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STUDY OF MULTI-TASKING MACHINE

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ABSTRACT

Special purpose machine is part of multi-tasking machine. This is new approach to increase the productivity of organization. If we compare between ordinary machine and special purpose machine in terms of time, costs, number of steps involved, etc. The multi-tasking machine is preferred choice.SPM is higher degree mechanism in which human participation is replaced by mechanical, electrical, fluid power technologies capable of doing physical effort and even mental work as in case of CNC machines. In some simultaneous SPM also demands accurate sensing, recall, memory storage, physical effort or movements requires special sensors for controlling the technologies processes.

I. PROJECT BACKGROUND

Special purpose machine is part of multi-tasking machine. This is new approach to increase the productivity of organization. If we compare between ordinary machine and special purpose machine in terms of time, costs, number of steps involved, etc. The multi-tasking machine is preferred choice.SPM is higher degree mechanism in which human participation is replaced by mechanical, electrical, fluid power technologies capable of doing physical effort and even mental work as in case of CNC machines. In some simultaneous SPM also demands accurate sensing, recall, memory storage, physical effort or movements requires special sensors for controlling the technologies process.

1. 2 Objectives

- To study the current method of operation.
- To design the Special Purpose Machine for various operations such as Drilling, Boring, Reaming, Taping etc.
- To improve repeatability and accuracy
- To improve the productivity.
- Less rejection due to automatic controls.

2.1 Drilling

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 work is held by the chuck.
- The most common drill used is the twist drill.

2.1.1 Drilling Machine

- It is the simplest and accurate machine used in production shop.
- The work piece is held stationary i.e. Clamped in position and the drill rotates to make a hole.

Types of Drilling Machine

A) Based on construction

- Portable,
- Sensitive,
- Radial,
- Up-right,
- Gang,
- Multi-spindle

B) Based on Feed

- Hand driven
- Power driven

2.1.2 Components of drilling machine

A) Spindle

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

B) 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's 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.

C) Column

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

D) 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.

E) Worktable

The worktable is supported on an arm mounted to the column. The worktable 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.

F) 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 larger for the table.

G) 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.

H) 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, at preset depth of cut per revolution of the spindle these machines are used in maintenance for medium duty work or 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 vise. A depth –stop mechanism is located on the head, near the spindle, to aid in drilling to a precise depth.

2.1.3 Drill Materials

The two most common types are

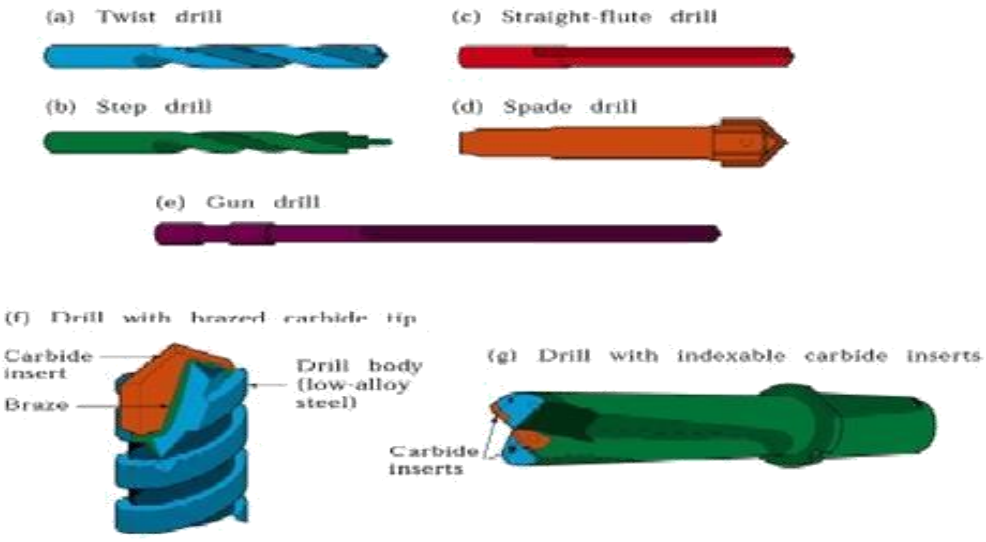
1. HSS drill

- Low cost

2. Carbide- tipped drills

- High production and in CNC machines

Other type's are-



S

olid Carbide drill, Tin coated drills, carbide coated masonry drills, parabolic drills, split point drill. Fig. shows various types of drills on next page.

