

Multi-Tool Mechanical Machining



Engineering

KEYWORDS :

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ABSTRACT

In this ever changing environment need for manufacturing of products and higher rate is greatly enhanced by the market trend and demand. The process involved in manufacturing also needs a global approach and has to be done by making the process more easy and reliable. Considering these aspects there is a need to design a methodology that would hope for the higher rate of production at greater quality. The aim of our paper is to design and fabricate an electrically operated multipurpose device for doing major operations carried out during manufacturing of a product. We have fabricated the device in such a way that the number of operations can be performed in it without shifting the work to next machine or station. The device is designed in such a way that we can carry out operations such as Drilling, Grinding and Milling in the same. This would reduce the set up time of each machine and increase productivity through conventional way

The work is one, in which actually we are leaning the theoretical concepts in practical way. Also the practical experience is one of the aims 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. There are a number of units having used in industries for various purposes.

For our thought the various project name are given below.

1. Pedaling sheet meal cutter.
2. Multi-tool device.
3. Versa mill.
4. Paint mixer
5. Mechanical Jack.

From the above we selected 'MULTI TOOL DEVICE'. In small scale Industries and automobile maintenance shops, there are frequent needs of tightening and loosening of screws, Drilling, Boring, Grinding, etc. Huge and complicate designed parts cannot be machined in ordinary machines. Further for every operation separate machine is required. This increases the initial cost required, large area requirements and a large number of machines are required. The milling-grinding-drilling and slotting attachment is commonly referred to as a Versa-Mil. It is a compact, portable unit capable of doing many machining operations that normally require expensive single-purpose machines. With the different attachments that are available with the unit, drilling, shaping, milling, and grinding can be performed quickly and inexpensively. This self-powered, vertical-feed, variable-speed precision tool may be mounted in any position on the carriage, table, ram, turret, or tool arm of other machine tools. With a two-directional feed table, the Versa-Mil unit becomes a com-

plete machining tool for bench or in place machining of parts too large to be moved or held in conventional machine tools.

3.1 USES:

An important factor in the efficiency of the Versa-Mil is that machine tools already in the shop area provide the power for feeds, a means of holding and moving the work, and the rigidity needed for machining. Faced with unusual machining problems, the Versa-Mil offers many solutions either as a separate tool or combined with other machine tools and machinery already in the shop to create special machines. The Versa-Mil increases the capabilities of standard machines by doing secondary operations without changing setups. The Versa-Mil provides power to interchangeable attachments allowing the unit to be used on site to perform different machining operations on equipment being repaired or rebuilt. Where space is limited, as in a shop area, floor space is needed only for the lathe. Different sizes of the Versa-Mil unit are available for light, medium, and heavy machining. This chapter will be limited to the Series 31 (light machining unit).

3.2 SAFETY PRECAUTIONS

Safety in the shop area or around power equipment cannot be overemphasized. Each piece of equipment has safety procedures unique to that particular piece of equipment.

COMPONENTS AND DESCRIPTION

The multi tool device consists of the following main parts.

4.1. SHAFT:

It is made up of mild steel. It is a straight rod having a step. It is supported by two bearings in the cylinder. The diameter of rod is 15 mm for a length of 150 mm and 13.5mm diameter for 22 mm length. The fan is fitted on the shaft through flanges. The fan is fixed to flanges and the flanges are fixed to the shaft through drilled holes.

4.2. COUPLINGS:

The couplings are made out of mild steel. The couplings cover the sides of barrel. The couplings have internal threads. With the help of these threads the couplings are fitted to barrel. It has a smaller diameter hole to place the bearings.

4.3. FLANGES:

The flanges are made out of mild steel. It is a cylindrical tube having a flange at its one of the ends. It also has a centre drill of 16mm. There are holes drilled in flanges correspondingly. Such that the holes drilled in two flanges coincide each other. The fan is placed between the two flanges and screwed.

4.4. FABRICATIONAL ASPECTS**4.4.1. Base:**

The base is made up of cast iron. The base is grinded at the top so as to mount the column. Four holes are drilled and tapped for ½" M.S. bolt to mount column support. On the rear end of the base motor bracket is fastened.

4.4.2. Column Support:

The material used for column support is cast iron. A cast iron flange is primarily turned and faced. A hole is drilled at the center of the flange of dia 144.995 mm. So that a press fit is made with the column of dia 45mm. Four holes are drilled radially to clamp it with the base.

4.4.3. Column:

The column is made up of mild steel. The column is of dia 45mm and length 500mm. One end of the column is fitted to the column support while the other end is inserted in the cone housing. A drill is made on the cone housing. A plug is inserted through their drilled hole to as to keep the cone housing in position.

