Multi-Functional Operating Machine

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Abstract— This paper presents the concept of Multi-Function Operating Machine mainly carried out for production-based industries. Industries are 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. We have developed a conceptual model of a machine, which would be capable of performing different operation simultaneously, and it should be economically efficient .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 sawing operation. On the main shaft we have use bevel gear system for power transmission at two locations. Through bevel gear we will give drive to drilling centre and grinding centre. The model facilitate us to get the operation performed at different working centre simultaneously as it is getting drive from single power source. Objective of this model are conservation of electricity (power supply), reduction in cost associated with power usage, increase in productivity, reduced floor space.

Key words: Drilling Tools, Belts Pulley, Shaper

I. INTRODUCTION

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

In an industry a considerable portion of investment is being made for machinery installation. So in this paper we have a proposed a machine which can perform operations like drilling, sawing, shaping, 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.

Economics of manufacturing: According to some economists, manufacturing is a wealth-producing sector of an economy, whereas a service sector tends to be rrwealth consuming. Emerging technologies have provided some new growth in advanced manufacturing employment opportunities in the Manufacturing Belt in the United States. Manufacturing provides important material support for national infrastructure and for national defense.

II. LITERATURE REVIEW

Before starting our work we have undergone through many research papers which indicates that for a production based industries machine installation is a tricky task as many factor being associated with it such as power consumption (electricity bill per machine), maintenance cost, no of units produced per machine i.e. capacity of machine, time consumption and many more….

Some research papers which have led us to approach to the idea of a machine which may give solution to all these factors are as follows:

Heinrich Arnold1 November 2001: Rather long re-investment cycles of about 15 years have created the notion that innovation in the machine tool industry happens incrementally. But looking at its recent history, the integration of digital controls technology and computers into machine tools have hit the industry in three waves of technology shocks. Most companies underestimated the impact of this new technology. This article gives an overview of the history of the machine tool industry since numerical controls were invented and introduced and analyzes the disruptive character of this new technology on the market. About 100 interviews were conducted with decision-makers and industry experts who witnessed the development of the industry over the last forty years. 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.

Dr. Toshimichi Moriwaki (2006): 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. Machine tools nowadays have to be veritable “jack of all trades”, able to handle all kinds of materials, to manage without any process materials as far as possible, and be capable of adapting to new job profiles with maximized flexibility. Two highly respected experts on machining and forming from Dortmund and Chemnitz report on what’s in store for machine tool manufacturers and users.

Multi-purpose machines are the declarations of independence.

A. *Need Identification*

Now a days carpenter workers are using more than one machine to perform the various operations. It requires more floor areas and the cost of installation of all machines is high. In the present work, we are planning to design and fabricate a machine that performs many operations. This in turn reduces the overall cost and usage of different machines.

B. Problem Definition

It is required to design and build a mechanism so that all the operations (i.e., cutting, planning, drilling, and forming) can be carried out in a single machine.

- Operating time must be low.
- Minimization of machine cost.

C. Aim and Objective of Work:

The aim of our project is to design and development of MULTI PURPOSE MECHANICAL MACHINE, a structured that is designed for the purpose of MULTI-Operations. They are as follows:

1) DRILLING,
2) CUTTING,
3) GRINDING
4) SHAPING.

D. Proposed Methodology

In this project, we will generally give the power supply to the shaft on which a bevel gear is mounted on it, and a second bevel gear at a right angle to it has been mounted on a drill shaft to which a drill bit is being attached. 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 (rotator y motion is converted to reciprocating motion).

