is designed which can perform operations like cutting, buffing, milling, and drilling.

Our Research describes the design of a "Multi-Purpose Mechanical Machine" which is based on the concept of concurrent engineering to perform multi-operations such as cutting, drilling, grinding. I have worked on the same project at my college presenting a synopsis showing its basic construction and working. The project work subject is one, in which actually we are learning the theoretical concepts in practical way. Also the practical experience is one of the aim of this subject. For a developing industry these operating performed and the parts or components produced should have its minimum possible production cost, then only the industry runs profitably

II. LITERATURE REVIEW

A. Rakesh S. Ambade, Komal D. Kotrange et.al. "Paddle operated multipurpose machine"

The survey of the literature regarding pedal driven machine are listed: Dharma Chaitanya Kirtikumar was design and develop of multipurpose machine which does not required electricity for several operation like cutting and drilling etc. This is a human power machine runs on chain drive mainly with human effort. But if we wanted to operate this machine by electric power this machine can also does that. This design is ideal for use in the developing world because it does not required electricity and can be build using metal base, pulley, rubber belt, chain, grinding wheel, saw, bearing, foot pedal for operated by human effort.

B. Krishnappa R1 , Venkatesh G2 , et. al . "Motorized multipurpose machine"

Industries are basically meant for Production of useful goods and services at low production cost, machinery cost and low inventory cost . Today in this world every task have been made quicker and fast due to technology advancement but this advancement also demands huge investments and expenditure, every industry desires to make high productivity rate maintaining the quality and standard of the product at low average cost.

C. Dr. Toshimichi Moriwaki (2006) "Multi-function operating machine"

Recent trends in the machine tool technologies are surveyed from the viewpoints of high speed and high performance machine tools, combined multifunctional machine tools, ultra precision machine tools and advanced and intelligent control technologies. Frankfurt-am Main, 10 January 2011. The crisis is over, but selling machinery remains a tough business.

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D. Mr.Gawari Tushar1 , Mr. Gawade Rahul2 , et.al. ' Multi Purpose Machine'

This model of the multi operational machine is may be used in industries and domestic orientation which can perform mechanical operation like drilling , cutting and shaping of a thin metallic as well as wooden model or body. Economics of manufacturing: According to some economists, manufacturing is a wealth-producing sector of an economy, whereas a service sector tends to be wealth-consuming.

E. Heinrich Arnold "The recent history of the machine tool industry and the effects of technological change"

The study establishes a connection between radical technological change, industry structure, and competitive environment. It reveals a number of important occurrences and interrelations that have so far gone unnoticed. The findings are supported by a worldwide qualitative survey in which statements from 59 companies were collected.

F. S. Perumal , T. Manikandan, et.al. "Design and Synthesis of Multipurpose Hand Driller Machine for Various Processes"

The portable driller is made and its advantages and disadvantages are discussed. Its motion characteristics are studied. It is concluded that this mechanism is a good choice to convert rotating motion into reciprocating motion because of fewer moving parts and smoother Operation.

G. Prof. S.S.Lande1, Shrishiel Desai2 et.al. "Design & Development of Multipurpose Machine"

Multipurpose machine we can perform number of operation on single machine. It helps to improve production rate and machining quality. We can see that all the production based industries wanted low production cost and high work rate which is possible through the utilization of multi-function operating machine which will less power as well as less time, since this machine provides working at different center it really reduced the time consumption up to appreciable limit. In an industry a considerable portion of investment is being made for machinery installation. So in this paper we have proposed a machine which can perform operations like drilling, sawing, grinding at different working centers simultaneously which implies that industrialist have not to pay for machine performing above tasks individually for operating operation simultaneously.

H. Frankfurt am Main, "Multi-purpose machines ensure enhanced independence"

The trend towards the kind of multi-purpose machining centers that are able to cost efficiently handle a broad portfolio of products with small batch sizes accelerated significantly during the crisis. "With a multi-purpose machine, you're less dependent on particular products and sectors", explains Biermann. "But there are still going to be specialized machines for large batch numbers." However even when it comes to the classical representatives for large-series production, there is definitely an incipient trend reversal: in the automotive industry.

III. ELEMENTS OF PROJECT

1) *Drilling:* A drill is a tool fitted with a cutting tool attachment, usually a drill bit used for drilling holes in various materials. The attachment is gripped by a chuck at one end of the drill and rotated while pressed against the target material. The tip of the cutting tool does the work of cutting into the target material. Drills are commonly used in woodworking, metalworking and construction. Specially designed drills are also used in medicine, space missions and other applications. Drills are available with a wide variety of performance characteristics.



