Review on Design of Cam Geometry for Minimization of Fillet Radius Effect in Square Hole Drilling Operations

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Abstract—*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. But with using this type of cutter we can produce almost square hole not exact square hole because there left a fillet radius on each corner of square which required further operation. To overcome these problem different types of drilling cutters are introduced in this work.*

Keywords: Square hole drill, fillet radius, Reuleaux triangle, floating chuck.

I. INTRODUCTION

Hole serves various purposes in any machine element. These holes may be round, square, rectangular or any other shape depending on the requirement. For round holes, the machines are available in the market. But for square or any other type of holes, the Methods presently used are broaching, electrode-discharge machine (E.D.M.), and electro-chemical machine. These are very expensive and require special tools or machines.

In square hole drill operation we can make square hole using reuleaux triangle tool with universal joint mechanism.The shape of the reuleaux triangle can be used to drill a (nearly) square hole. The triangle rotating about an axis through its centre and the axis itself tracing a curve as shown fig.
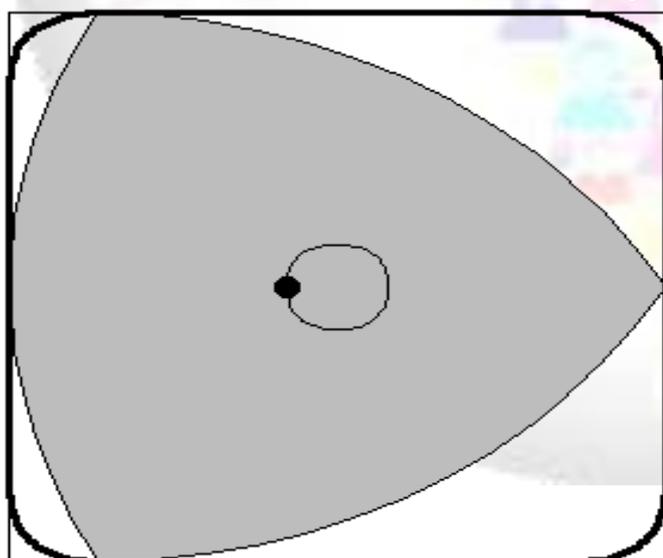

Fig.1: Reuleaux triangle

The reuleaux triangle is a constant width curve based on an equilateral triangle. All points on sides are equidistance from opposite vertex and its trajectory of three points can be shown as follow.
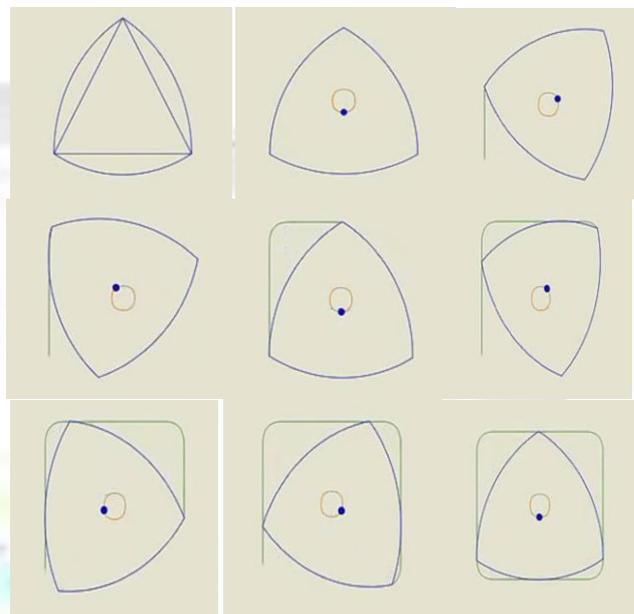

Fig.2: Trajectories of reuleaux triangle

Suppose we want to do drilling a square hole operation on a flat plate of any straight edge, the flat side on which we want to do the square drilling operation, we have to place the work piece on the work piece holder so that the face near to that cutter remains on each of the faces of the work piece. At the time switch on the hand drill machine. When hand drill starts properly, slide the reuleaux casing on the sliding bars. Thus by cutter the square drilling operation on the work piece is to be done.

II. VARIOUS METHODS TO MAKE SQUARE HOLE

According to the Mr. R. G. Sparber [1]there are four basic approaches to making square hole,

1. Only remove material
2. Only add material
3. Remove and add material
4. Reshape Existing Material

Mr. Barry Cox and Stan Wagon [2] investigate how one can turn circular motion into square motion by a purely mechanicallinkage; an application is to the construction of a drill that drills *exact* square holes. They conclude with an extension of this idea to a drill that drills hexagonal holes.They showed that A Reuleaux triangle is a shape made from arcs of circles centered at the vertices of an equilateral triangle (Fig. 3). It has constant width. When rotated inside a square, each vertex traces a curve that is almost a square. If one makes a cutting tool at each vertex (by cutting away part of the device so as to have a sharp end at each vertex) then this shape can be used to make a working drill that drills almost-square holes. For this to work from a rotating drive (such as a drill press) one must force the Reuleaux triangle to rotate inside the square, and that requires a square template to constrain the Reuleaux triangle as well as a

