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AN EXAMINATION OF DESIGN AND MANUFACTURING PROCESSES FOR A COMPACT LATHE MACHINE

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Abstract-
A work piece is rotated on a lathe machine to carry out operations such as sanding, parting off, drilling, knurling, and turning. Lathes have been employed diligently for a long time in woodworking, essential corridors, and plastic nylon corridors. Next, we examine the design and construction of a miniature lathe. The lathe chuck is driven by a motor in our machine that is set up using a belt system. The device is made up of a bed that can be moved around. It has a holder to keep the requested tool in the requested position. To operate the motor, we utilize a chuck that is fastened to the spindle shaft. Our motor, which was previously driven, uses a belt medium to transfer this power to the spindle, which also rotates the chuck. This causes the work piece's chuck to revolve. To accomplish the desired tasks, the machine is set up to hold, spin, and move the tool in a sliding medium.

***Keywords*—**
Design, Manufacturing Processes, Compact Lathe Machine, Motor, Sanding, Parting Off, Drilling, Knurling, Turning.

INTRODUCTION

The word "machining" refers to a broad range of production techniques used to remove undesired material from a workpiece, often in the form of chips. Castings, forgings, or prepared metal blocks can be machined into the appropriate forms, with size and finish specifications satisfied to meet design requirements. Components of almost every produced good need to be machined, frequently with extreme accuracy. The majority of industrial applications of machining are in metals. Although the metal cutting process has resisted theoretical analysis because of its complexity, the application of these processes in the industrial world is widespread. Metal cutting processes can be viewed as consisting of independent input variables, dependent variables, and independent dependent interactions or relationships. The engineer or machine tool operator has direct control over the input variables and can specify or select them when setting up the machining process. The metallurgy and chemistry of the work piece can either be specified or is already known. Quite often, a material is selected for a particular application chiefly because it machines well. Cast iron and aluminium, for example, are known to machine easily. Other metals, such as stainless steel or titanium, are difficult to machine. They often have large cutting forces or poor surface finishes, which can result in short cutting tool life, yet these metals are selected to meet other functional design criteria. The size and shape of the work piece may be dictated by preceding processes casting, forging, forming, and so forth or may be selected from standard machining stock for example, bar stock for screw machines. Usually this variable directly influences the machining process or processes that are selected, as well as the depth of cut. The selection of machining processes required to convert the raw material into a finished product must be based on the geometry of the part size and shape, rotational or non-rotational, the required finishes and tolerances, and the quantity of the product to be made. The three most common cutting tool materials currently in use for production machining operations are High-Speed Steel, both in wrought and powder metallurgy form, carbides and coated tools. Cubic Boron Nitride, ceramics, and diamonds are also being widely employed. Selection of a tool material that provides reliable service while fulfilling the functional requirements is still an art. The harder the tool material, the better it can resist wear at faster cutting speeds. The faster the cutting speed, higher the cutting temperature and the shorter the tool life. Retention of hardness at elevated temperatures as well as long tool life is desirable characteristics in cutting tools. For every machining operation, it is necessary to select a cutting speed, a feed, and a depth of cut. Many factors impinge on these decisions because all of the dependent variables are influenced by them. Proper selection of variables also depends on the other input variables that have been elected, that is, the total amount of material to be removed, the work piece and tool materials, and the machining process or processes. These need to be selected before preliminary choices for speed, feed, and depth of cut can be made.

