

Design and Fabrication of Multi-Spindle Machine

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Abstract

The growth of Indian manufacturing sector depends largely on its productivity & quality. Productivity depends upon many factors, one of the major factors being manufacturing efficiency with which the operation /activities are carried out in the organization. Productivity can be improved by reducing the total machining time, combining the operations etc. In case of mass production where variety of jobs is less and quantity to be produced is huge, it is very essential to produce the job at a faster rate. This is not possible if we carry out the production by using general purpose machines. The best way to improve the production rate (productivity) along with quality is by use of special purpose machine. Usefulness and performance of the existing radial Multi-spindle machine will be increased by designing and manufacturing of Multi-spindle head attachment. This paper deals with design and development of Multi-spindle head for cycle time optimization of the component.

Keywords: Performance of the existing radial Multi-spindle machine will be increased by designing and manufacturing of Multi-spindle

I. INTRODUCTION

Multiple-spindle machines are used for mass production, a great time saver where many pieces of jobs having many operations can be carried out. Multi-spindle head machines are used in mechanical industry in order to increase the productivity of machining systems. The multiple spindle machines is a production type of machine. It is used to perform the different operation in a work piece simultaneously, in one setting.

This machine has four spindles driven by a single motor and all the spindles are fed in to the work piece alternately.

Feeding motions are obtained either by raising the work table or by lowering the drills head. The center distance between the spindles can be adjusted in any position as required by the different jobs.

For adjusting the center distance between the spindles they are connected to the main spindle by bevel gear joint. In mass production work drill jigs are used for guiding the drills in the work piece so as to achieve accurate results.

In today's market the customer demands the product of right quality, right quantity, right cost, & at right time. Therefore it is necessary to improve productivity as well as quality. One way to achieve this is by using multi spindle machine.

II. LITERATURE REVIEW

Dr. Toshimichi Moriwaki[1] :-Multi Function Operating Machine : A Conceptual Model (www.iosrjournals.org)

Dr. Toshimichi Moriwaki :-Recent trends in the machine tool technologies are surveyed from the viewpoints of high speed and high performance machine tools, combined multi-functional machine tools, ultra precision machine tools and advanced and intelligent control technologies.

Frankfur-tam 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.

S.G.Bahaley, Dr. A.U. Awate, S.V. Saharkar[2]:-Designed and fabricated a pedal powered multipurpose machine. It is a human powered machine which is developed for lifting the water to a height 10 meter and generates 14 Volt, 4 ampere of electricity in most effective way. Power required for pedaling is well below the capacity of an average healthy human being. The system is also useful for the work out purpose because pedaling will act as a health exercise and also doing a useful work.

III. IDENTIFIED GAPS IN LITERATURE

The objectives of this experiment are to investigate the performance of transmission of motion by bevel gear box and verify the rpm of all spindles.

IV. PROBLEM FORMULATION

To design & fabrication of Multi-purpose machine a structured which is designed for the purpose of multi- operations i.e DRILLING, COUNTER BORING, BORING, BUFFING.

The machine perform multi-purpose operation alternately one by one with require same speed and this machine is controlled or operated by motor which is run with the help of current .this machine is based on the mechanisms of transmission of rotary motion through the bevel gearbox.

This model of the operational machine is may be used in industries and domestic operatic which perform mechanical operation like drilling, tapping, counter boring and buffing etc on metal as well as wooden block.

V. OBJECTIVE

This experiment is to investigate the performance of transmission of motion by bevel gear box and verify the rpm of all spindles. In the conventional manner only one job can be worked at a time for either of the above operations, but with increase in productivity demands a special purpose device or attachment is need which will increase productivity by,

- Performing operation on more than one job at a time.
- Performing multiple operations in one cycle.
- Indexing capability to sequence operation one after another.

The Multi-tool drilling attachment is an ideal solution to the above problem where in the conventional drilling machine is used to perform three operations at a time, so also different operations like drilling, reaming, countersinking or spot facing can be done simultaneously. The multi-spindle drilling attachment is easy to mount on the drilling machine, where in the MT-2 taper arbor directly fits into the Drilling machine sleeve; if necessary a support sleeve can be attached to the top casing plate for extra stability. In the multi-spindle drilling attachment three Spindles are driven simultaneously which carry three drill chucks. The drill chucks can receive twist drills, reamers, countersink drills or spot facing cutters to perform the desired operation.