Fig.2.1.3 various types of drill

2.1.4 Drill fixed to the spindle

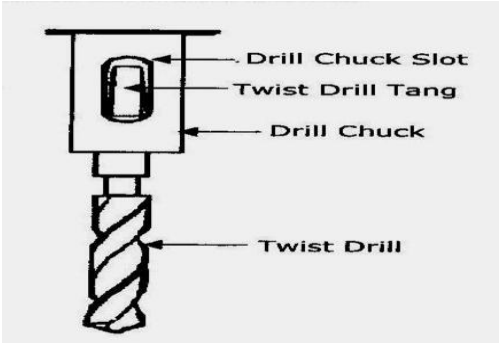


Fig.2.1.4 Drill fixed to a spindle

2.1.5 Tool Nomenclature

The typical nomenclature of the Drilling tool is shown below.

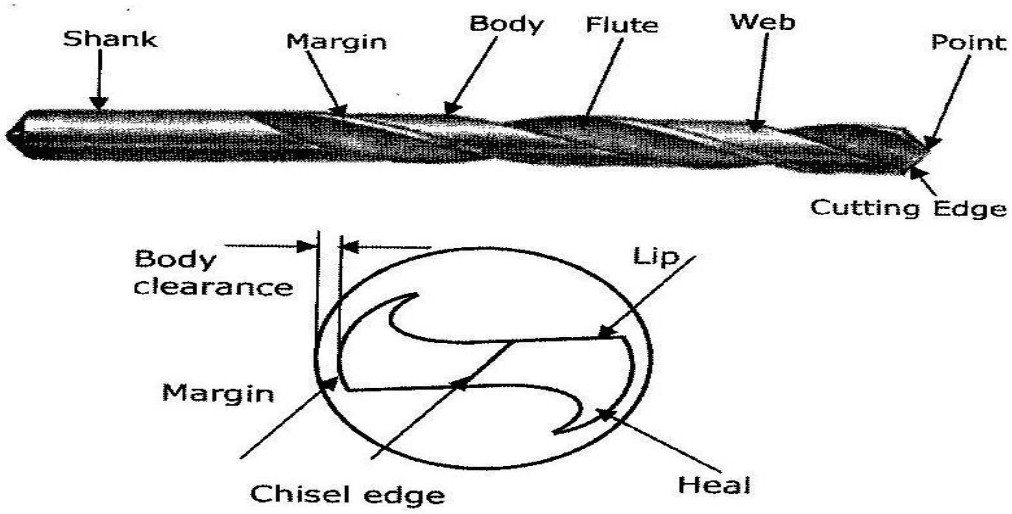


Fig.2.1.5 Nomenclature of twist drill

2.1.6 Radial Drilling Machine

- It the largest and most versatile used for drilling medium to large and heavy work pieces.
- Radial drilling machine belong to power feed type.
- The column and radial drilling machine supports the radial arm, drill head and motor. Fig.3 shows the line sketch of radial drilling machine.

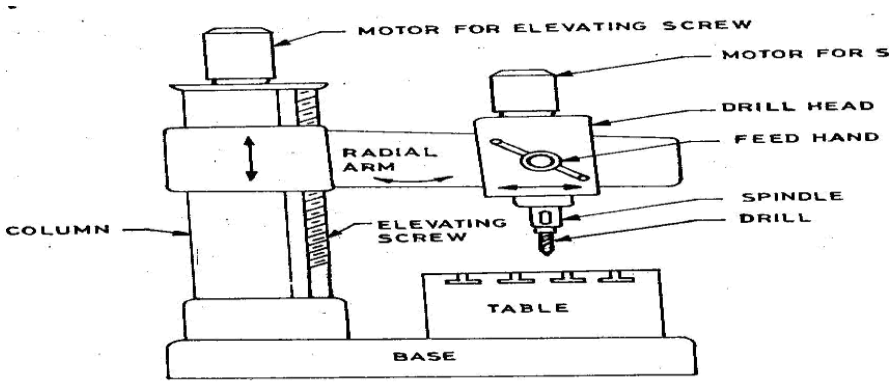


Fig.2.1.6 Radial Drilling Machine

- The radial arm slides up and down on the column with the help of elevating screw provided on the side of the column, which is driven by a motor.
- The drill head is mounted on the radial arm and moves on the guide ways provided the radial arm can also be swiveled around the column.
- The drill head is equipped with a separate motor to drive the spindle, which carries the drill bit. A drill head may be moved on the arm manually or by power.
- Feed can be either manual or automatic with reversal mechanism.

