Design and Fabrication of Six Jaw Chuck

R. Arun Kishore[1] S. Hari Haran[2] S. Jakir Hussain[3] B. Dhinesh[4] M. Herose Arockiaraj[5]
[1,2,3,4,5]UG Scholar
[1,2,3,4,5]Department of Mechanical Engineering
[1,2,3,4,5]K.Ramakrishnan College of Technology, Trichy, Tamilnadu, India

Abstract— In this project, the six jaw chuck is designed and fabricated with provision of replaceable soft jaw. Standard chuck in the market has only hard jaws and soft jaw in two jaw and three jaw chuck type In our project, six jaw self centering chuck uses soft jaws. So, it can hold various type of work piece of different materials.
Keywords: Chuck, Jaws, Lathe

I. INTRODUCTION

The main work holding devices used in the lathe is chucks. They are divided into two based on the centering mechanism

- Self-centering chuck
- Independent jaw chuck

We concentrated on gripping force, vibration reduction in self-centering chucks. The parameters like surface area, clamping force and length of the component determines the vibration and surface finishing of the product.

In this, we have considered the surface area of clamping to reduce the vibrations

A. Lathe:

Turning machines are also known as lathe. A lathe consists of bed, head stock, carriage with cross slide and tool mounted on cross slide. The carriage moves parallel to axis of the work spindle. Required power is obtained by feed shaft geared to spindle drive.

B. Work Holding Devices:

The work holding devices plays the major role. Its function is to fix the work piece in the proper position. So, finishing and accuracy is achieved.

The main work holding devices are

- Fixtures
- Vice
- Chuck

C. Function of Work Holding Devices:

The main function is to hold the work piece at proper position (i.e.) concentric to the spindle axis. Then turning against the cutting tool which will remove the material.

If the work piece rotates with some vibration, that will reduce the surface finish of the work piece.

II. CHUCK

Different types of chucks used in the lathe are

1) Jaw chuck
2) Collet type chuck
3) Quick change chuck
4) Magnetic type chuck

In those, we select the self-centering jaw type. In this, we select speciality jawed type and select the SIX JAW CHUCK.

A. Jaw Chucks:

1) Self Centering Chuck:

A self-centering chuck also known as scroll chuck uses the dogs inter connected via a scroll gear to gold onto a tool or work piece.

More jaws grip the work piece more securely if it truly in cylindrical in shape and thin walled work will deform less. Four jaw chuck also useful for holding the square work piece.

2) Independent Chuck:

In this, each jaw are moved independently, because they have four jaws. The non-centering action of the independent jaws makes centering highly controllable but at the expense of speed and ease. Four jaw chucks is used in the lathe and indexing head. It easily holds the work piece eccentrically.

3) Speciality Jawed Type:

This chuck is used to hold the fragile materials. These chucks are available at six and eight jaws. These are usually of self-centering type and May built to very high accuracy standards.

They have hard type jaw type and it cannot be machined the work piece. The soft jaws are used for particular work piece.

B. Collet Type Chuck:

It is a sleeve. Its inner surface is cylindrical. The collet can be squeezed against the matching taper such that its inner surface contracts to a slightly smaller diameter, which can hold the work piece.

C. Quick Change Type:

In this, the manipulation of an outer control sleeve, a tool holding collet may be quickly mounted in or removed from a tubular spindle head.

D. Magnetic Type Chuck:

These type, uses the magnetic force to hold the ferrous metal during machining, in this it uses the magnets to hold the work holder such as vise or other fixture to the work machine.

E. Jaws Construction:

Many of the removable jaws which allows the user to replace them with new jaws, specialized jaws, or soft jaws. Soft jaws are made of soft metal, wood or plastics. They can be machined for particular setups. There is interface between master jaw and removable jaw, once clamped by the mounting screws, cannot allow relative slipping between the two parts.

F. Replacable Soft Jaw Chuck:

The mostly available chuck in the market is 2 or 3 jaw type and some special jaw are 6 or 8 jaw type. In the six jaw chuck, the jaws are replaceable.

G. Principle Function of Six Jaw Chuck:

We have developed a two piece jaw with one of the base jaw. The base jaw has thread flanks at the bottom of the scroll plate. The sides of the base jaw have a slot which guides the base jaw in the slot provided in the chuck body.

The replaceable jaw can be hard or soft type of material, we have selected soft material type to enhance the gripping force and to facilitate machinability of the jaw to required work piece size.

It has provision of replaceable with slots to fit precisely on the base jaw.

III. SPECIFICATION

S.NO	PARAMETERS	VALUES
1.	Diameter of the chuck	150 mm
2.	Number of jaws	6 no's
3.	Angle between jaws	60 degrees
4.	Number of teeth in scroll plate	72 no's
5.	Number of teeth in pinion	12 no's
6.	Gear ratio	1:6

A. Parts:

1) Chuck Holder:

It is the special type of clamp used to hold the object with radial symmetry, especially the cylinder. In drills and mills, it holds the rotating tool whereas in the lathes it holds the rotating work piece.