- Design of conceptual trailer which would help in loading and unloading of bricks with much ease with the assistance of mechanical machine mounted on the trailer.
- Design a frame with some mechanical movement which would assist in the movement of the hoist mounted on it.
- The hoist can slide on the guide rail along the length of truck.
- It can also move perpendicular to it on sliding rail.
- The hoist can be manually operated which is electrically or pneumatically driven and may use chain, fiber or wire ropes as its lifting medium.

VI. WORKING PRINCIPLE

A Multi tool operation machine will do the number of operation alternately in a work piece. Multi tool head machines are employed for work of a light character, especially repetition work, such as drilling small components for the Automobile and Aircraft industries. A Multi tool operation machine has a number of tool heads driven by a single motor. All the tool heads holding the tools are fed in to the work piece alternately as per requirement. For this purpose, either the drill heads can be lowered onto the work piece or the work table is raised. The Main eccentric is driven by the machine tool head which is driven by a single motor. The several drill holding eccentrics are driven by the main Eccentric through a Revolving plate. Eccentric is a mechanism which is usually used to convert rotary motion into sliding motion. It shall be noted that a bevel gear arrangement transfer the rotary motion of the main tool head into to the four cross tool head, the pillars provided for solid base to avoid the vibration.

In this model when the motor will start the power from the motor is transmitted to the driving pulley the driven pulley is connected to the driving pulley by means of V belt. V-belt is used when the distance between to pulley is small. The power from the motor is transmitted to the driving pulley and then to the driven pulley through the v belt. Now when the motor will start, the driving pulley will rotate and then driven pulley will also rotate with it. One shaft is placed between a hallow horizontal pipe this shaft is connected to driven pulley and fixed to the internal plate at one end and other end of this shaft to the internal plate.

In this internal plate one plate is fixed and other is movable when the shaft will rotate this movable plate is also rotate. During operation this movable plate is fixed by means of nut and bolt. When we want to changed operation we will remove the nut and bolt and move the plate. When move the plate the chuck or spindle move in clock wise or anticlockwise direction with plate and hence we can perform another operation.

When the power will transmit from motor to the shaft, it is then transmit to the main bevel gear box. The four small bevel gears is arrange in such a way that, when the main bevel gear will rotate this small bevel gear will also rotate with it by meshing with each other. Now, when this gear box arrangement will rotate, the all four small spindle or chuck will rotate because this four spindle is connected to the four small bevel gears. The four tool is place on spindle so that we can preformed four operation like drilling, boring, counter boring, buffing.

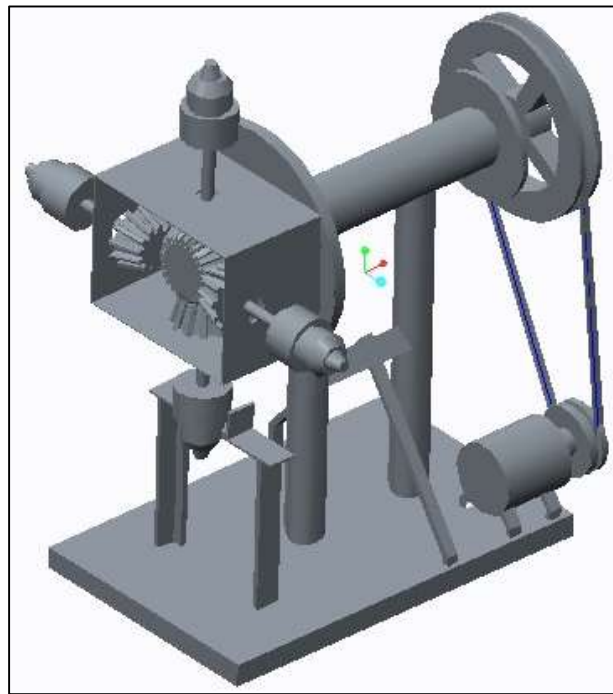


Fig. 1.1: Cad Model of Multi Spindle Machine



Fig. 1.2: Fabrication Model of Multi Spindle Machine

A. Drilling Process

Drilling is a cutting process that 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 workpiece 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.

In rock drilling, the hole is usually not made through a circular cutting motion, though the bit is usually rotated. Instead, the hole is usually made by hammering a drill bit into the hole with quickly repeated short movements. The hammering action can be performed from outside of the hole (top-hammer drill) or within the hole (down-the-hole drill, DTH). Drills used for horizontal drilling are called drifter drills.