TURNING PROCESS CAPABILITIES

Turning is the removal of metal from the outer diameter of a rotating cylindrical work piece. Turning is used to reduce the diameter of the work piece, usually to a specified dimension, and to produce a smooth finish on the metal. Often the work piece will be turned so that adjacent sections have different diameters. Turning is the machining operation that produces cylindrical parts. Turning is a machining process for generating external surfaces of revolution by the action of a cutting tool on a rotating work piece, usually in a lathe. Often other machining operations are performed in conjunction with turning. These include facing, longitudinal drilling, boring, reaming, tapping, threading, chamfering, and knurling. Common cutting tool modes used on turning equipment are shown in Fig. 1. Turning operations may be divided into two classes: those in which the work-piece is situated between centers, and those in which the work-piece is chucked or gripped at one end with or without support at the other end. Also, accessories can be obtained for milling, grinding, and cross drilling, although these operations are less frequently combined with turning. When more than two or three different operations are performed on identical parts, it is usually more practical to employ processes that use a single tool with the capability of performing two or more operations simultaneously or consecutively. Availability of equipment that can hold and rotate the work-piece is the major restriction on the size of the work-piece that can be turned. Turning is done on parts ranging in size from those used in watches to steel propeller shafts more than 25 m long. Aluminium parts over 3.0 m in diameter have been successfully turned. In actuality, the weight of the work metal per unit of volume may restrict the size of the work-piece that is practical to turn. Problems in holding and handling increase, as weight and size increase. Some large parts are turned in vertical boring mills, some of which are capable of machining up to a 60 ton work-piece. Sometimes the entire work-piece is so unwieldy that rotating is virtually impossible. A notable example is in the turning of crankpin diameters on large crankshafts. This condition, however, usually can be overcome, and an acceptable degree of dynamic balance obtained, by counter-weighting. Counterweights may be attached either to the spindle of the machine or to the work Engagement of the cutting tool with the rotating work results in a tangential force that, for a specific work metal, tool shape, and feed rate, generally is independent of the cutting speed and directly proportional to the depth of cut. That force, multiplied by the surface speed of the work-piece, serves as a basis for calculating the net horsepower required to remove metal from the piece being turned. Power required to move the tool longitudinally is usually negligible, with the exception of spade-drilling operations.

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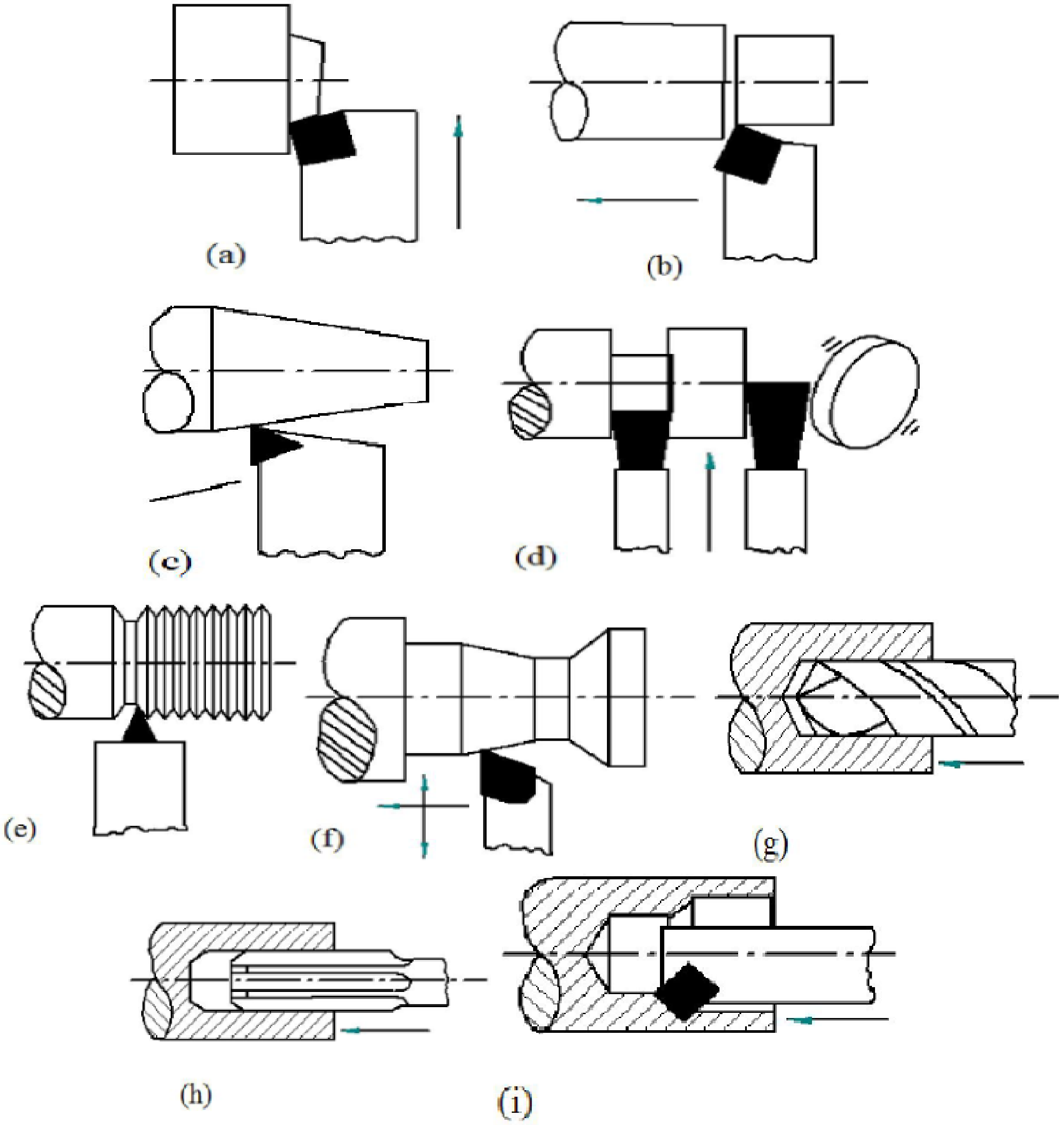