4.4.4. Table Housing:

The table housing is made up of mild steel. A collar of inner dia 45mm and outer dia 55mm is machined and it is cut on one side along the axis and two flats are welded. In which hour are drilled and tapped to as to fix collar at any position on the column. A flat strip is welded to the collar on the other end of the strip another collar is welded, so as to support the table with the rack. On this collar two flats have been welded and holes are drilled on it, a shaft placed in this hole acts as a support to the pinion. The pinion is provided with a handle in order to rotate the pinion, thereby lifting the rack.

4.4.5. Work Piece Table:

The work piece table is made up of cast iron the table is machined to get a flat surface. The table is drilled and bored at the centre for a dia of 30mm and threaded. Four slots are cut on the table for clamping the work piece. A groove 14 x 14 mm near the 30mm dia shaft for a length of 190mm. The square rack of length 150mm is placed on the groove and welded. The upper end of the shaft is threaded. The shaft with the rack is fastened to the tables.

4.4.6. Cone Housing:

The cone housing is made up of mild steel. Initially a square bar of 80mm x 80mm of length 280mm is machined. A drill of 45mm is made on one side for a depth of 75mm. A cylindrical bar of dia 80mm and length 100mm is welded to the square bar at a distance of 64mm from the top. A bore of 90mm is drilled axially along the cylindrical bar against the square bar, and bearing rating of 52mm dia is taken at the ends of the bore to a depth of 22mm. A rectangular flat is taken at the ends of the bore to a depth of 22mm. A rectangular flats of 45 x 45mm, length 150mm is welded at the middle of the upper end of the square bar. A similar rectangular flat is welded in line with the upper arm at a distance of 130mm between the arms.

4.4.7. Cones:

There are two types of cones in this machine. They are

1. Mild steel cone
2. Fibre cone

4.4.8. Mild steel cone:

There are two Mild steel cones which are placed vertically in the main spindle the diameter of the cone at larger end is 108 mm and at lower smaller end is 28mm and a cylindrical portion of dia 28mm for a length of 10mm is machined. A hole is drilled axially for a dia of 22mm through the cones. Four holes are drilled and tapped for dia 6mm on the cylindrical part of the cone grub screw 1 x 6 mm is used to fix the cone to the main spindle.

4.4.9. Fiber Cone:

The fiber cone is machined in such a way that larger dia is 108mm and the smaller dia is 38mm. The height of the cone is 35mm. A steel bush of outer dia is 35mm is pasted to the fiber cone. A key way of 4 x 4mm is been cut.

4.4.10. Main Vertical Spindle:

This is made up of mild steel. The shaft is machined to a dia of 22mm. By using end mill cutter a flat of 10 mm thick, 50mm length is taken radially on four side of the shaft in order to grip the screw. At the lower end of the shaft a step of dia 15 mm is given for a length of 10mm. A taper is given for a length of 30mm such that the larger end is of dia 22mm and smaller end is of dia 20mm in order to hold the chuck.

4.4.11. Main Drive Shaft:

This is made up of mild steel. This is a stepped shaft of dia 19mm for a length of 45mm and of dia 25mm. The shaft is machined for a dia of 25mm. The shaft is machined for a dia of 25mm of a length 75mm and a 6 x 6 mm key way is cutted for a length of 50mm.

DESIGN OF D.C. MOTOR**Torque in a motor:**

By the term torque, it is meant the turning or twisting moment of a force about an axis. It is measured by the product of the force and the radius at which this force acts.

For an armature of a motor, to rotate about its centre, a tangential force is necessary. This force is developed with in the motor itself.

$$\text{Torque (T)} = \frac{1}{2} (I_a / A) BDC Z \text{ Newton meters}$$

Using the relation,

$$\begin{aligned} B &= \frac{\phi}{a} \\ &= \frac{\phi}{(\pi D / P)} \\ &= \frac{\phi \times P}{(\pi D)} \end{aligned}$$

$$\begin{aligned} T &= \frac{1}{2} \times (I_a / A) \times Z \times \frac{\phi \times P}{(\pi D)} \times D \\ &= \frac{\phi \times Z \times P \times I_a}{(2\pi A)} \text{ Newton meters} \\ &= 0.159 \times \phi \times Z \times I_a \times \end{aligned}$$

$$(P/A) \text{ Newton meters} = 0.162 \times \phi \times Z \times I_a \times (P/A) \text{ Kg-m}$$

The torque given by the above equation is the developed torque in the machine. But the output torque is less than the developed torque due to friction and wind age losses.

