DESIGN AND FABRICATION OF SQUARE HOLE DRILLING MACHINE

[1]Prof. D.L.Shinde, [2]Sagar Mhaisagar, [3]Ganesh Nagare, [4]Sagar Mergal, [5]Suraj Nalawade

[1]Assistant Professor, [2,3,4,5]UG Students
Department of Mechanical Engineering
P.V.P.I.T., Pune, (India)

***ABSTRACT*: This paper describes about producing square holes in the industry, is very common and useful and at the same time along with problems such as high cost complexity of manufacture. There are number of machine tools producing round and taper holes. But many Engineering components require square and non-circular holes. At present square and other non-circular holes are produced using CNC machines or spark erosion or slotting machines. But there is no any quality machine tool to produce square and polygon holes at minimum cost. Thus we made an Attempt to design and fabricate an attachment for drilling machine which would produce square holes much more easily than the current method.**

Square hole found many applications in various areas like wood, marble and metal work for different purposes. There are many methods available to make square hole as discussed in this work. But making a square hole with drill operation is a different concept as in this concept reuleaux triangle type drill cutter is used to make a square hole. This will be very useful to seat bolt heads etc. This attachment can be fitted either in drilling machine or vertical milling machine.

A complete design for this attachment for a size of maximum 40 mm square has been successfully done.

***Keywords*: productivity improvement, use of Realeaux triangle, Universal Coupling, EN8**

I INTRODUCTION

Nowadays, sometimes we need to do square holes (in metal or wooden parts), and we try alternative solutions, because of the difficulty of making square holes.Most of these conventional approaches of making a square hole start by drilling a hole either with a Diameter equal to the width of the hole or slightly smaller as in (fig). Then you can saw it square, file it square, or you can first drill small holes that are tangent to the lines near the corners.

In industry it is common to use a punch press and hardened dies to make all shape of holes. But it is expensive and also need some external means to operate the machine, apart it is not mobile to be used in other places rather than in a fixed position.

Square holes are used widely in industry. Examples of these applications are used in some of the couplings. Since the square shape of the hole and shaft, will lead to full involvement of couplings.

Considering the present project, a bit that drills square holes ... it defies common sense. How can a revolving edge cut anything but a circular hole? Not only do such bits exist but they derive their shape from a simple geometric construction known as a Reuleaux triangle (shown above).This is elaborated

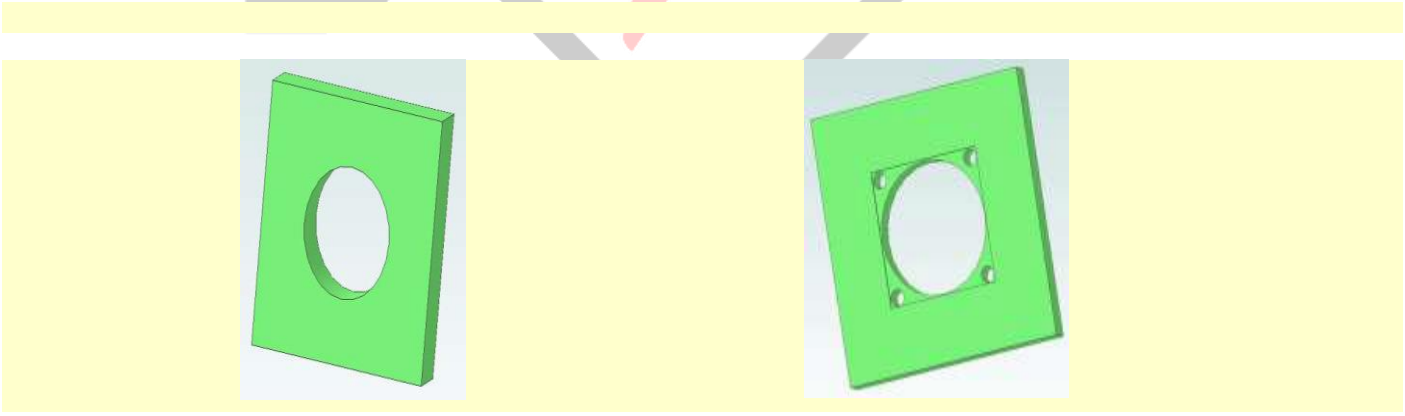

Fig.Conventional Method

further in the present paper with its own set of mechanical linkages which differ from past in their application. The conventional method of drilling a square hole will be replaced by mechanical arrangement of square hole drilling machine.