special coupling to address the fact that the center of rotation moves. In this paper they discussed an idea that is no more complex, but leads to a drill that produces *exact* square holes.
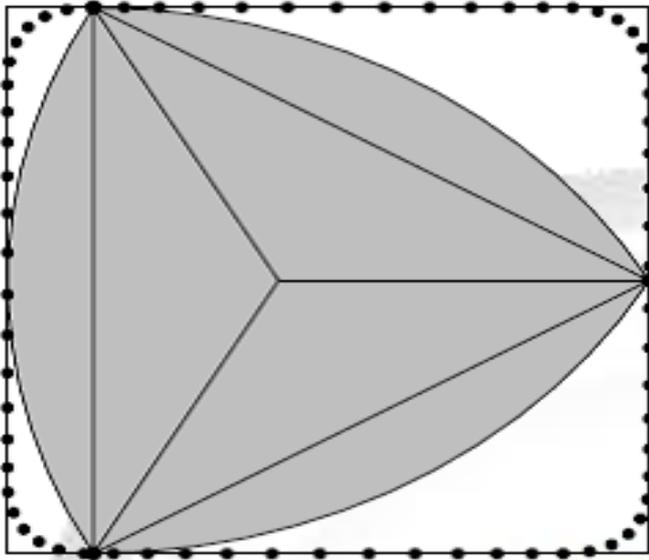

Fig.3: The locus of a vertex of the Reuleaux triangle is almost square

Mr.Gurpreet singh heer[3] has done design and fabrication of square hole drill machine. He makes special type mechanism that involves the use of special floating chuck, which allows the drill to wobble and a guide plate which guides the drill to make the square shape of cavity. Cutting is done by the ends of the drill as with straight flutes. The rotary motion from drilling machine is transmitted to floating chuck which provides floating type motion which allows wobbling the drill and helping in making corner of square hole.cam provide exact size of the hole. The major improvement in the accuracy can be attained during manufacturing and drill point geometry, along with the shorter and stiffer drill due to which it produces accurate size of hole.

According to Mr. Scott G. smith [4] reuleaux triangle is the basis of a tool that produced holes with an almost square cross-section which is most recently used. In this method, the reuleaux triangle rotates smoothly within a square housing, the three cutting bits trace out a curve that is almost, but not exactly, a square hole. He showed various mathematical formulas to represent the path of reuleaux triangle which is not circular but nearer about square. He is showed various position of reauleaux triangle in different quadrant with help of mathematics.

III. Various Drill Bits (Cutters) Used To Make Square Hole

Mr.Roger J. Morrell [5] introduced square hole drill having a cutter head configuration whose outline is in the form of a Reuleaux triangle and which also has a planetary gear drive. Two counter revolving motions are present in the drill at the same time. One is the pure rotary motion of the drill's cutter head about its own shaft. The other is the circular motion of the cutter head as a unit about a center line due to its eccentric mounting and drive.
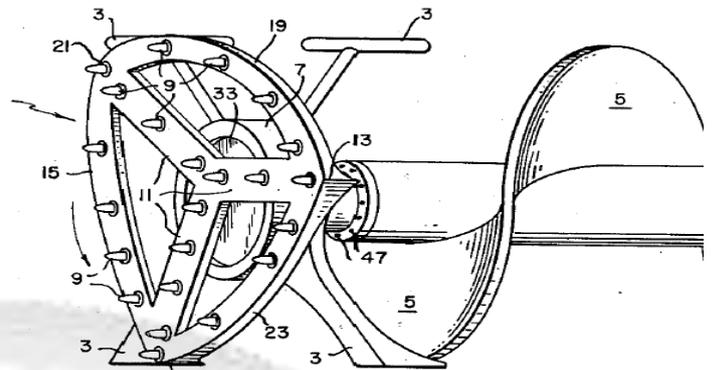

Fig.4: Reuleaux type drill cutter

Mr. Erick A. Sandoval [6] provides a square hole cutter that can be completely disassembled into its individual moving parts. It is one object of this invention to provide a square hole cutter that has all the individual moving parts attach to a central hub position. It is another object of the this invention to provide a square hole cutter that has unitary one piece rotary cutters that attach directly onto the central hub. There is an additional object of the this invention to provide a square hole cutter that has a central rotation gear that is slide by disposed over the central rotating shaft.
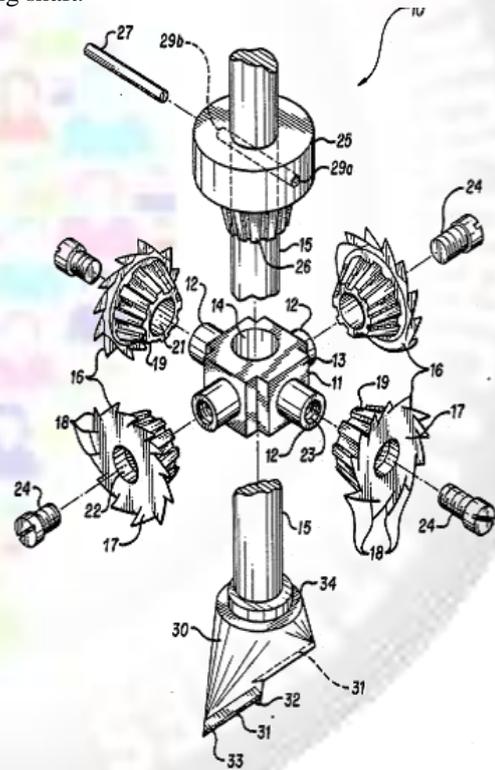

Fig.5: Disassembled type drill cutter

IV. Conclusion

From above work, we can show that we can produce square hole with different method but from the above, reuleaux triangle type drill tool is more effective compare to other. However, still thereis a problem of fillet radius on each corner of square hole.so there is much work required to reduce fillet radius of square hole.

V. REFERENCE

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