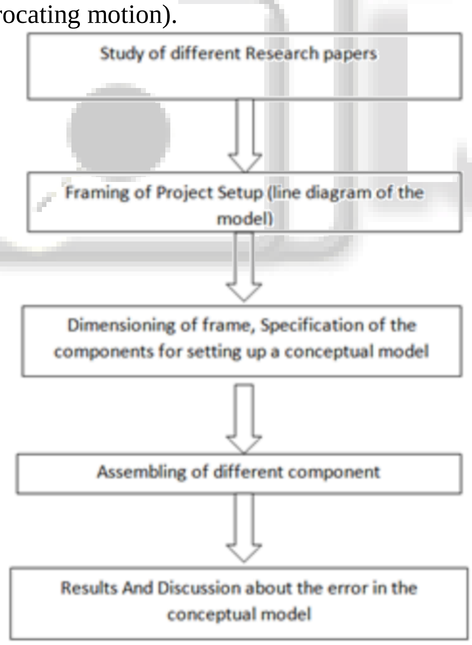

Fig. 1: Proposed Methodology

III. IMPLEMENTATION, WORKING PRINCIPLE & OPERATION

A. Reason to Design Machine

The reason to design a multipurpose mechanical machine because there is no machine which perform various operation(i.e. drilling, cutting, shaping & grinding) at same time with required speed & this machine is automatic which is controlled or operated by motor which is run with the help of current. This machine is based on the mechanism of whit worth return and belt drive. This model of the multi operational machine is may be used in industries and domestic operation which can perform mechanical operation like drilling, cutting &shaping of a thin metallic as well as wooden model or body.

In this conceptual model we have involved the gear arrangement for power transmission at different working centers, basically gear or cogwheel is a rotating machine part having cut teeth, or cogs, which mesh with another toothed part in order to transmit torque, in most cases with teeth on the one gear being of identical shape, and often also with that shape on the other gear. Two or more gears working in tandem are called a transmission, can produce a mechanical advantage through a gear ratio, and thus may be considered a simple machine. Geared devices can change the speed, torque, and direction of a power source. The most common situation is for a gear to mesh with another gear; however, a gear can also mesh with a non-rotating toothed part, called a rack, thereby producing translation instead of rotation.

B. Working Principle of Machine

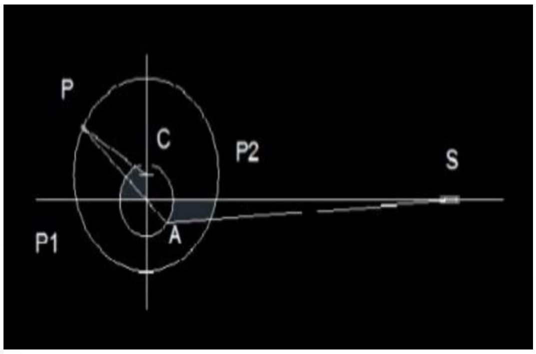

Fig. 2: Whitworth's Quick Return Mechanism

There are only three major principles on which this proposed model generally works.

1) Whitworth's quick return mechanism
2) Power transmission through belt drive
3) Eccentric-and-rod mechanism

The above diagram shows the mechanism as used on the apparatus. Link 1 on the top diagram is extended to point A. attach to point A is another link with pivot. The other end of this link terminated in a slider. In a machine tool where this mechanism is used the cutting tool is attached to this slider.

The link POA rotates about an O. The mechanism is driven by crank PC that rotates at about C with constant velocity. The slider at P slides along POA as the crank is turned. Its path is shown by the dashed circle, centered on C and through P. Clearly, when P is at P1 the slider S is at the outer extremity of its travel .When P is at P2 the slider S is at the inner extremity of its travel.

Now as PC rotates with constant velocity the time taken to go from P1 to P2 is less than that taken to go from P2 to P1. However, during both those time intervals the slider as moving the same distance. Therefore, the speed of S is different during the different parts of cycle. During the shorter time intervals P1 to P2 the slider as has the greater speed and during the interval P2 to P1it has slower speed. Thus P1 to P2 is quick return and P2 to P1.

When applied to metal cutting machine the other advantage is variable power distribution during the cycle. When S is on the return stroke the slider at P is nearer to O and simple moment's shows that the torque applied is low.

Hence, the return stroke uses less power as P=T. w. During the cutting stroke, the slider at P is at greater radius from O and thus more power is available to perform useful work in cutting metal.