FABRICATION

The fabrication of main parts is given below

7.1. SHAFT:

The shaft is a rod of two different diameters. The shaft is made up of mild steel. The shaft has a diameter of 15 mm for a length of 180 mm and a diameter of 13.5 mm for a length of 22 mm. The shaft is turned to the required diameter in a lathe. Flanges are fixed to the shaft by means of bolts and nuts through a drilled cross hole. Corresponding holes are made on flanges also.

The shaft is supported on either ends by means of bearings which are placed in couplings. The shaft should be turned accurately, because it should not be very tight or loose to hold the bearings. At the front end of the shaft a drill chuck is fitted.

7.2. FLANGES:

The flanges are hollow cylinders having flanges at its any one of the two ends. The flanges are made out of mild steel. The flange is turned in a lathe. The centre hole is drilled in a radial drilling machine. The flanges are placed in either sides of the fan. Holes are drilled in the two flanges correspondingly and also in the fan. Further cross holes are drilled to fix the flanges on the shaft. The fan is fixed between the flanges using nuts and bolts through the holes in flanges and the fan. The flange is fixed to the shaft by using nuts and bolts through the cross holes drilled.

7.3. FAN:

The fan is made up of aluminium. The outer diameter of the fan is 73mm, so the fan can rotate freely inside the barrel. First the aluminium sheet is cut to the required diameter. Dimensions for leaves are marked and the leaves are cut and the edges are filed. Then the fan is fixed to the flanges.

The fan with flanges on either side is held in a vise, and each leaves are twisted to a particular angle, such that it could rotate in either direction, when the direction of air is varied. The fan is fixed to flanges and flanges are fixed to the shaft. Thus the rotation of fan is transmitted to the shaft through flanges to the shaft. The thickness of the fan leaves are 2mm.

7.4. CONTROL UNIT:

The control unit controls the air pressure and volume entering the barrel. The control unit consists of gate valve-10ft, pressure gauge-10ft, T-tube - 20ft., Reducer - 10ft., one way corks - 20ft and connectors 40ft. Clamps are used to clamp the tubes to avoid dis-connection during mounting of pressure. Thread seals are used to prevent leakage through threads. The above parts are enclosed in a wooden box. The wooden box is pointed with Decholon sheet. The compressed air before entering the barrel passes through the control unit.

APPLICATIONS

This multipurpose device has a numerous applications in various fields. In industries, this is used in assembly section. The required pressure is set and the operation is carried out. In automobile shops various operations are required frequently. Drilling, boring, reaming, grinding etc. It is also used as a screw driver for tightening and loosening nuts and bolts. It is used.

1. In automobile workshops
2. In small scale industries
3. In such places where frequent changes in operations are required
4. In welding shops for grinding.
5. For performing operations in huge parts which cannot be done in ordinary machines, since it is portable.

ADVANTAGES

The electrically operated multipurpose device has many advantages. They are as follows:

- ❖ Low cost, so it can be used in small scale industries.
- ❖ Higher rate and quicker operations
- ❖ A number of operations like (drilling), screw driving, reaming etc., can be done.
- ❖ The nuts and bolts can be tightened to a particular pressure by operating the gate valve placed in the control unit and the pressure gauge.
- ❖ Both loosening and tightening is possible. Since there is air flow in both directions.
- ❖ The weight of the unit is less and can be easily handled.
- ❖ Efficient operation. Since it does not require any electricity for running.
- ❖ The weight of the machine is concentrated towards the machining head to facilitate easy manipulation of the machining.
- ❖ The design is simple and there is no maintenance required.

The control valve for allowing or restricting air may be placed on handle to make easier to control the speed of the machine.

- ❖ The maximum rpm of the unit of the unit is 7000 rpm. The speed provides a torque which is suitable for machining. The maximum pressure that can be used is 7 kg/cm². The rpm and torque can be varied by varying the pressure of the air inlet.

CHAPTER-13**CONCLUSION**

This project can be readily commercialized in the market due to its efficient operation and competitive cost. Since a number of operation can be performed in a single and simple unit. It is efficient and economical. Considering its uses and cost of this project, it becomes relatively cheap when compared to other units.

12.1. Improvement of the project:

The project work done by us can be used in various fields. However the weight of the handling unit can be reduced by using aluminium or fibre instead of mild steel.

Further the controlling of the unit is slightly difficult for a single man flow. The above modifications can be made. Due to very short period, we could not carry out further. However this project is a successful one because we have tested it for the fullest satisfaction.

Photos:

