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Implementation and Development of Multi-Purpose Mechanical Machine

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Abstract: **This 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 centres 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 scotch yoke mechanism is directly attached, scotch yoke mechanism is used for cutting operation. On the main shaft power is transmitted by chain-sprocket mechanism to the other shaft such that one end consist of drill chuck having drill bit for drilling operation and at one end consist of an abrasive grinding wheel for the purpose of surface finishing & grinding operations such that it resembles working as concurrent engineering technology of FMS.**

Keywords: Scotch Yoke Mechanism, Power transmission (Chain & Sprocket), Concurrent Engineering, FMS (Flexible Manufacturing System)

1. INTRODUCTION

My 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 &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.

2. ELEMENTS OF THE PROJECT

2.1 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: Types of drill bit

2.2 Cutting

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 mechanism (Hacksaw blades)

2.3 Grinding

A grinding wheel is a wheel composed of an abrasive compound and used for various grinding (abrasive cutting) and abrasive machining operations. Such wheels are used in machines. The wheels are generally made from a composite material consisting of coarse-particle aggregate

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pressed and bonded together by a cementing matrix (called the bond in grinding wheel terminology) to form a solid, circular shape of a grinding wheel arrangement.

Fig 3: Grinding Wheel

2.4 Scotch Yoke Mechanism

The Scotch yoke is a mechanism for converting the linear motion of a slider into rotational motion or vice-versa. The piston or other reciprocating part is directly coupled to a sliding yoke with a slot that engages a pin on the rotating part. The shape of the motion of the piston is a pure sine wave over time given a constant rotational speed. The Rotary motion of drilling operation performed is also used for performing other tasks like cutting and grinding simultaneously. The work pieces are to be clamped on the work table using suitable clamping device like vice for the three operations.After machining the work pieces are to be removed and cleaned.

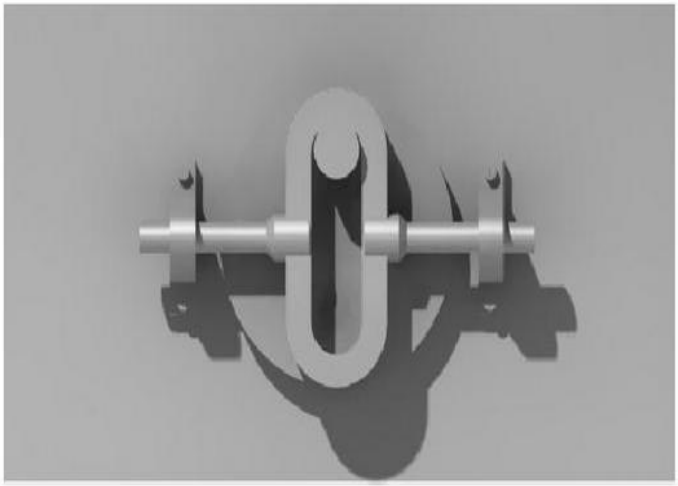

Fig 4: Scotch Yoke Mechanism

2.5 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 minimise 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 5: Frame

2.6 Bearing

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.

Fig6: Bearing no (SKF-6294)

2.7 AC 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.

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Fig 7: AC (alternating current) motor

2.8 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 chain (timing chain) & sprocket 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 8: Shaft (Mild Steel)

2.9 Timing chain &Sprocket (Power Transmission)

The power transmission in the setup provided by AC motor is transferred or transmitted to other shafts having drill chuck and grinding wheel at both the ends by means of timing chain & sprocket mechanism to rotate shafts, such that it performs multiple mechanical operations.Timing Chain drive is a way of transmitting mechanical power from one place to another. Most often, the power is conveyed by a roller chain, known as the **drive** chain or transmission chain, passing over a sprocket gear, with the teeth of the gear meshing with the holes in the links of the chain. The gear is turned, and this pulls the chain putting mechanical force into the system.

Fig 9: Timing chain & Sprocket

2.10 Vice

It is a device consisting of two parallel jaws for holding a work piece; one of the jaws is fixed and the other movableby a screw, a lever, or a cam. When used for holding a work piece during hand operations, such as filing, hammering, or sawing, the vice may be permanently bolted to a bench. In vices designed to hold metallic work pieces, the active faces of the jaws are hardened steel plates, often piece; to prevent damage to soft parts, the permanent jaws can be covered with temporary jaws made from sheet removable, with serrations that grip the work copper or leather.

Fig 10: Vice job holder

3. PROPOSED METHODOLOGY

In this project we will generally give the power supply to the shaft such that the AC motor is connected at one end of the shaft and consistScotch Yoke Mechanism at one end to carry out the cutting operation.At one end of the shaft is connected to power supply, other end is being joined to a circular disc, through this circular disc Scotch Yoke Mechanism is being performed (rotating motion is

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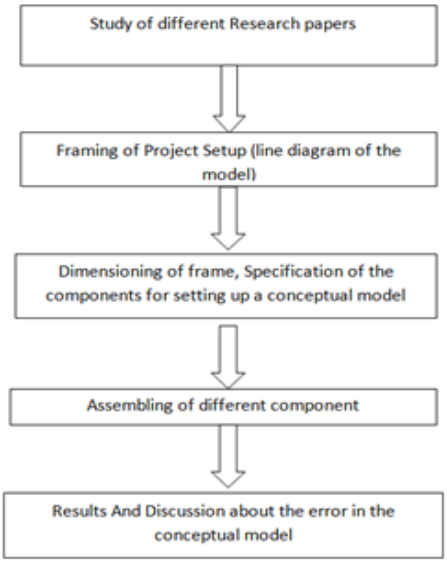
converted into reciprocating motion).Such that the parallel shaft consist of drilling chuck having drill bit and grinding wheel at other end for grinding operations and power is transmitted from AC motor source to parallel shaft by means of timing chain and sprocket drive system.