Thus, the overall performance is to provide high power forward cutting stroke with a low power and higher speed quick returning preparation for the next cut. Power Transmission through belts

Belts are the cheapest utility for power transmission between shafts that may not be axially aligned. Specially designed belts and pulleys achieve power transmission. The demands on a belt-drive transmission system are large, 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. However, improvements in belt engineering allow use of belts in systems that only formerly allowed chains or gears.

C. Types of Bely Drive

1) Flat Belt
2) V Belts
3) Timing Belt
4) Round Belt Flat Belt Drive

Flat belts were widely used in the 19th and early 20th centuries in line shafting to transmit power in factories. They were also used in countless farming, mining, and logging applications, such as bucksaws, sawmills, threshers, water pumps (for wells, mines,), and electrical generators. Flat belts are still used today, although not nearly as much as in the line-shaft era. The flat belt is a simple system of power transmission that was well suited for its day. Flat belts were traditionally made of leather or fabric.

Today most are made of rubber or synthetic polymers. Grip of leather belts is often better if they are assembled with the hair side (outer side) of the leather against the pulley, although some belts are instead given a half-twist before joining the ends, so that wear can be evenly distributed on both sides of the belt. Belts ends are joined by lacing the ends together with leather thronging (the oldest of the methods), steel comb fasteners and/or lacing, or by gluing or welding (in the case of polyurethane or polyester). Flat belts were traditionally jointed, and still usually are, but they can also be made with endless construction

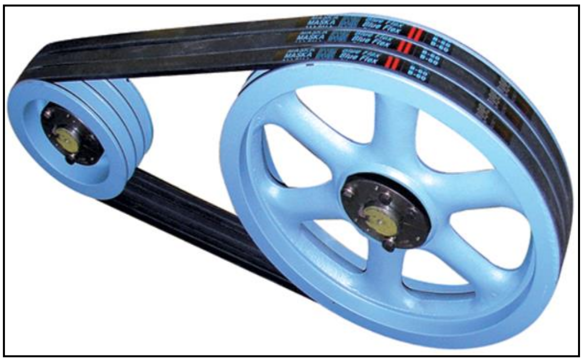

Fig. 3: Belts Pulley

D. Eccentric-and-rod Mechanism

Eccentric-and-rod mechanism, arrangement of mechanical parts used to obtain a reciprocating straight-line motion from a rotating shaft; it serves the same purpose as a slider-crank mechanism and is particularly useful when the required stroke of the reciprocating motion is small in comparison with the dimensions of the driving shaft.

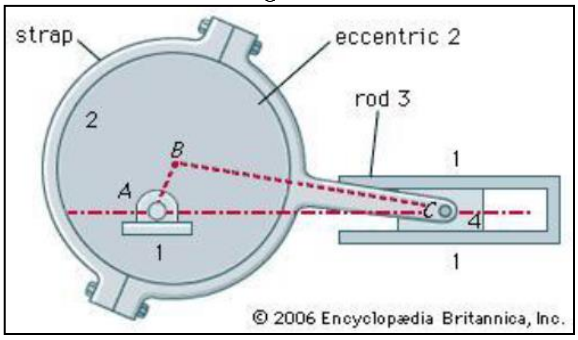

Fig. 4: Eccentric-and-rod Mechanism

In the figure, the eccentric disk 2 is fixed off center to the rotating shaft at A and has an eccentricity AB. The strap and rod 3 consist of two pieces clamped together in a sliding fit in a groove on the periphery of the disk. The rod is connected to the piston 4 within a housing 1.As the eccentric rotates with the shaft, it slides inside the strap, and the piston 4 moves on a straight path of length 2AB. AB is equivalent to the crankshaft and BC is equivalent to the connecting rod of a slider-crank mechanism.

Because an eccentric can be attached anywhere along a shaft it is unnecessary to form any part of the shaft into a crank. Eccentrics are seldom used to transmit large forces because friction loss would be high; they are commonly used to drive the valve gears of engines.

IV. OPERATION OF MACHINE OPERATION PERFORMS BY MACHINE

1) DRILLING
2) SHAPING
3) CUTTING
4) GRINDING

Drilling is the operation of producing circular hole in the work-piece by using a rotating cutter called DRILL.