Basic components used are all described as

1) Reuleaux Triangle
2) Universal Coupling
3) Drilling Machine
4) Drill Bit

II PROBLEM STATEMENT

There are very limited options available in manufacturing if the geometry of an operation which is to be cut on a part is non-circular. In the present manufacturing processes, square hole are produced by Press working, Broaching, Non-conventional machining process like Wire EDM, Laser cutting, etc. Other methods can be used for drilling a square hole but all this process very much costly as it used a laser beam operations, some where use an EDM machine.We can rotate Reuleaux triangle inside a shape that is almost a square. The only problem is you cannot just spin the triangle. That would produce a circular hole. You have to move the centre of the triangle at the same time to create square hole.

Thus to make a machine which can be mobile can be operated as manually and can be used for general purpose as well as mass production we have fabricated square hole drilling machine

IV LITERTURE RIVIEW

1) A Reuleaux Triangle is a shape made from arcs of circles centered at the vertices of an equilateral Triangle. To construct a RT, firstly, we make an equilateral triangle of side 's' Now, with a radius equal to 's' and the center at one of the vertices, draw an arc connecting the other two vertices. Similarly, draw arcs connecting the endpoints of the other two sides. These three arcs form the 'Classic Reuleaux Triangle'. One of its properties is that of constant width, meaning the figure could be rotated completely around between two parallel lines separated by distance s. (2)

2) Review on Design of Cam Geometry for Minimization of Fillet Radius Effect in Square Hole Drilling Operations [1]

In today"s life we have to make square hole on various material like wall, wood etc. Making square hole one of the major problem. But making a square hole with drill operation is a different concept in this we have studied the concept reuleaux triangle type drill cutter is used to make a square hole. By using reuleaux triangle type of cutter we can produce almost square hole but it is not exact square hole because there left a fillet radius on each corner of square which required further operation for making it exact square. To overcome these problem different types of drilling cutters are introduced.

3) Modification Of Drilling Tool To Make Square Hole (Bangar Sunil Kisan, Prof. Mythili Sreeram.ref 3)

In today"s life we have to make square hole on various material like wall, wood etc. Making square hole one of the major problem. But making a square hole with drill operation is a different concept in this we have studied the concept reuleaux triangle type drill cutter is used to make a square hole. By using reuleaux triangle type of cutter we can produce almost square hole but it is not exact square hole because there left a fillet radius on each corner of square which required further operation for making it exact square. To overcome these problem different types of drilling cutters are introduced in this work. Today"s, machines used everywhere in the industry from the small industry to large industry. The machines or drilling machine either in low or high frequency will produce vibration

METHODOLOGY

Here some parameters to be consider while designing the square hole drilling machine this are as follows:

1) Construction of reuleaux triangle

Reuleaux triangle required special type of design specification and calculations to drill a perfect square hole.

2) Conversion of circular motion in square or any other non-circular motion

This problem can be solved with the help of universal type of coupling connected to a drilling machine which will rotate to reuleaux triangle a square restriction.

3) Use of high cutting edge tool

High cutting edge tool will help to drill a square hole without interruption and a good accuracy.

3) DESIGN OF COMPONENTS

To achieve the objective that of square drill machine somewhat critical arrangement is required. Many literatures says about different calculations required for designing different parts required. Different design data aspect gives same output with some defects in square hole formed. In previous review we already familiar with their design. Here we will describe the design of all the necessary parts to perform square hole design.