2.2 Tapping

Today most of the industries are trying to make improvement in their production processes as well as relevant machinery to improve the productivity along with the Automation. Tapping is one such operation which is most frequently used in small and large scale industries. Thread tapping is the method to produce the fine thread inside the drilled hole on the plate. Most of the industries uses the conventional method says hand tapping. This conventional method is very time consuming process, less accurate and includes higher labor cost, and ultimately leads to less productivity. So there is a scope to develop the machine for tapping operation which would overcome all the problems faced by the conventional process. So we are going to develop the pneumatics tapping machine which will make the use of compressed air for it operation without human involvement as which is used in hand tapping. Now days the hand operated machines are replaced with the application of automation in automatic or semi automatic machines which utilized to improve the productivity. Tapping may either be achieved by hand tapping by using a set of taps first tap, second tap & final (finish) tap. Machine tapping is a process to produce the female threads inside the drilled hole. Machine tapping is faster and generally more accurate because human error is eliminated. Final tapping is achieved with single tap. Although in general machine tapping is more accurate, tapping operations have traditionally been very tricky to execute due to frequent tap breakage and inconsistent quality of tapping.

Machine tapping can be performed by electric drives and the problems concerned with the machine tapping can be eliminated with the application of pneumatic tapping machine. In industries there are frequent needs for fine internal thread tapping. Huge and complicated designed parts cannot be machined with the help of conventional tapping operation and increasing the area required for them to be accommodated and hence overall initial cost required.

2.2.1 Conventional Tapping Process

Fig. 2.2.1 Conventional Tapping Process

2.2.2 Different types of Tap

Fig.2.2.2 Tapping tools

Tapping is cutting a thread in a drilled hole. Tapping is accomplished on the drilling machine by selecting and drilling the tap drill size, then using the drilling machine chuck to hold and align the tap while it is turned by hand. The drilling machine is not a tapping machine, so it should not be used to power tap. To avoid Breaking taps, ensure the tap aligns with the center axis of the hole, keep tap flutes clean to avoid jamming, and clean chips out of the bottom of the hole before attempting to tap.

2.2.3 Tapping Large Holes

One method of hand tapping is to mount an adjustable tap and reamer wrench on the square shank of the tap and install a pointed tool with a center in the drilling machine spindle. The tap is placed in the drilled hole and the tool's center point is placed in the center hole. The tap is held steady, without forcing, by keeping light pressure on it with the hand feed lever of the drilling machine, while turning the wrench and causing the tap to cut into the hole.

2.2.4 Tapping Small Holes

Another method of hand tapping, without power, is to connect the tap directly into the geared drill chuck of the drilling machine and then turn the drill chuck by hand, while applying light pressure on the tap with the hand feed lever. This method works well on small hand-feed drilling machines when using taps smaller than 1/2-inch diameter.