The machine used for drilling is called drilling machine.

The drilling operation can also be accomplished in lathe, in which the drill is held in tailstock and the chuck holds the work.

The most common drill used is the twist drill.

A. Drilling Machine

It is the simplest and accurate machine used in production shop.

The work piece is held stationary ice. Clamped in position and the drill rotates to make a hole.

B. Drilling Bit

Drill bits are cutting tools used to create cylindrical holes. Bits are held in a tool called a drill, which rotates them and provides torque and axial force to create the hole. Specialized bits are also available for non-cylindrical-shaped holes. Drill bits come in standard sizes, described in the drill bit sizes article. A comprehensive drill and tap size chart lists metric and imperial sized drills alongside the required screw tap sizes. The term drill can refer to a drilling machine, or can refer to a drill bit for use in a drilling machine.

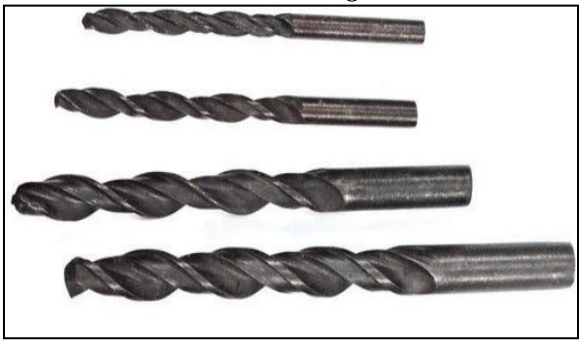

Fig. 5: Drilling tools

C. Components of Drilling Machine

1) Spindle:

The spindle holds the drill or cutting tools and revolves in a fixed position in a sleeve.

2) Sleeve:

The sleeve or quill assembly does not revolve but may slide in its bearing in a direction parallel to its axis. When the sleeve carrying the spindle with a cutting tool is lowered, the cutting tool is fed into the work: and when it is moved upward, the cutting tool is withdrawn from the work. Feed pressure applied to the sleeve by hand or power causes the revolving drill to cut its way into the work a fraction of an mm per revolution.

3) Column:

The column is cylindrical in shape and built rugged and solid. The column supports the head and the sleeve or quill assembly.

4) Head:

The head of the drilling machine is composed of the sleeve, a spindle, an electric motor and feed mechanism. The head is bolted to the column.

5) Worktable:

The worktable is supported on an arm mounted to the column. The worktables can be adjusted vertically to accommodate different heights of work or it can be swung completely out of the way. It may be tilted up to 90 degree in either direction, to allow long pieces to be end or angle drilled.

6) Base:

The base of the drilling machine supports the entire machine and when bolted to the floor, provides for vibration-free operation and best machining accuracy. The top of the base is similar to the worktable and may be equipped with t- slot for mounting work too large for the table.

7) Hand Feed:

The hand- feed drilling machines are the simplest and most common type of drilling machines in use today. These are light duty machine that are operated by the operator, using a feed handled, so that the operator is able to "feel" the action of the cutting tool as it cuts through the work piece. These drilling machines can be bench or floor mounted.

8) Power feed:

The power feed drilling machine are usually larger and heavier than the hand feed ones they are equipped with the ability to feed the cutting tool in to the work automatically duty worker the work that uses large drills that require power feed larger work pieces are usually clamped directly to the table or base using t –bolts and clamps by a small work places are held in a vice. Adept –stop mechanism is located on the head, near the spindle, to aid in drilling to a precise depth.