Parts required to perform square hole drill:

1) Reuleaux triangle/rotor
2) Universal coupling
3) Guide plate
4) Special type of tool
5) Drilling machine

Assembly of all the above parts combine works to achieve the desired objectives. Before that we will be familiar with all the components used with their design in catia cad software. Here all the parts designed by using dimension required for drilling a square hole of size 4 cm each. But as per the need we can design all the parts for all dimension squares for that parametrical equation are explained in their respective description. All the parts produced are provided with the tolerance limit used for manufacturing.

1) Reuleaux Triangle

Reuleaux triangle principle is named after franz Reuleaux, a 19th century german engineer who pioneerd the study of machine to transmit one type of motion into another, and who used reuleaux triangle in this design.

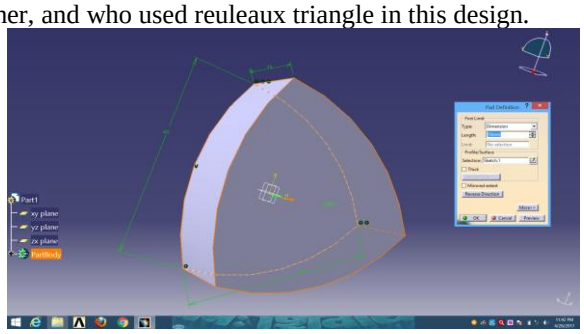

Fig. Reuleaux triangle in CATIA

Side of the equilateral triangle to construct Reuleaux triangle is taken as S = 40mm i.e. it will produce a square of side 40 mm. From one edge to center of Reuleaux triangle i.e. AP = 14.434 mm

Thickness of Reuleaux triangle shape shank i.e. t = 210 mm

As we know, the area of equilateral triangle is $(S*S/2)$

2) also the area of Reuleaux

triangle i.e. A = $(S*S\ 2)*(\pi - \sqrt{3})$ [8].

Therefore, area of RT,

A = $(40*40/\ 2\ )*(\pi - \sqrt{3}) = 1127\ mm^2$.

To construct Reuleaux triangle start with an equilateral triangle of sides with radius equal to ‘s’ and the center at one of the vertices draw an arc containing the other two vertices. Similarly, draw arcs connecting the end points of other two sides this three arcs of Reuleaux triangle. One of its properties of constant width, meaning that figure could be rotated completely between two parallel lines separated by distance and always be tangent to each other.

2) Flexible couplings

It is required to transmit the rotary motion into square action. It can be achieved by the use of flexible couplings. Non–coaxial Oldham’s coupling, double universal joint, Richard Schmidt couplings are the flexible couplings which can be used to achieve the required motion. Flexible couplings can transmit the one type of motion into other

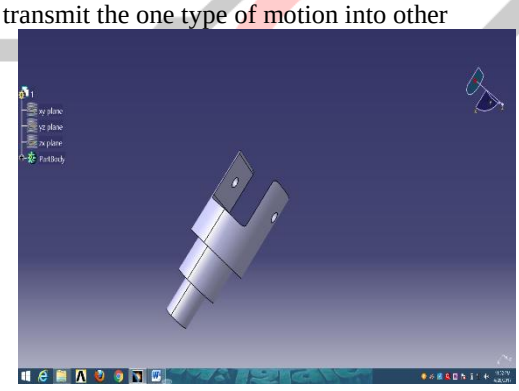

Fig. Universal coupling in CATIA

The most important point is that, during the rotation of the Reuleaux polygon, the center of rotation will not stay at a fixed point. So, in order to transmit the torque from drill to the cam, it is needed to use a non- coaxial coupling which can transmit torque between non-aligned axles. Oldham coupling, Universal coupling or Hook coupling and Richard Schmidt coupling are some examples of non-coaxial couplings.

3) Drill Bit

The drill bit for this drilling machine is a way different than the regular drill bits used for the circular holes. The shank of the tool is taken as Reuleux triangle shape to guide the tool motion in square shape. Firstly we decided a random size of the drill i.e. 40 mm side square. Then as per the calculations of drilling square holes we got all the relations for determining all the dimensions associated with the Reuleux triangle.