2.2.5 Tapping on Radial Drilling Machine

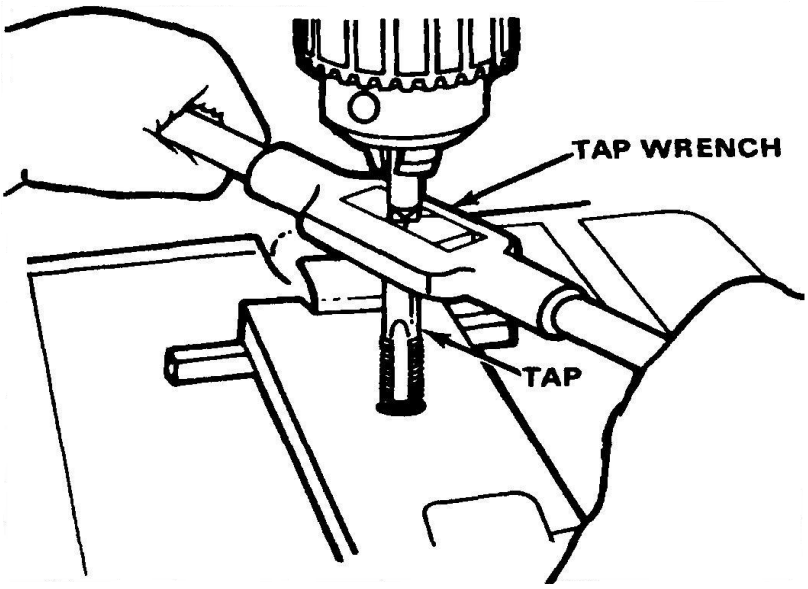


Fig.2.2.5 Tapping with Radial Drilling Machine

2.2.6 Case Study of Tapping

Mukesh Shantilal Patel, in 1982, has studied on An Improved Tapping attachment and/ or tap holding device, the principle object of the is innovation is to provide tapping attachment or tool holder with the clutch of the design which act readily thereby eliminating axial thrust right from the machine spindle up to the job, and thereby eliminating not only the tap breakage but also damage to any part of the equipment and further objective of the innovations to provide tapping attachment or tool holder with the clutch of the design which act very smooth and thereby keeps the heat generation during its operation, at a very low level to achieve greater stability to set the spring pressure on clutch and higher functional efficiency[1]. Shigeo Kasai, in 1983, has worked on Tapping Machine, it is the type in which the work piece is automatically positioned, has a releasable connection of the work table and carriage with means for horizontally moving the work table and the means horizontally moving the carriage, so that the work table and carriage may realised for manual operation.

The tapping machine also has means for detecting the position of the carriage and means for detecting excessive thrust from the work piece. In addition, the tapping machine may be provides means for detecting the position of the worktable and controlled devices memory connected with the means for positioning the worktable so that when the worktable manually position, the manual position may be entered and recorded in memory of the control device.

The tapping machine may thus be programmed so that multi variety small volume tapping is efficiently performed [2]. Russel Bruerton, in 2013, has worked on, Short Tapping machine, A drilling or tapping machine includes a housing having a front end through which a drill mounting stub projects; a drill shaft having an inner drill tube carrying a splined bush at a rear thereof and carrying the drill mounting stub at a front thereof, a support tube coaxial with the drill tube, having front and rear bearing nuts mounting the support tube on the drill tube for relative rotation; a spline shaft extending from rear to front through the drill tube, and slid ably engaged within the splined bush whereby rotation thereof rotates the drill tube; a moving plate fixed to the rear bearing nut and moveable axially relative to the spline shaft, the moving plate engaging the drill tube to axially move the drill tube relative to the housing; a first drive rotating the spline shaft; and a second drive causing the moving plate to move axially[3]. Prof. P.R. Sawant, Mr. R. A. Barawade, in 2012, has study, a case study in multi drilling and tapping machine, This paper discuss the case study and comparison of productivity of component using conventional radial drilling machine and special purpose machine(SPM) for drilling and tapping operation. In this case study, the SPM used for 8 multi drilling operation (7 of Ø6.75 and Ø12), linear tapping operation of Ø12 and angular tapping operation of Ø5.1 of TATA cylinder block. [4]. Koichi Asakura, Makoto Demura, Takenori Matsumoto, in 1989, they worked on, Thread cutting with synchronized feed and rotation motors, A machine is provided with a control system in which, according to one aspect, the rotation of the spindle is controlled in the synchronous manner following up the feed amount of the spindle head and the rotation instruction is computed in accordance with the feed deviation, In another aspect, the feed of the spindle head is controlled in the synchronous manner following up the rotation of the spindle and the feed instruction is computed in accordance with the rotation deviation. In a further aspect, the rotation instruction is operated in accordance with the feed

speed and the feed acceleration.

In still a further aspect, the feed instruction is computed in accordance with the rotation speed and the rotation acceleration. In the preferred embodiments disclosed herein, the synchronism between the rotation of the spindle and the feed of the spindle head can be remarkably improved with various control modes, thus achieving the high speed thread cutting working with high accuracy [5]. Edward G. Rourke, 20705 Cheney Dr., Topanga, Calif. 90290 worked on an improved numerically controlled machine tool is provided by resiliently coupling an independent drive mechanism to a tool holder which in turn is fitted to the numerically controlled machine. The drive mechanism in turn is coupled to a working tool used for drilling, tapping, milling or other machine functions. The drive mechanism and the tool holder are resiliently coupled together so that they may be relatively displaced one with respect to each other depending upon the amount of vertical force being through the working tool applied to the drive mechanism tending to urge the drive mechanism either toward or away from the tool holder.