Fig. 1:

2) Chuck Adaptor:

It is used to fix the chuck in the milling machines having standard spindle end. It is also made up of same material of the chuck holder. It also have produce big support to the work piece.

Fig. 2:

3) Scroll Plate:

Self-centering chuck is also called as scroll chuck. Inside the chuck there is a scroll which is a steel ring with a scroll track. The chuck jaw will engage with the scroll. When the scroll is rotated, all the jaws will rotates inwards or outwards.

Fig. 3:

4) Pinion:

The gears where the axis of the two shaft intersect. The tooth bearing of the gears faces themselves. They are conical shaped. Bevel gears are mounted on shafts that are 90 degree apart. The pitch surface of the bevel gear is cone.

Fig. 4:

5) Jaws:

In drills and mills, it holds the rotating tool, as in lathe it holds the work piece. The lathe chuck is mounted on the spindle which rotates within the head stock often the jaws are tightened and loosened by the chuck key.

B. Process Planning:

1) Definition:

Process is defined as any group of action instrumental to the achievement of the output of the operational system in accordance with the specified measure of effectiveness.

2) Requirements of Process Planning:

In order to do the job, the process planner must have available basic information. Some of the information is developed in work authorization function, some of them are mentioned below.

- The volume that must be produced
- Complete information of the product design and function
- Equipment and personal available within the organisation
- Availability of time

3) Steps in Process Planning:

1) Selection of process
   a) Correct production commitments
   b) Delivery to be produces
   c) Quantity to be produced

d) Quality standards to be maintained
2) Selection of materials
3) Selection of fixtures
4) Routing
5) Time requirement
6) Material handling equipment
7) Process sheet

C. Estimation of Machining Time

1) Terms used:

a) Length of cut [L]:
It is distance travelled by the tool to machine the work piece.

b) Feed [f]:
It is the distance through which the tool advances into the work piece during one revolution of the work piece or cutter

c) Depth of Cutter [t]:
It is the thickness of layer removed in one cut or pass measured in the distance in the direction perpendicular to the material surface.

d) Cutting Speed [s]:
It is relative speed between the tool and job. The estimation of machining time for turning, drilling, boring and milling operation can be calculated by the formula

$$T=(L*n)/(f*N)$$

Where,
T = machining tool
L = length of cut
F = feed
N = speed
n = number of pass

D. Process Sheet:

1) Process Sheet for Base Machining:

S.NO	OPERATION	MACHINE NAME	CUTTING TOOL	FEED (mm/hr)	DEPTH OF CUT(mm)	NO OF PASS	MACHINE TIME/SLOT
1	10.6mm slot machining	Milling	10mm carbide end mill	0.11	1	22	16
2	18mm slot machining	Milling	10mm carbide end mill	0.11	1	10	7.25
3	T-slot machining	Milling	T-slot cutter	0.075	5	2	5.3

2) Process Sheet for Jaw Machining:

S.NO	OPERATION	MACHINE NAME	CUTTING TOOL	FEED(mm/hr)	DEPTH OF CUT(mm)	NO OF PASS	MACHINE TIME/SLOT
1	Sizing	Milling	Dia 80mm ball milling cutter	0.1	0.5	6	15.4
2	8.4mm slot machining	Milling	6 mm carbide end mill	0.1	0.5	16	21
3	Scroll teeth milling	Milling	3 mm carbide end mill	0.08	0.25	102	40.8
4	Teeth start and end milling	Milling	10 mm carbide end mill	0.1	1	5	4

E. Cost Accounting:

The process of listing out the expenses involved in fabrication of the attachment is called as cost accounting.
It includes
– Direct material cost
– Factory expenses

F. Direct Material Cost:

The cost of the material which is to make the parts of the chuck is called as direct material cost.
It includes
1) 3 jaw chuck cost
2) Cost of jaw material
3) Cost of jaws

G. Factory Expenses:

The cost spent for the manufacturing the parts of the attachment is known as factory expenses.
It also includes
1) Cost of power consumption
2) Cost of tool materials

H. Merits:

Produces more grip for holding the work pieces
1) Slippage of work pieces is reduced
2) Due to the usage of soft jaws, impression is not produced in the work pieces
3) Vibrations in the work pieces is reduced

IV. CONCLUSION

The six jaw chuck is fabricated not yet been hardened. It is used to increase the gripping force on the job during machining. It is used to reduce the vibration in machining. So the slip can be avoided. It is capable of handling soft materials. Base jaw will be heat treated to improve the hardness for wear resistance. Soft jaw sets can be replaced with required size based on the component size.

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