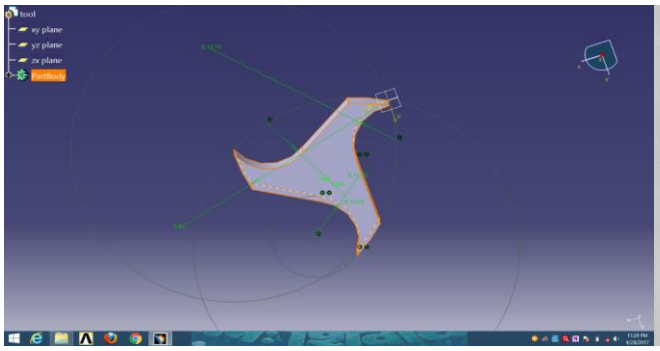

Fig. drill Bit in CATIA

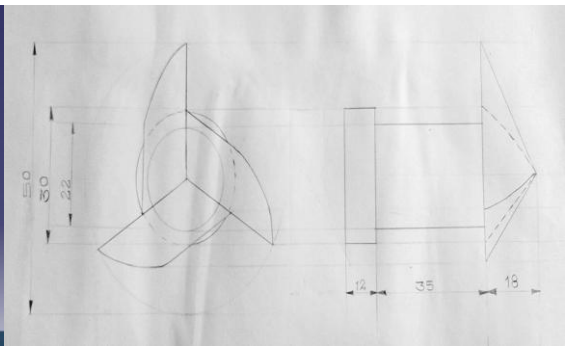

Fig Diamensions of Drill Bit

The shank of the tool is taken as Reuleux triangle shape to guide the tool motion in square shape. Firstly we decided a random size of the drill i.e. 40 mm side square. Then as per the theory of drilling square holes we got all the relations for determining all the

4) Square guide

Square guide is a flat metal sheet having a square hole and of material mild steel. The square guide is required to navigate or guide the drill bit in square shape motion with the help of Reuleux triangle and universal coupling. The square guide is as shown in the following figure.

It is required that the Reuleux triangular shape of the drill bit to be rotated in the square guide by touching its side. It will cause the drill bit to rotate in the same motion as of the Reuleux triangle and as a result a square hole can be drilled on the workpiece.

The size of the square guide is taken with respect to the width of the Reuleux triangle i.e. the side of equilateral triangle. Side of square hole in the guide = S i.e. the side of equilateral triangle = 40 mm. Thickness of square guide = 20 mm dimensions associated with the Reuleux triangle.

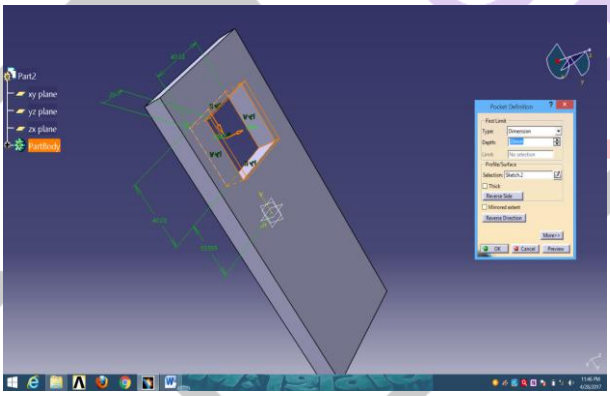

Fig Square Guide in CATIA

The tool will rotate in the square guide as shown in the following figure of tool and guide assembly.

Frame and Sliders are also used for assembly of square hole drilling arrangement

V WORKING PRINCIPLE

The square hole machine works on the principle of Reuleux triangle. It states that if Reuleux shaped cam is rotated in a square guide it can convert the rotating motion of shat and rotor into square guided by the square guide. The rotary motion can be provided by means of a motor or hand drill. A flexible coupling is required to rotate the shaft eccentrically i.e. at a distance from the center of the chuck of the motor. This will help the Reuleux triangle shaped cam to rotate in the square guide. As the eccentric motion is provided to the drill it can reliably rotate in the guide which could help the drill bit to drill a square shaped hole on the workpiece.