Fig 1: Drill bits

2) *Cutter:* Cutting is used to machine flat metal surfaces especially where a large amount of metal has to be removed. Other machines such as milling machines are much more expensive and are more suited to removing smaller amounts of metal, very accurately. The reciprocating motion of the mechanism inside the cutting machine can be seen in the diagram. As the disc rotates the top of the machine moves forwards and backwards, pushing a cutting tool. The cutting tool removes the metal from work which is carefully bolted down. The shaping machine is a simple and yet extremely effective machine. It is used to remove material, usually metals such as steel or aluminium, to produce a flat surface.



Fig 2 cutting

3) *Frame:* The frame of setup for the Multi-Operational Machine consist of four ends inclined at certain position to transmit power from AC motor connected to shaft at one end having Scotch Yoke Mechanism such that the power to another parallel shaft is transmitted via chain sprocket system (time driving chain) having drill chuck fitted with drill bit at one end and grinding wheel at other end for the other two operations to be performed under single workstation. The frame is made up of mild steel which holds the mainframe of the project such that to minimize the vibrations and oscillations during it working operation ,all the four ends of the frame is clamped at fixed position by means of mechanical clamps.

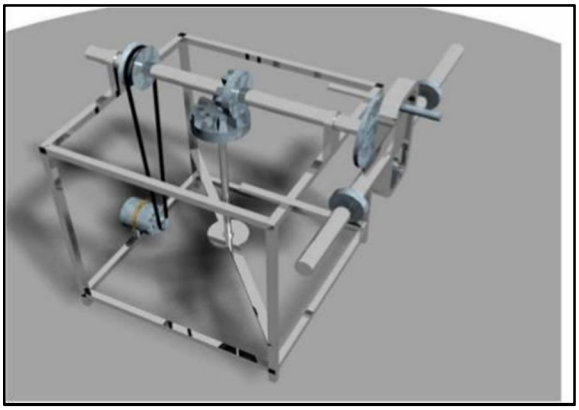

Fig 3 Frame

4) *Bearings:* A bearing is a device to permit constrained relative motion between two parts, typically rotation or linear movement. Bearings may be classified broadly according to the motions they allow and according to their principle of operation. Low friction bearings are often important for efficiency, to reduce wear and to facilitate high speeds. Essentially, a bearing can reduce friction by virtue of its shape, by its material, or by introducing and containing a fluid between surfaces. By shape, gains advantage usually by using spheres or rollers. By material, exploits the nature of the bearing material used. Sliding bearings, usually called bushes journal bearings, sleeve bearings, rifle bearings or plain bearings. Rolling-element bearings such as ball bearings and roller bearings are used for this purpose. In this project roller ball bearing such as bearing no: - (SKF-6294) is used for this purpose.

5) *A.C. Motor:* An AC motor is an electric motor driven by an alternating current (AC). The AC motor commonly consists of two basic parts, an outside stator having coils supplied with alternating current to produce a rotating magnetic field, and an inside rotor attached to the output shaft producing a second rotating magnetic field. The rotor magnetic field may be produced by permanent magnets, reluctance saliency, or DC or AC electrical windings.

6) *Shaft:* A shaft is a rotating machine element, usually circular in cross section, which is used to transmit power from one part to another, or from a machine which produces power to a machine which absorbs power. The various members such as pulley & belt and bearings are mounted on it. The material used for ordinary shafts is mild steel. When high strength is required, an alloy steel such as nickel, nickel-chromium or chromium-vanadium steel is used. Shafts are generally formed by hot rolling and finished to size by cold drawing or turning and grinding.



Fig. 4 Shaft

7) *Belt and Pulley:* A belt is a loop of flexible material used to link two or more rotating shafts mechanically, most often parallel. Belts may be used as a source of motion, to transmit power efficiently or to track relative movement. Belts are looped over pulleys and may have a twist between the pulleys, and the shafts need not be parallel. In a two-pulley system, the belt can either drive the pulleys normally in one direction, or the belt may be crossed, so that the direction of the driven shaft is reversed As a source of motion, a conveyor belt is one application where the belt is adapted to carry a load continuously between two points. Belts are the cheapest utility for power transmission between shafts that may not be axially aligned. Power transmission is achieved by specially designed belts and pulleys. The demands on a belt-drive transmission system are huge, and this has led to many variations on the theme. They run smoothly and with little noise, and cushion motor and bearings against load changes, albeit with less strength than gears or chains.



Fig. 5 Belt and pulley

8) *Gears:* Bevel gears are used as the main mechanism for a hand drill. As the handle of the drill is turned in a vertical direction, the bevel gears change the rotation of the chuck to a horizontal ratio. Bevel gears are gears where the axes of the two shafts intersect and the tooth- bearing faces of the gears themselves are conically shaped. Bevel gears are most often mounted on shafts that are 90 degrees apart, but can be designed to work at other angles as well. The pitch surface of bevel gears is a cone.