In rare cases, specially-shaped bits are used to cut holes of non-circular cross-section; a square cross-section is possible. Drilling is a cutting process that uses a drill bit to cut a hole of circular cross-section in solid materials. The drill bit is 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.



Fig. 1.3: Drilling Operation

B. Buffing Process

Buffing are finishing processes for smoothing a work piece's surface using an abrasive and a work wheel or a leather strop. Technically polishing refers to processes that use an abrasive that is glued to the work wheel, while buffing uses a loose abrasive applied to the work wheel. Polishing is a more aggressive process while buffing is less harsh, which leads to a smoother, brighter finish. A common misconception is that a polished surface has a mirror bright finish, however most mirror bright finishes are actually buffed.

Polishing is often used to enhance the looks of an item, prevent contamination of instruments, remove oxidation, create a reflective surface, or prevent corrosion in pipes. In metallography and metallurgy, polishing is used to create a flat, defect-free surface for examination of a metal's microstructure under a microscope. Silicon-based polishing pads or a diamond solution can be used in the polishing process. Polishing stainless steel can also increase the sanitary benefits of stainless steel.

The removal of oxidization (tarnish) from metal objects is accomplished using a metal polish or tarnish remover; this is also called polishing. To prevent further unwanted oxidization, polished metal surfaces may be coated with wax, oil, or lacquer. This is of particular concern for copper alloy products such as brass and bronze.

The term chem-mechanical was coined to describe action of corrosive slurry on silicon in a polishing process. Multiple rotating heads, each studded with silicon wafers, get forced against a large rotating buffing pad, which is bathed in corrosive slurry. Material removal at elevated temperature progresses first through oxidation, then through oxide removal by abrasion. This cycle repeats with each rotation of a head. Potassium hydroxide and Silox (white paint-base) can be combined with deionized water to form such slurry.



Fig. 1.4: Buffing Operation

C. Boring Process

In machining, boring is the process of enlarging a hole that has already been drilled (or cast), by means of a single-point cutting tool (or of a boring head containing several such tools), for example as in boring a gun barrel or an engine cylinder. Boring is used to achieve greater accuracy of the diameter of a hole, and can be used to cut a tapered hole. Boring can be viewed as the internal-diameter counterpart to turning, which cuts external diameters. There are various types of boring. The boring bar may be supported on both ends (which only works if the existing hole is a through hole), or it may be supported at one end (which works

for both through holes and blind holes). Line boring (line boring, line-boring) implies the former. Back boring (back boring, back-boring) is the process of reaching through an existing hole and then boring on the "back" side of the work piece (relative to the machine headstock).

Because of the limitations on tooling design imposed by the fact that the work piece mostly surrounds the tool, boring is inherently somewhat more challenging than turning, in terms of decreased tool holding rigidity, increased clearance angle requirements (limiting the amount of support that can be given to the cutting edge), and difficulty of inspection of the resulting surface (size, form, surface roughness). These are the reasons why boring is viewed as an area of machining practice in its own right, separate from turning, with its own tips, tricks, challenges, and body of expertise, despite the fact that they are in some ways identical. Boring is used to achieve greater accuracy of the diameter of a hole, and can be used to cut a tapered hole. Boring can be viewed as the internal-diameter counterpart to turning, which cuts external diameters. A Multi tool operation machine has a number of tool heads driven by a single motor. All the tool heads holding the tools are fed in to the work piece alternately as per requirement.