Figure 1- Basic operations performed on turning equipment. (a) Facing. (b) Straight turning. (c) Taper turning. (d) Grooving and cutoff. (e) Threading. (f) Tracer turning. (g) Drilling. (h) Reaming. (i) Boring

COMPACT LATHE MACHINE

A lathe is a machine tool which rotates the work-piece on its axis to perform various operations such as cutting, knurling, drilling, Thread cutting etc. with tools that are applied to the work-piece to create an object which has symmetry about an axis of rotation. Lathes are used in woodturning, metalworking, metal spinning, Thermal spraying, parts reclamation, and glass-working. A suitable classification of these machines is difficult because there are so many variations in the size, design, method of drive, and application. Most lathes are designated according to some outstanding design characteristic: speed lathes, engine lathes, bench lathes, tool room lathes, special-purpose lathes, turret lathes, automatic-turning machines, and modifications of these types.

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(i) Speed Lathes- The speed lathe, the simplest of all lathes, consists of a bed, a headstock, a tailstock, and an adjustable slide for supporting the tool. Usually it is driven by a variable-speed motor built into the headstock, although the drive may be a belt to a step cone pulley. Because hand tools are used and the cuts are small, the lathe is driven at high speeds up to 4000 rev/min, with the work either held between centers on a chuck or attached to a face plate on the headstock. The speed lathe is principally used for turning wood for small cabinet work or for patterns, and for centering metal cylindrical parts prior to further work on the engine lathe. In the latter operation, the center drill is held in a small chuck fastened to the headstock, and the work is guided to the center drill either by a fixed center rest or by a movable center in the tailstock. Metal spinning is done on lathes of this type by rapidly revolving a stamped or deep-drawn piece of thin, ductile metal and pressing it against a form by means of blunt hand tools or rollers.

(ii) Engine Lathes- The engine lathe derives its name from the early lathes, which were powered by engines. It differs from a speed lathe in that it has additional features for controlling the spindle speed and for supporting and controlling the feed of the fixed cutting tool. There are several variations in the design of the headstock through which the power is supplied to the machine.

(iii) Bench Lathes- The name bench lathe is given to a small engine lathe that is mounted on a work bench. In design it has the same features as speed or engine lathes and differs from these lathes only in size and mounting. It is adapted to small work, having a maximum swing capacity of 255 mm at the face plate. Many lathes of this type are used for precision work on small parts.

(iv) Tool Room Lathes- This lathe, the most modern engine lathe, is equipped with all the accessories necessary for accurate tool work, being an individually driven geared-head lathe with a considerable range in spindle speeds. It is often equipped with center steady rest, quick change gears, lead screw, feed rod, taper attachment, thread dial, chuck, indicator, draw-in collet attachment, and a pump for a coolant. All tool room lathes are carefully tested for accuracy and, as the name implies, are especially adapted for making small tools, test gages, dies, and other precision parts. Their beds frequently are shorter than ordinary engine lathes having comparable swing dimensions because they are usually used for machining relatively small parts.

(v) Special-Purpose Lathes- Several types of special-purpose lathes are made to accommodate specific types of work. These include wheel lathes, hollow-spindle lathes, and gap-frame lathes. Wheel lathes permit the turning of journals and wheel treads of railroad car wheel and axle assemblies. A special headstock drives the assembly at a point between the two wheels.