The torque, power and/or rate of rotation of the working tool is controlled as a function of the relative displacement of the working tool with respect to the tool holder along a predetermined axis of coupling between them .A longitudinal force exerted on the working tool is a function of a spring constant of the resilient coupling between the drive mechanism and tool holder and their relative displacement. The vertical thrust of the working tool is hence both proportional and limited [6].

III. INTRODUCTION OF SPM

The growth of Indian manufacturing sector depends largely on its productivity & quality. 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 productivity along with quality is by use of special purpose machine. This paper show the way of development of SPM for drilling and riveting operation. The concept of SPM is that the plate having different size and thickness are drill on drilling spindle first and then riveted on orbital riveting spindle. Both the operation performs on same machine having two separate spindles. This machine is containing automation by using pneumatic system.

The present work relates to drilling and tapping machines, and more particularly to a relatively compact type of device which is readily portable and operates automatically to clamp a work piece, drill a hole therein, insert and hold a tap in the hole, and make a tap.

In developing world, performing drilling and tapping operation simultaneously on the same machine was a bigger problem for manufacturing company and workshop holders, individual drilling and tapping machines were exist in the market, but they were not beneficial for workshop holders, small industrialist and entrepreneurs to buy separately due to very high cost. In recent past year more stress was given to design and development of existing machines.

In this regard attempts had been made to develop a machine that can perform drilling and tapping operations simultaneously on the same machine. There were so many machines had been developed as

portable drilling, orbital riveting machine, hand tapping and flexible automatic tapping.

This machine concept provided most compact, economical and portable design which was very easy to handle and simple in operation by a single person. The machine consist of single phase induction motor transmit power to the tool and a pneumatic cylinder which drive the process unit. During field testing it was observed that all the equipment were operating satisfactorily and could be used in industries and workshops.

3.1 Case Study of Special Purpose Machine

The exhausted literature study has been carried out on design and fabrication for SPM. The findings of various scholars in the field of design, fabrication and analysis of SPM have been presented below: A. M. Takale et.al [5] was focused on "Design & manufacturing of multi spindle drilling head (msdh) for its cycle time optimization", This paper deals with design and development of multispindle drilling head for cycle time optimization of the component. Their attempts have to improve the productivity by reducing the total machining time and combining the operations. They have design the major components of multispindle drilling head like main spindle gear and main spindle and calculate the stress analysis. By using multispindle drilling head productivity will increase. Because with the present process one hole produces at a time requires 4 minutes for each component (because tool change takes place for drilling 5mm hole (for M6x1 tap)). i.e. 12-15 parts are produced during one hour, but by using multispindle drilling head cycle time approximately takes place 1 minute.Prof. P. R. Sawant et.al [4] had been published a paper on "Design and development of SPM-a case study in Multi drilling and tapping machine", This paper discuss the case study and comparison of productivity of component using conventional radial drilling machine and special purpose machine(SPM) for drilling and tapping operation.In this case study, the SPM used for 8 multi drilling operation (7 of Ø6.75 and Ø12), linear tapping operation of Ø12 and angular tapping operation of Ø5.1 of TATA cylinder block. In this paper the following studies are carried out

1. Time saved by component handling (loading and unloading), using hydraulic clamping,
2. Increase in productivity both qualitative and quantitative,
3. Less human intervention, indirectly reduction in operator fatigue,
4. Less rejection due to automatic controls, and
5. Increase the profit of company.

The main concept of this project work is to design & develop a special purpose machine, which can be used for drilling and tapping the work piece having different thickness and material on the same machine. This kind of SPM is very much required in the mechanical workshops, small scale industries, where it is essential for specific job applications.

It is finding that the machine is beneficial for work shop where drilling and tapping perform simultaneously on job. This machine reduces operation as well as transportation time and cost of raw material involved in the concern. Despite our best efforts we realize that our machine is less noisy and quite stable. By using drilling and tapping spindle on the same machine the time requires for drilling and tapping operation is very less as compare to conventional method.

3.2 Advantages of SPM

- Increased Production Rate
- To achieve Accuracy.
- To reduce hustles to the operator.
- To improve Tool life.
- The System is Easy to understand.

3.3 Disadvantages

- Over-all cost of the Machine is increased.
- Skilled Operator is requird.
- Increased maintainance cost.

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