MANUFACTURING OF AN INDEXING JIG OPERATED BY LEVER MECHANISM

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Abstract:

Some machining operations are so simple which are done quite easily, such as turning, the job is held in position in chuck and turning operation is done easily In this work main focus is given to the mandrel & lever design, specific cutting resistance of the material and selection of spring. Such design is validated and verified.

Key words: Machining, Jigs and Fixtures, Drill Jig

1. INTRODUCTION:

Increasing the productivity and accuracy are the two basic aims of mass production. As we know the solution to this is by reducing the set up cost of the machine and also reducing the manual fatigue[1]. In this case the device that caters our needs is the use of jigs. Let us take one example. Let us consider that one gets an order of say 1000 products. There need to be three holes drilled on this product. In such a case the designer tries to draw out every single hole with the help of square, strengtheners, scribers and center hole[2]. Hence using of jig to position and guide the tool to its right path is preferred rather than using scribers, square, strengtheners or center punch etc. Thus the productivity is increased which is done by eliminating individual positioning, marking and frequent checking. Interchangeability is the chief advantage here[3]. The successful running of any mass production depends upon the interchangeability to facilitate easy assembly and reduction of unit cost. Mass production methods demand a fast and easy method of positioning work for accurate operations on it[4].

2. DESIGN CONSIDERATIONS:

The points that are taken into consideration for designing a product are as following:

- Jig must be so strong that the deflection in the jig should be as less as possible. The deflection that is mentioned includes the forces of cutting, clamping of workpiece to the machine table. The frame of the fixture should have sufficient mass to prevent vibrations during the machining of the job[5].
- Another important design consideration is the clamping which should be fast enough and require less amount of effort.
- Arrangement of clamps should be such that they are easily available[6]. They should

also have the arrangement for easy removal as well.

- Is swinging of clamp system is provided for removal of workpiece the clamp should swing as far as possible for unclamping the device.
- There should also be provision for easy removal of chip. This will prevent the interference of the chip with the operation on the workpiece i.e. cutting operation[7].
- The clamps and support points which are to be adjusted in due course of time should be preferred of same size. It will be better if the clamps and adjustable support points can be operated from the front of the fixture.

3. PROBLEM IDENTIFICATION AND PROPOSED CONCEPT:

3.1 EXISTING METHOD:

Indexing is a necessary kind of motion. Usually when the word indexing is used, it refers specifically to rotation. That is, indexing is most often the quick and easy but precise rotation of a machine part through a certain known number of degrees[8]. The existing indexing drill jig is of the rotating type where the indexing head has to be pulled and rotated.

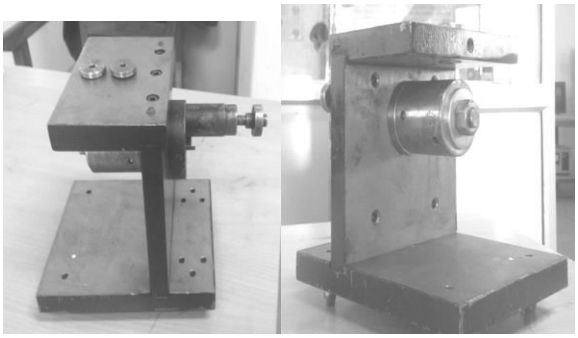

Fig 3.1 Existing Indexing Drill Jig with mandrel.

3.2 PROPOSED METHODOLOGY

Modification of existing drill jig which is operated by an indexing mechanism, by the lever operated indexing mechanism considering the three orders of lever. This jig is being modeled by the calculation of Torque, Thrust Force, Leverage and Spring loading for the improvement in productivity.

