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Research Paper

Design of Pneumatic Operated Drill Jig for Cylindrical Component

Engineering

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A.Sivasubramanian	Assistant Professor, Department of Mechanical Engineering, Saveetha School of Engineering , Saveetha University,Thandalam, Chennai.
K. Syed Abuthahir	Pre- Final Year , Department of Mechanical Engineering, Saveetha School of Engineering, Saveetha University, Thandalam, Chennai.
Arshad Basha	Pre- Final Year , Department of Mechanical Engineering, Saveetha School of Engineering, Saveetha University, Thandalam, Chennai.
R. Deepak Kumar	Pre- Final Year , Department of Mechanical Engineering, Saveetha School of Engineering, Saveetha University, Thandalam, Chennai.
B. Arun kumar	Pre- Final Year , Department of Mechanical Engineering, Saveetha School of Engineering, Saveetha University, Thandalam, Chennai.
Karthick.S	Pre- Final Year , Department of Mechanical Engineering, Saveetha School of Engineering, Saveetha University, Thandalam, Chennai.

ABSTRACT

The growth of Manufacturing industry and its need for increased productivity is greatly enhanced by the nature of the industry, their possible work culture and most important thing is the use of improvised techniques and systems. The concept of increased productivity, reduced lead time, high quality and precision can be achieved by making some improvisation in available systems and techniques. In this paper we would deal with a design of pneumatic operated drill jig which can be universally used for a specific drill size. We have designed the jig especially for cylindrical components which involves drilling of hole of size 6mm and 12mm diameter. This design would greatly help in increased productivity of jobs in mass production.

1.INTRODUTION

The management of Jigs system in machining remain relatively stagnant especially the progress of technology development. This condition governs to the needs of scientifically-based management of model formalization which can give significant contribution to the development of jigs systems.[1]

CAD/CAM/CAE software's can be used for designing jigs. When assembling jig in a machining process, the Work piece position, tool movement, pin/locator flexibility have to be considered so that the elements of jig and fixture will be interchangeable and reusable [4]. Designing and assembling of jig and fixture can be carried out using finite element method, and then simulated by the ANSYS software [3]. Carbon fiber composite has been used as the material of jig and fixture in car assembling [2].

In this paper Jigs are designed mainly to save manufacturing time and for each type of work where quantity of production is desired, to maintain consistency in dimensioning, and to facilitate quick and easy assembly and also to reduce cost of manufacturing. The work may be clamped and unclamped quickly using valves. Holes may be drilled at the same relative positions on each of the identical work pieces, without marking the work individually. The wok is clamped below the Jig and holes are located. The jig plate is rotated for the required holes and kept it in position using locating pins. The drill bushes provided on the jig plate guide the drill. When the work is completed, the second work is clamped as per the procedure and process is again repeated.

2.PRINCIPLE OF DRILL JIG:

Location: Locating surfaces should be as small as possible and the location must be done from the machined surface. Sharp corners in the locating surfaces must be avoided. **Clamping:** Quick acting clamps should be used wherever possible Clamping should always be arranged directly above the points supporting the work, otherwise the work would be sprung and machined in a distorted position thus resulting in accuracies. The supporting points should be strong enough to resist bending. All the clamps and adjustments should be on the side.

Loading: The process of loading and unloading the work piece should be as easy as possible. Enough space should be left for hand movements that it between the walls of a jig and position of the work piece. Size variation is to be accounted and some means should be provided for releasing the components if it sticks. Loading and supporting surface usually made of hardened material should be renewable wherever possible.

Stability and Rigidity: Jigs and fixtures should be rigid enough to withstand the cutting forces. For stability at least four legs should be provided for clamping the fixtures on the machine bed. Arrangements to clamp out absorb the vibrations should also be provided.

Clearance for Chips: For cleanliness and accuracy, good swarf and chip clearance should be made. Adequate space should be provided to clear the metal chips by using compressed air.

Fool proofing: Jig and fixture should be fool proof. The design of the jigs and fixtures should be such that it is impossible for an operator to insert either the work piece or the cutting tools in any position other than the correct one Pins and similar devices of a simple design driven into the face of the jig will prevent the component being located incorrectly.

Provision for indexing: Provision for indexing the work piece should be thee if necessary. Such devices are required in work piece on which several equi-spaced similar operations are to be performed..

Ejector devices: Ejector devices may be provided wherever necessary for quick and self-unloading. **Weight:** Jig should be light in construction and should be kept below 15kg since they are to be handled often.

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Handling & Safety: Provisions like lifting arrangements for handling heavy jigs should be made.

Jigs must be designed for safety. Handles or levers should be large enough and clear off adjacent parts so that pinched fingers, for example are avoided. All sharp edges should be removed.

Coolant supply: Adequate arrangements should be made for the supply of coolant to the cutting edges, so that at the same time the drills are cooled and the swarf is removed.

3.COMPONENTS OF DRILL JIG:

- Pneumatic cylinder
- Direction control valve
- Flow control value
- Bottom plate
- Top Plate
- Connectors
- Hoses

4. DESIGN OF COMPONENTS:

The components are designed with at most care and specification for making the design more precise and easy for its application. The design is made under assumption of certain design data to make it work under standard conditions [9]. Each and every part is designed for proper functioning and it is solved for requirement.