4. EXPERIMENTAL SET-UP

Left side view

Front view

Fig11: Experimental set-up of the working project

In this conceptual model we have involved the timing chain and sprocket drive mechanism for power transmission at different working-stations.

5. WORKING PRINCIPLE

5.1 Scotch Yoke Mechanism

It is a simple mechanism, the rotary motion of pin convert into linear motion. First, the power supplied to be connected in AC motor, when the shaft to start in rotation moment, now the crank rotate the pin slider inside of yoke part and also move in forward direction. When the Crank will be rotate in clockwise direction and yoke will be getting displacement moment at forward. The maximum displacement of yoke depends upon the length of crank. The crank is completed the clockwise Revolution at the same time the Yoke sliding completely moved in forward. When this position takes more time to start return stroke, after some time, the crank will be rotate in continuously it to be come back in initial position of rotation. So the Yoke move in backward direction and come back for initial position. Therefore the crank has full Revolution to be completed, at the same time the Yoke will be complete the forward and backward movement of Sliding. By means of the full revolution of Crank, the Yoke will be sliding through equal of double length of Crank. The Yoke displacement can be controlled by varying of crank length.

Fig 12: Scotch Yoke Mechanism

5.2 POWER TRANSMISSION (TIMING CHAIN AND SPROCKET SYSTEM)

A sprocket is a toothed wheel that fits onto a shaft. It is prevented from rotating on the shaft by a key that fits into keyways in the sprocket and shaft.A chain is used to connect two sprockets. One sprocket is the driver sprocket. The other sprocket is the driven sprocket. Motion and force can be transmitted via the chain from one sprocket to another, therefore from one shaft to another. Chains that are used to transmit motion and force from one sprocket to another are called power transmission chains.

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Fig 13: Power transmission through chain and sprocket (drive system)

6. MAINTAINANCE & LUBRICATION

Many bearings require periodic maintenance to prevent premature failure, although some such as fluid or magnetic bearings may require little maintenance. Most bearings in high cycle operations need periodic lubrication and cleaning, and may require adjustment to minimize the effects of wear. Bearing life is often much better when the bearing is kept clean and well-lubricated. However, many applications make good maintenance difficult. For example bearings in the conveyor of a rock crusher are exposed continually to hard abrasive particles. Cleaning is of little use because cleaning is expensive, yet the bearing is contaminated again as soon as the conveyor resumes operation. Thus, a good maintenance program might lubricate the bearings frequently but never clean them.

7. ADVANTAGE AND DISADVANTAGE

It also has following demerits

- ✓ Multi operations can be performed at the same time.
- ✓ Size is compact therefore it requires less space.
- ✓ Low manufacturing & maintenance cost.
- ✓ Easy machinery used.

It also has following demerits

- ✓ Without human effort it's not operated.
- ✓ Not fit for heavy production.

8. SPECIFICATION OF THE COMPONENTS

I. Frame of the model: length=2.5 ft., width=2.5 ft., height=3.5 ft.
II. Shaft dia. =10 mm (approx.), shaft length=2.5ft
III. Roller bearings of inside dia. =9.5 mm
IV. Roller bearing no:- SKF 6294
V. Shaft is also of mild steel.
VI. Frame is also made of mild steel
VII. AC motor rotates at 1440 rpm and has a power capacity of 0.75 HP
VIII. Chain length= 1.5 ft., Sprocket dia=50 mm
IX. Drill bit length=6mm
X. Grinding wheel dia=60mm
XI. Operation can be performed are: sawing/cutting, drilling, and grinding.

9. 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, sawing, grinding at different working centres simultaneously which implies that industrialist have not to pay for machine performing above tasks individually for operating operation simultaneously.The scotch yoke mechanism 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. It can be used in direct injection engines like diesel engines, hot air engines. In this project report we provide an overview of the issues concerning different aspects of multipurpose machine using scotch yoke mechanism. The paper focused on the principle of scotch yoke mechanism, type of tooling and machining parameters and process performance measure, which include cutting speed, depth of cut, material removal rate with different type of equipment which can be run simultaneously and fabricate the work piece in multipurpose machine has been presented. The presented results can help to plan the machining of work piece with expected tolerance.

10. FUTURE SCOPE

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

REFERENCE

[1] Heinrich Arnold1"The recent history of the machine tool industry and the effects of technological change "University of Munich, Institute for Innovation Research and Technology Management, November 2001.
[2] Dr. Toshimichi Moriwaki "Trends in Recent Machine Tool Technologies" Professor Department f Mechanical Engineering Kobe University ,NTN Technical Review No.74(2006).
[3] T. Moriwaki "Multi-functional machine tool" ,Department of Industrial and Systems Engineering, Setsunan University, Neyagawa, Japan CIRP Annals - Manufacturing Technology DOI:10.1016/j.cirp.2008.09.004 .
[4] Frankfurt am Main "Multi-purpose machines ensure enhanced ", 1 January 11.
[5] "Selecting and Planning the Process of Manufacture: Dr. Pulak M.Pandey. http://paniit.iitd.ac.in/~pmpandey.