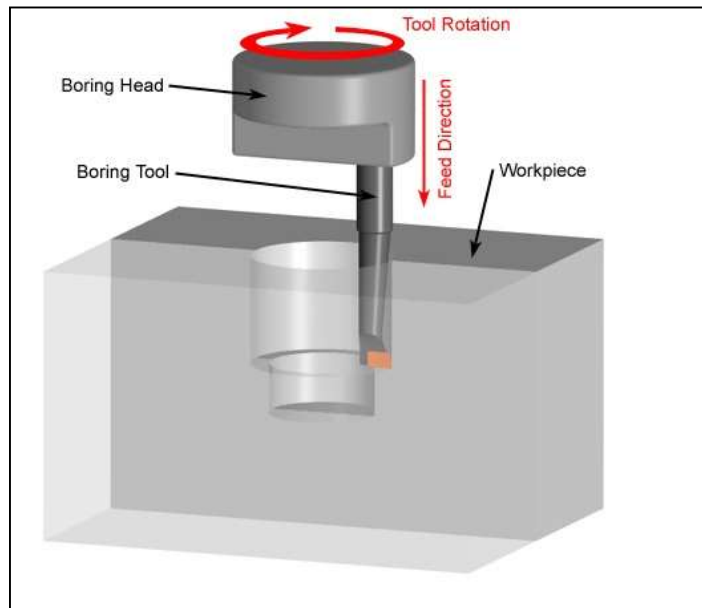


Fig. 1.5: BORING OPERATION

D. Counter Boring Process

A counterbore is a cylindrical flat-bottomed hole that enlarges another coaxial hole, or the tool used to create that feature. A counterbore hole is typically used when a fastener, such as a socket head cap screw, is required to sit flush with or below the level of a work piece's surface.

Whereas a counter bore is a flat-bottomed enlargement of a smaller coaxial hole, a countersink is a conical enlargement of such. A spot face often takes the form of a very shallow counter bore.

As mentioned above, the cutters that produce counter bores are often also called counter bores; sometimes, to avoid ambiguity, the term counter bore cutter is used instead.



Fig. 1.6: Counter Boring Operation

VII. RESULT

- Performing operation on more than one job at a time.
- Performing multiple operation in one cycle.
- Indexing capability to sequence operation one after another.
- Easy operation and attachments.
- Easy to install and use anywhere.
- It improves the environmental condition.
- Easy to operate.
- Robust in design.
- Low maintenance.
- Simple in construction.

VIII. CONCLUSION

Using Multi-tool Drilling Attachment, increase productivity at low cost and in less time. Also with the help of our equipment, reduce the cycles of operations. Although these multiple spindle drilling attachment performs basic drilling Operations, there are some specific functions that are performed more accurately and conveniently by each of these types. For enhancement and fast production an Index-able drill jig can be mounted-on the drill machine table.

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. It requires 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, boring, buffing, counter boring at different working centers simultaneously which implies that industrialist have not to pay for machine performing above tasks individually, since this machine will perform different operation simultaneously This machine can be used in remote places where electricity is irregular or insufficient. It can be used for light duty cutting and drilling operations of plywood. also the grinding operation can be used to sharp the tools edges as well as to remove extra materials Its working can be done in less floor space. Unskilled lab-our can also handle it efficiently because of this we can reduce the cost of production which is the most important factor in production industry.

- Multipurpose machine is derived from turning lathe which has been a well-established industrial processes offering attractive capabilities for handling work piece of various length to be used at micro level.
- We have presented the development of multipurpose machine in various modes by which it can be actively adopted.
- We have explained the various parts and components of multipurpose machine using scotch yoke mechanism.
- Different types of attachments and tools which can be implemented on multi-purpose machine have been discussed.

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REFERENCES

- [1] M.Takalwe and V.R. Naik, "Design & manufacturing of Multi spindle drilling head (msdh) for its cycle time optimization (Vol03, Issue01; January-pril2012) International Journal of Mechanical Engineering applications Research- IJMEAR.
- [2] Dharwa Chaithanya Kirthikumar, "A Research on Multi-Purpose Machine", International Journal for Technological Research in Engineering (Vol.1, Issue.1, ISSN: 2347-4718) (2013).
- [3] S.G.Bahaley, Dr.A.U.Awate, S.V.Saharkar, "Performance Analysis of Pedal Powered Multipurpose Machine", International Journal of Engineering Research and Development (IJERD) (Vol.1, Issue.5, eISSN:2278-0181) (2012).
- [4] Linxu, Weinan Bai, Jingyu Ru, Qiang Li, "Design and Implementation of the Reciprocating Pedal Powered Electricity Generating Device", Advanced Materials Research (Vol.282-283 (2011) pp 735-738.
- [5] Heinrich Arnold "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.
- [6] Dr. Toshimichi Moriwaki "Trends in Recent Machine Tool Technologies" Professor Department of Mechanical Engineering Kobe University, NTN Technical Review No.74(2006).
- [7] 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.
- [8] Frankfurt am Main "Multi-purpose machines ensure enhanced", 1 January 11.
- [9] "Selecting and Planning the Process of Manufacture: Dr. Pulak M.Pandey.
- [10] "M.D.-P.S.G.(Sixth Edition)" Tata McGraw Hill Education Private Limited".