4.1PNEUMATIC CYLINDER:-

Design of Piston rod:

Under the following assumption:36kgf/mm²

Diameter of the Piston (d) = 40 mm
Pressure acting = 6 kgf/cm²
Material used for rod = C45
Yield stress (σ_y) = 36kgf/mm²
Assuming factor of safety = 2
Force acting on the rod (P) =73.36 Kgf
Design Stress(σ_y) = σ_y / F.O.S
∴Minimum Diameter of rod=2.3m

4.2Design of Piston rod[7]

4.2.1Diameter of Piston Rod:

Force of piston Rod (P) =Pressure x area
=p x Π/4 (d^2)
=6 x (Π / 4) x $(4)^2$
=73.36 Kgf
Also, force on piston rod (P)= (Π/4) $(d_p)^2$ x f_t
P =(Π/4) x $(dp)^2$ x 625
73.36 =(Π/4) x $(dp)^2$ x 625
∴ d_p^2 =73.36 x (4/Π) x (1/625)
=0.15
d_p =0.38 cm=3.8 mm
By standardizing dp =15 mm

The component is placed in between the Jig plate and the locator, which is on the piston rod. When the valve is opened, the compressed air from the compressor will enter into the cylinder through a hole at the bottom of the cylinder. The piston inside the cylinder is made to push in the upward direction. When the piston moves the locator clamps the component rigidly. Now the component is ready for drilling operation. When the two-way valve is closed the piston will return to bottom position to release the clamps. When we close the valve, the piston will come in very high force in downward direction. So these are chances for the damage of piston. To avoid this, we are using FLOW CONTROL VALVE to control the flow of piston. This can be repeated with the same procedure as described above.

5. PRINCIPLES OF CLAMPING

The purpose of the clamping device is to hold the work in the correct relative position in the jig or fixture and to ensure that the work is not displaced under the action if cutting forces. The most efficient way of clamping should be adequate and at the same time. The clamping device design should be such that the handling time of jig and fixture is least possible. In order to achieve this some of the following principles of clamping should be followed.[8]

1. The clamping pressure should be exerted on the solid supporting part of the work to prevent distortion.
2. The clamping pressure should be kept minimum
3. The movement of the clamp for loading and unloading purposes should be kept.
4. The clamp should be positive guided to facilitate loading action.
5. The design should be such as to enable the clamp to be completely lifted out of the work while unloading. This can be achieved by using compression springs.
6. The clamp should be simple and fool proof.
7. The clamp should be sufficiently robust to prevent bending.
8. The clamps should caseharden to prevent wear of the clamping faces.
9. The clamps should be arranged on the work to perform as many operations as possible in one setting.

6.5 Design Drawings.

The design was made using CAD and the parts where designed with required specifications.

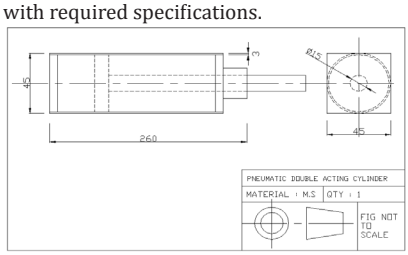

Figure 1 Pneumatic Double Acting Cylinder

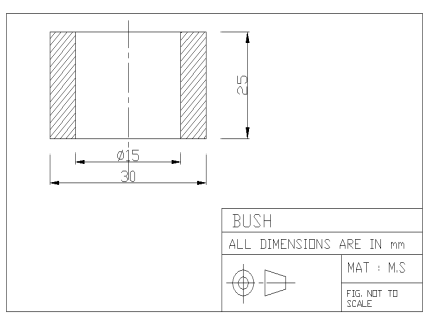

Figure 2: Bush

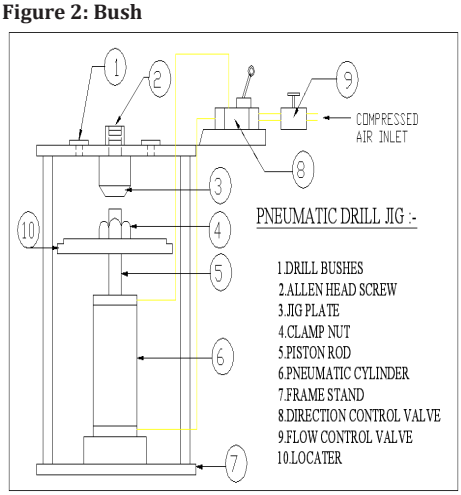

Figure 3: Pneumatic Drill Jig

6. LISTOF MATERIALS

Sl. No.	PARTS	Materials	Qty.
i.	Double Acting Pneumatic Cylinder	C.I	1
ii.	Flow Control Valve	Aluminum	1
iii.	Top Plate	M.S	1
iv.	Bottom Plate	M.S	1
v.	5/2 Direction control Valve	Aluminum	1
vi.	Bushes	M.S	3
vii.	Frame Stand	M.S	1
viii.	Polyethylene Tube		-
ix.	Hose Collar and Reducer		-

Table 1: Material List

7.Specification

Double acting pneumatic cylinder			Flow control Valve		Connectors		Hoses		
Stroke Length	Temperature	Pressure Range	Port size	Pressure	Max working pressure	Temperature	Max pressure	Outer diameter	Inner Diameter
0.16 m	0-80 º C	8 N/ m^2	0.63 $x10^{-2}$ m	8 x 10^5 N/m^2 -	10x10^5 N/m^2	0-100^{0}C	10x10^5 N/m^2	6mm	3mm

Table 2: Specification

9.CONCLUSION:

The pneumatic operated drill jig was designed the jig was fabricated for drilling cylindrical components of 6 and 12mm diameter. The size of machine is smaller than the older machine so it is very simple to move from one place to another. So this machine can be easily transported. The overall space required is also minimum. The efficiency of this machine is better than the older machine. Large saving in power have been achieved. The machine is very simple to operate. Power requirements of the drilling process, depends on the mechanical properties of materials. Materials with higher mechanical properties consume more power in order to accomplish the process than lower ones.

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