Fig. 6 Gears.

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9) *Buffing:* Buffing is defined as a finishing process that involves the use of a loose abrasive on a wheel. To polish a work piece, a manufacturing company may use a wheel that's covered with an abrasive disc. Generally, the wheels used in the buffing process are made up of cloth or the fiber which is charged with loose abrasive grains. The buffing belts are made in the same way as wheels. A very fine abrasive is used for being charged to these wheels or belts and charging is generally done by using sticks made up of abrasive or/and wax.



Fig. 7 Buffing wheel.

10) *Milling:* Milling is the process of machining using rotary cutters to remove material by advancing a cutter into a work piece. This may be done varying direction on one or several axes, cutter head speed, and pressure. Milling covers a wide variety of different operations and machines, on scales from small individual parts to large, heavy-duty gang milling operations. It is one of the most commonly used processes for machining custom parts to precise tolerances.

IV. METHODOLOGY

Power is transmitted through the motor to the shafts with the help of belt and pulley mechanism, this helps is transferring the power of the motor to the shafts. The shafts are held on to the frame with the help of pedestal bearings which are bolted to the frame. Then on one end of the shaft a gear is fixed and on the other end an operation is fixed. The gears are set in such a way that they face each other at 90° forming a differential type system where power can be distributed four ways equally. Bevel gears are used in this condition and they are strong and rigid and can work in dry condition as well. Splines are ridges or teeth on a drive shaft that matches with grooves in a mating piece and transfer torque to it, maintaining the angular correspondence between them. For instance, a gear mounted on a shaft might use a male spline on the shaft that matches the female spline on the gear. The splines on the pictured drive shaft match with the female splines in the center of the clutch plate, while the smooth tip of the axle is supported in the pilot bearing in the flywheel. An alternative to splines is a keyway and key, though splines provide a longer fatigue life, and can carry significantly greater torques for the size.

V. OPERATIONS PERFORMED

A. Drilling
B. Cutting
C. Milling
D. Buffing

VI. PROPOSED PROJECT FIGURE

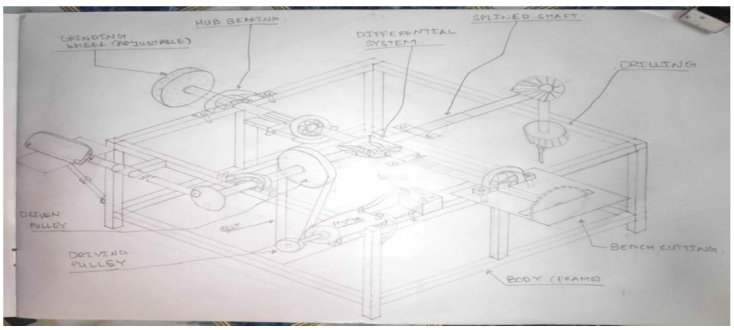

Fig. 8 Design and Fabrication of Multipurpose Mechanical Machine

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VII. FINAL DESIGN OF PROJECT



Fig. 9 Final Design of Multipurpose Mechanical Machine.

VIII. SPECIFICATIONS OF COMPONENTS

1) Frame of the model: length=2.5 ft., width=2.5 ft., height=3.5 ft.
2) Shaft dia. =20 mm (main.), shaft length=360 mm
3) Bush Dia.= 25mm outer, 16mm inner, 2mm splined
4) Roller bearings of inside dia. =20 mm and 25 mm
5) Roller bearing no:- SKF 6294
6) Shaft is also of mild steel.
7) Frame is also made of mild steel
8) Belt length= 4.5 ft., Pulley dia.=3”
9) Drill bit length=6mm
10) Cutting wheel dia.=110mm.
11) Centre to centre dist. Of pulley and shaft=48cm.
12) Speed of motor = 1440 rpm, 0.5 H.P.
13) Torque transmitted = 2455.5 N.mm

IX. RESULT

1) Performing operation on more than one Job at a time.
2) Performing multiple operation in one cycle.
3) Indexing capability to sequence operation one after another.
4) Easy operation and attachments.
5) Easy to install and use anywhere.
6) Easy to operate.
7) Low maintenance cost.
8) Simple in construction.

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X. ADVANTAGES AND APPLICATION

A. *Advantages*

1) Machine cost is minimum.
2) More than one work at a time.
3) Five operation work at a time in machine.
4) Maintenance cost is low.
5) Easy to assemble.
6) Simple in operation.
7) No need of skill operator.
8) All operation is performing by only in one motor.

B. *Applications*

1) This machine can be used in Steel industry.
2) It can be used in workshop.
3) It can be used for multiple operations in workshop.
4) It can be used in welding shop.
5) It can be used in part manufacturing work.