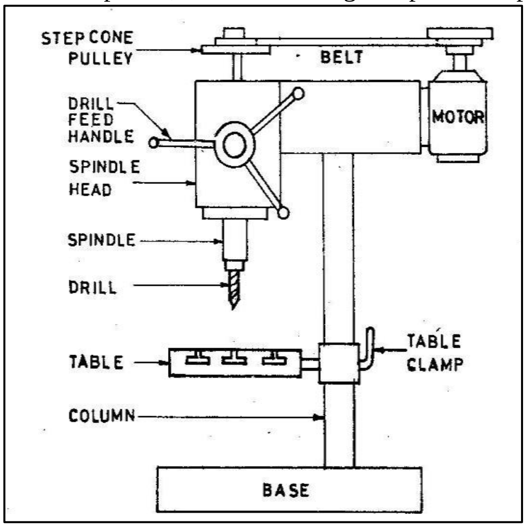

Fig. 6: Drilling Machine

D. Shaping

The shaping machine 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 shaping 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 aluminum, to produce a flat surface. However, it can also be used to manufacture gears such as rack and pinion systems and other complex shapes. Inside its shell/casing is a crank and slider mechanism that pushes the cutting tool forward and returns it to its original position. This motion is continuous

E. Types of Shaper

Shapers are mainly classified as standard, draw-cut, horizontal, universal, vertical, geared, crank, hydraulic, contour and traveling head. The horizontal arrangement is the most common. Vertical shapers are generally fitted with a rotary table to enable curved surfaces to be machined (same idea as in helical planning). The vertical shaper is essentially the same thing as a slotter (slotting machine), although technically a distinction can be made if one defines a true vertical shaper as a machine whose slide can be moved from the vertical. A slotted is fixed in the vertical plane. Cutting a hacksaw is a fine-tooth saw with a blade held under tension in a frame, used for cutting materials such as metal or plastics. Hand-held hacksaws consist of a metal arch with a handle, usually a pistol grip, with pins for attaching a narrow disposable blade. A screw or other mechanism is used to put the thin blade under tension. The blade can be mounted with the teeth facing toward or away from the handle, resulting in cutting action on either the push or pull stroke. On the push stroke, the arch will flex slightly, decreasing the tension on the blade. Blades are available in standardized lengths, usually 10 or 12 inches for a standard hand hacksaw. "Junior" hacksaws are half this size. Powered hacksaws may use large blades in a range of sizes, or small machines may use the same hand blades

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

Various profiles and cross sections are available depending on the intended usage for the wheel. They may also be made from a solid steel or aluminium's disc with particles bonded to the surface. Today most grinding wheels are artificial composites made with artificial aggregates, but the history of grinding wheels began with natural composite stones, such as those used for millstones

F. Types of Grinding Wheel:

1) Cup wheel A cup wheel as pictured to the right is predominantly used in Tool and Cutter grinders where orientation of the wheel and a slim profile are required. These wheels are used (and dressed) on the side face and have the advantage of producing a truly flat surface on the side of lathe tools. They are used in jig grinders to produce flat surfaces or counter bores.
2) Straight wheel these are by far the most common style of wheel and can be found on bench or pedestal grinders. They are used on the periphery only and therefore produce a slightly concave surface (hollow ground) on the part. This can be used to advantage on many tools such a chisels.
3) Diamond wheel: Diamond wheels are grinding wheels with industrial diamonds bonded to the periphery. They are used for grinding extremely hard materials such as carbide tips, gemstones or concrete. The saw pictured to the right is a slitting saw and is designed for slicing hard materials, typically gemstones.

V. DESIGN AND METHODOLOGY

A. Final Assembly

Fig. 7: Final Assembly

VI. ADVANTAGES / DISADVANTAGES

A. Advantages

Multi operations are performed at one time.
All operation is performed by only one motor.
The return stroke of shaper machine is utilized as cutting operation.
Time saving.
Less man power is required.
Size is compact therefore it requires less space.
Low manufacturing & maintenance cost.

B. Disadvantages

Not fit for heavy production.
Without human effort it's not operated.
Limited availability cannot be used for parallel shafts, can become noisy at high speeds.

REFERENCES

[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] Frankfurt am Main "Multi-purpose machines ensure enhanced ", 1 January 11.
[4] 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.
[5] "Selecting and Planning the Process of Manufacture: Dr. Pulak M. Pandey. http://paniit.iitd.ac.in/~pmpandey