4. DESIGN OF COMPONENTS:

4.1 Jig Plate:

Jig plate is a machined product, with flat surfaces and a surface finish equal to 32 micro-inches or better on both sides[9]. It is readily machined with very little distortion. Using proper aluminum machining methods, tolerances in the thousandths can be maintained. The dimensions of the jig plate used here are as follows:

Length = 100mm

Width = 150mm

Thickness = 20mm

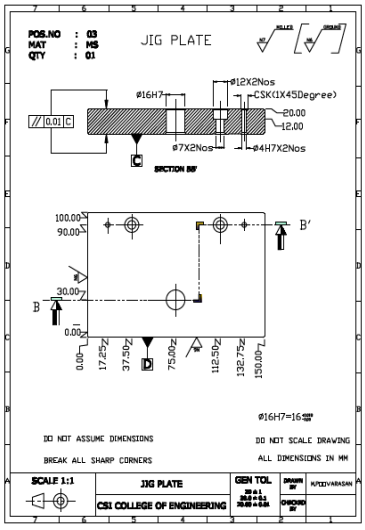

Fig 4.1 CAD drawing Jig Plate

4.2 Angle Plate:

An angle plate is a work holding device used as a fixture in metalworking. The angle plate is made from high quality material (generally spheroidal cast iron) that has been stabilized to prevent further movement or distortion[10]. The dimensions of the angle plate used here are as follows:

Length = 150mm

Width = 150mm

Thickness = 20mm

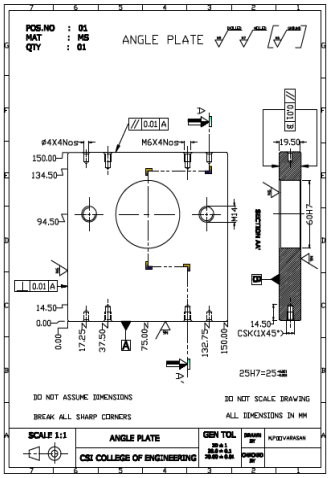

Fig 4.2 CAD drawing Angle Plate

4.3 Base Plate:

A solid piece of material that has enough strength and sturdiness to serve as the surface to which other things are attached to be supported[11]. The dimensions of the base plate used here are as follows:

Length = 190mm

Width = 150mm

Thickness = 20mm

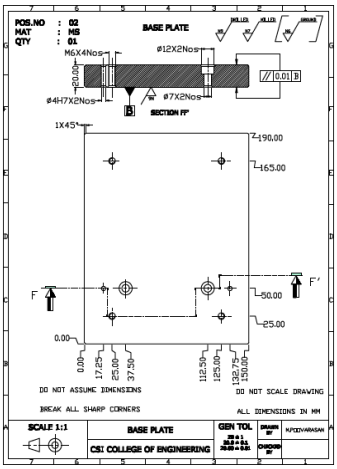

Fig 4.3 CAD drawing Base Plate

4.4 Mandrel:

A mandrel is a round object against which material can be forged or shaped, or a tool component such as a chuck that grips or clamps materials to be machined in a lathe[12].

The dimensions of the mandrel used here are as follows:

Length = 72mm

Larger Diameter = 63.4mm

Smaller Diameter = 24.8mm

Taper Angle = 15^0

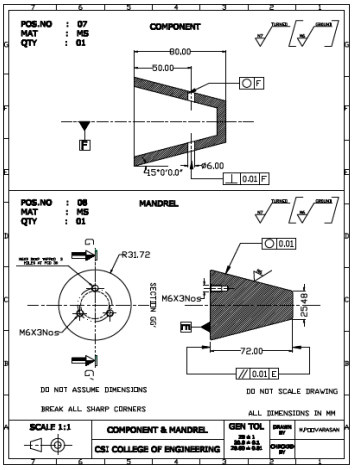

Fig 4.3 CAD drawing Mandrel

4.5 Indexing Plate:

An indexing plate is a specialized tool that allows a workpiece to be circularly indexed; that is, easily and precisely rotated to preset angles or circular divisions[13]. The dimensions of the indexing plate used here are as follows:

Diameter = 80mm

Angle = 22.5^0

Thickness = 20mm

Depth = 15mm

Pitch = 10mm

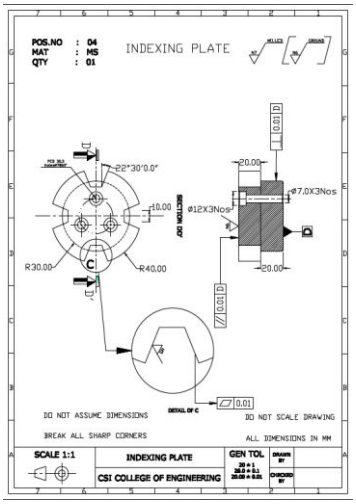

Fig 4.3 CAD drawing Indexing Plate

4.6 Lever:

A lever is a machine consisting of a beam or rigid rod pivoted at a fixed hinge, or fulcrum. A lever is a rigid body capable of rotating on a point on itself[14]. The major categories of them are Class 1,2,3 lever.

The mechanical advantage of the lever is given by the equation,

$$F \times a = Q \times b$$

$$F \times 160 = 600 \times 40$$

$$F = 150N$$

4.7 Bush:

A bush is a mechanical fixing between two, possibly moving, parts, or a strengthened fixing point where one mechanical assembly is attached to another[15]. The dimensions of the bush used here are as follows:

Length = 20mm

Top diameter = 20mm

Bottom diameter= 16mm

4.8 Dowel pin:

A dowel is a solid cylindrical rod, usually made from wood, plastic, or metal. In its original manufactured form, a dowel is called a dowel rod[16]. Dowel rods are often cut into short lengths called dowel pins.

Diameter = 4mm

Length = 30mm

4.9 Allen screw:

A hex key, Allen key or Allen wrench is a tool used to drive bolts and screws with hexagonal sockets in their heads[17].Metric hex wrench sizes are sometimes referred to using the designation "M" followed by the size in millimeters of the tool or socket. The alen screws used here are M5 and M6.

4.10 Stud:

The stud pin is used to hold the latch at one end of it. Two stud pins are used in this jig which has the latch which is used to hold the workpiece firmly with the mandrel[18].

Diameter = 15mm

Length of pin_1 = 130mm

Length of pin_2 = 150mm

4.11 Latch:

A latch is a type of mechanical fastener that is used to join two or more objects or surfaces together[19]. Depending upon the type and design of the latch, this engaged bit of hardware may be known as a *keeper* or *strike*.

The calculation for the moment of inertia of latch is shown below:

$$I = \frac{bd^3}{12}$$

$$I = \frac{15 \times 11^3}{12}$$

$$I = 1663.75mm^4$$

The calculation for the deflection of latch is shown below:

$$\delta l = \frac{Pl^3}{48EI}$$

$$\delta l = \frac{300 \times 110^3}{48 \times 2.1 \times 10^5 \times 1663.75}$$

$$\delta l = 0.0238m\text{m}$$

4.12 Pressure pad:

A pressure pad presses against the material during bending, and is used for preventing the springing back of the material and the sliding of the material during forming[20]. The dimensions of the pressure pad used here are as follows:

Max. Diameter = 25mm

Min. diameter = 18mm

Height = 15mm

Screw thread = M12

6. CONCLUSION:

In this project, a complete model of work holding and tool guiding indexing drill jig was manufactured in the special machines laboratory. The device is operated by using the lever setup provided with the indexing plate. The newly designed drill jig helps to simplify the operation and reduces the risk of the operator during loading and unloading.

7. PHOTOGRAPHY:

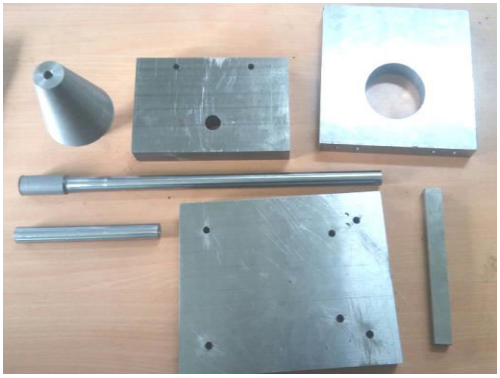

Fig 7.1 Elements of the Indexing Drill Jig

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