METHODOLOGY

Methodology that we follow to complete the study or paper is highlighted as follows

(i) Data collection done by literature survey, user study and market study through questionnaires, videos and

observation etc. about the existing lathe machine. Identify the drawbacks or limitations of the existing lathe machine.

(ii) Generate new ideas to solve these problems.

(iii) Select the best idea to model the new mini lathe machine.

(iv) Prepare preliminary design or model of the modified sprayer depends on our idea using solid work software. And material specification is done.

(v) Geometric and force analysis of each component is done based on the preliminary designor model.

(vi) Design the components.

(vii) Preparation of manufacturing drawing or part and assembly drawing.

(viii) Manufacture all components

(ix) Assemble and testing

(x) Check prototype, finally conclude the study.

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TREND IN LATHE MACHINE FABRICATION

(i) Centre Lathe Machine- the Centre lathe is used to machine metals, by rotating the work piece mounted between centers against a cutting tool. The tool can be fed both transversely and longitudinally with respect to the turning axis of the job. The tool can be operated manually of automatically and many shapes as well as different works can be carried out on the Centre lathe such work as cylindrical, eccentric or conical shapes can be machined. Also done on the Centre lathe are threading and boring operations.

Figure 2-Centre Lathe Machine

CUTTING TOOL MATERIALS

As rates of metal removal have increased, so has the need for heat resistant cutting tools. The result has been a progression from high-speed steels to carbide, and on to ceramics and other super hard materials. Developed around the year 1900, high-speed steels cut four times faster than the carbon steels they replaced. There are over 30 grades of high speed steel, in three main categories: tungsten, molybdenum, and molybdenum-cobalt based grades. Since the 1960s the development of powdered metal high-speed steel has allowed the production of near-net shaped cutting tools, such as drills, milling cutters and form tools. The use of coatings, particularly titanium nitride, allows high-speed steel tools to cut faster and last longer. Titanium nitride provides a high surface hardness, resists corrosion, and it minimizes friction. In industry today, carbide tools have replaced high-speed steels in most applications. These carbide and coated carbide tools cut about 3 to 5 times faster than high-speed steels. Cemented carbide is a powder metal product consisting of fine carbide particles cemented together with a binder of cobalt. The major categories of hard carbide include tungsten carbide, titanium carbide, tantalum carbide, and niobium carbide. Each type of carbide affects the cutting tool"s characteristics differently. For example, a higher tungsten content increases wear resistance, but reduces tool strength. A higher percentage of cobalt binder increases strength, but lowers the wear resistance. Carbide is used in solid round tools or in the form of replaceable inserts. Every manufacturer of carbide tools offers a variety for specific applications. The proper choice can double tool life or double the cutting speed of the same tool. Shock resistant types are used for interrupted cutting. Harder, chemically-stable types are required for high speed finishing of steel. More heat-resistant tools are needed for machining the super-alloys, like Inconel and Hastelloy. There are no effective standards for choosing carbide grade specifications so it is necessary to rely on the carbide suppliers to recommend grades for given applications. Manufacturers do use an ANSI code to identify their proprietary carbide product line. Two thirds of all carbide tools are coated. Coated tools should be considered for most applications because of their longer life and faster machining. Coating broadens the applications of a specific carbide tool. These coatings are applied in multiple layers of under .001 of an inch thickness. The main carbide insert and cutting tool coating materials are titanium carbide, titanium nitride, aluminium oxide, and titanium carbonitride. Ceramic cutting tools are harder and more heat-resistant than carbides, but more brittle. They are well suited for machining cast iron, hard steels, and the super alloys. Two types of ceramic cutting tools available are the alumina-based and the silicon nitride-based ceramics. The alumina-based ceramics are used for high speed semi- and final-finishing of ferrous and some non-ferrous materials. The silicon nitride-based ceramics are generally used for rougher and heavier machining of cast iron and the super alloys. Ceramic tools are produced from the materials used to coat the carbide varieties such as titanium carbides and nitrides. They are especially useful in chemically reactive machining environments, for final finishing and some turning and milling operations.

CONCLUSION

Compared to conventional manual machining processes, the portable tiny wood lathe machine offers a number of advantages. We performed a variety of operations on the tiny lathe and discovered that it is capable of machining more jobs in the same amount of time as a carpenter working manually. Its construction is very simple, and the materials needed for it are readily available, allowing anybody to make it for their own usage. Studies on small lathe machining shown that it reduces human effort and is energy efficient.

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