Fig. Machine assembly

wooden table was fixed at the bottom with the help of nut and bolts. The machine assembly was required all the pointed work as welds should be done not outside the decided portion which required perfection in welding and that is why the welding was done by an experienced person in the workshop.

For assembly, there was requirement of drilling holes at particular points to insert the bolts for the bolted joints. The frame was made of welded joints. The wooden plate on the base was joint by the use of machining Allen bolts and nuts. The sliders were attached to the vertical support by means of CO_2 gas welding. The hand drill machine, square guide and tool and the universal joint were rested on the moving plate of the slider and joint to it by means of welding. The slider was able to move the weight of the motor and tool assembly in the vertical direction which is the required motion for

RESULTS

The drilled hole obtained is 98 % square.

1. The Reuleux triangle principle is successfully implemented to obtain square hole on a vertical drilling machine.
2. Due to excess vibrations the tool runs a little out of the predefined path which resulted into a 0.2 to 0.3 error in the drilled hole size.
3. As the foundation of the machine is not fixed the vibrations occurred are more.

CONCLUSION

After illustrating and taking trial on the workpiece, we concluded that drilling square hole by using a vertical drilling machine arrangement is possible. The circular motion of the motor or hand drill machine can be converted into square action by using the flexible coupling. This resulted into achieving almost a 98% square shape hole. But as we took one after one trials we observed that there are some modifications required to be done to implement the concept 100% successfully such as predrill of circular shape was required on the workpiece to make it square later. Also, as the vibrations produced are in large amount it is required that the base of the machine is to be fixed strongly. Modifications in the tool design also could give better results as the Reuleux triangle shape shank of the tool can be kept longer in length and the guide support can constraint the motion of the tool as it could not run out of the guide. As it was required in our machine also as we later provided another guide plate to constraint the motion of the tool.

FUTURE SCOPE

The concept of square hole drilling machine can be implemented on the conventional vertical drilling machine. It is only required to change a little setup of the machine to provide guide plate and the fixture of the plate which could further move up and down with the feed mechanism. The plate which can be used for the conventional vertical drilling machine is as shown in the following figure

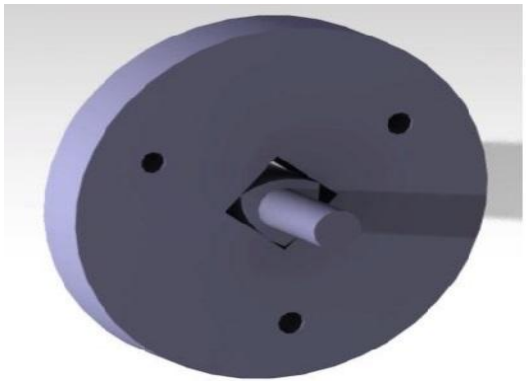

Fig. Guide and tool assembly for conventional drilling machine

REFRENCES

1) International journal for scientific research & development| vol. 4, issue 01, 2016 | issn (online): 2321-0613 Design And Development Of Special Tool To Produce Square Hole Rohit G. Kamble, Manoj Y. Chougule, Rohan K. Churi, Sanjay R. Lohar

2) International journal for research in technological studies| vol. 1, issue 5, april 2014 | issn (online): 2348-1439Review on design of cam geometry for minimization of fillet radius effect in square hole drilling operations R.d.gohil, m.s.kagthara

3) International journal for engineering applications and technology Modification of drilling tool to make square hole (bangar sunil kisan, prof. Mythili sreeram.)

4) Indian j.sci.res.1(2) : 583-586, 2014

1corresponding authorSquare hole created by drilling down by using universal non Shahramhosseini chaleshtori.