XI. CONCLUSION

We can see that all the production based industries wanted low production cost and high work rate which is possible through the utilization of multi-function operating machine which will less power as well as less time, since this machine provides working at different centre it really reduced the time consumption up to appreciable limit. In an industry a considerable portion of investment is being made for machinery installation. So in this paper we have proposed a machine which can perform operations like drilling, cutting, grinding at different working centres simultaneously which implies that industrialist have not to pay for machine performing above tasks individually for operating operation simultaneously.

XII. FUTURE SCOPE

A. Other operations can also be incorporated in to the machine
B. The machine can be made more portable
C. Cost can also be reduced to some extent by manufacturing it on a mass scale.
D. Regulator can also be incorporated onto the AC motor to regulate the speed of moving motor (varying speed of motor).

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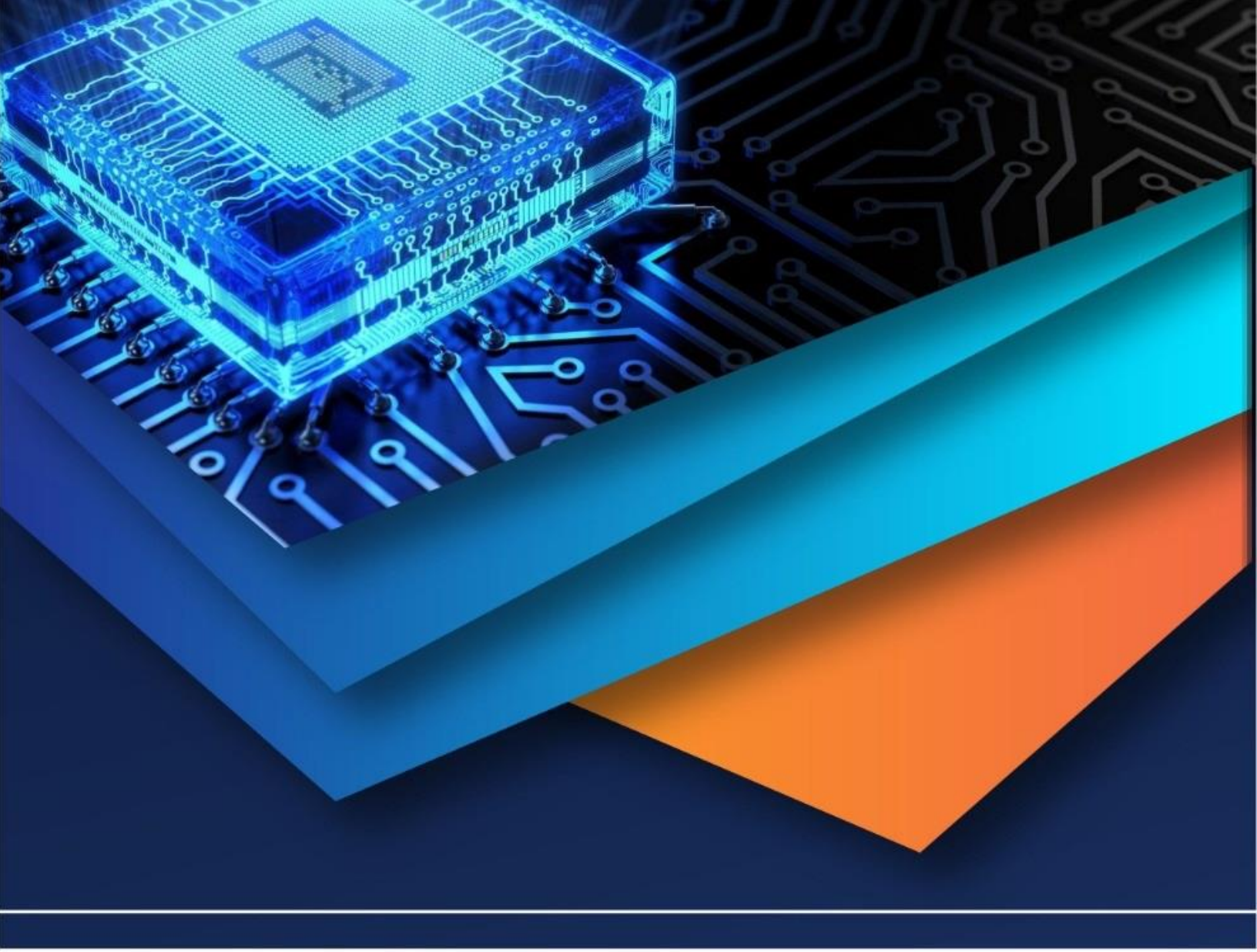

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