Design And Fabrication Of Drill Bit Reconditioning Fixture

Srinivasa kannan Jeyakanthan[1]

[1] *UG student, Department of Mechanical Engineering, Prince Shri Venkateshwara Padmavathy Engineering College, Chennai, Tamilnadu, India*

ABSTRACT

Drill bits have so far been manually grinded in order to restore their functionality conforming to specified lip angle. Usually drill bits have been grinded manually by some skilled operators. Due to this sometimes imperfections may occur, leading to reduced drill bit's efficiency. This project aims at developing a fixture which is capable of holding drill bit firmly against the grinding wheel during reconditioning or re-sharpening process making it less susceptible to minor deviations from specified lip angle. This fixture could be mechanically operated by even a less skilled operator. Also this fixture will eliminate the need for tool inspection during or after reconditioning. It also reduces wastage of drill tools which have been not preferred after a wearer condition. In addition, the cost of buying a new drill bit can be reduced by using this fixture and can prolong the lifespan of the drill. It also helps the drill bits to be more economic. However, this fixture is a hope that will be a successful product and be able to use to sharpen blunt drill bits to the exact angle safely and effectively.

Keyword: - *Drill bits, fixture and grinding wheel.*

1. INTRODUCTION

In many industries, high speed drilling operations were carried out, as it was a preliminary step for mass production. During this operation we have many possibilities for wear of the drill bits i.e. the edges of the drill bits get more wear. At that time the drill bits have been re-grinded. The grinding may be done manually or by using some automated arrangements. Manual grinding may cause damages to the drill bit chisel edges. This manual grinding or sharpening of drill bits were called off-hand method. It requires that the operator should have the knowledge of drill tool's geometry. So our idea is here to implement a fixture arrangement in order to avoid those kinds of failures. The fixture arrangement is very simple and leads to a smooth grinding operation and also to increase the repeatable usage of such drill bits. This fixture is fixed to the bench grinder by means of some clamping arrangements. Various types of drill bits can also be grinded by using this fixture by with respect their respective tool geometry. This fixture arrangement will be fixed nearer to the bench grinder setup. This was more simple and a time consuming process for the sharpening of the drill bits.

1.1 General Description of fixture

A fixture is a work-holding or supporting device, which is used in the most of the manufacturing industry. Fixtures are used to securely locate (position in a specific location or orientation) and support the work, ensuring that all parts produced using the fixture will maintain conformity and interchangeability. Fixture is used in order to improve the production economy. This can be achieved by allowing smooth operation and mainly quick transition from part to part, reducing the requirement for skilled labor by simplifying how work pieces are mounted, and increasing conformity across a production run.

Fixtures must always be designed in an economic way; the purpose of these devices is to reduce costs, and so it must be designed in such a way that the cost reduction outweighs the cost of implementing the fixture. These design considerations include many factors like weight of the component .The frame of fixture should be strong in nature in order to withstand deflection. The reason for the deflection of fixture is because of cutting force, work piece clamping or clamping to the machine table. The frame of the fixture should have the enough mass to prevent vibration. Frames may be built from simple sections so that frames may be fastened with screws or welded whenever necessary.

2. LITERATURE REVIEW

P.Stephen Antony Predeep, S.Sivason Raja, C.Rammurugan, R.Senthilkumar (2015) [1], performed an analysis and suggested a design procedure for the drill bit fixtures. Here they monitored the tool design, which have been conventionally used in the industries for the machining process. Their main aim was to reduce the production cost for the tool bits by making some alterations in design of the drill bits and simultaneously they encrypted the design requirements for the jigs and fixtures. They calculated the clamping forces which were acting normally while holding a component. This implementation reduces the labour cost and also serves as an exemplary for machining accuracy.

Dhanraj Patel and Rajesh Verma (2015) [2], conducted an analysis of drill tool life based upon their various operations .They have taken various types of drill bit which were classified based upon their geometry. Various drill tool nomenclature were determined and they were taken into consideration for the analysis purpose. They done an experimental analysis for a constant hole depth for various types of drill bits for the same work piece material. They finally made a conclusion regarding the life of drill bits by taking the various forces acting along the surface of the drill bits. This forces which were acting may be in a varying form or a constant form depending upon the feed rate and depth of cut of the drill tool it also impinges on the tool life criteria of the drill bits.

B.Suresh kumar and N.Baskar (2014) [3], investigated the process of drilling over the titanium alloys by the both conventional and CNC machines. He performed an experimental analysis work and founded results for them and he plotted them with a graph. They calculated the various parameters like thrust force cutting speed and machining time for the titanium alloys. They also concluded the various parameters like force, cutting speed varies for both the CNC and conventional process. It was also founded that there was more roughness experienced on the surface in case of CNC machining when considered to conventional machining. This conclusion bought a rectification that drilling process depends upon both the conventional and CNC machining process.

Mohd Najib Bin Talibin and Haji Mohd Mahadi Bin Haji Mydin (2014) [4], designed a drill bit sharpening device which rectifies the various discrepancies which were happening in the manual grinding of the drill bits. They made a detailed survey regarding the various drill tool angles depending upon their materials and also their dimensions. He implemented a complete arrangement for the grinding process; he determines the need for the fixture in order to grind the drill bits depending upon their various angles like relief, lip angle, etc. Here a special grinding wheel attachment has been encrypted and it contains a diamond dressed grinding wheels. It will serve as more cost efficient and time consumption process. This machine is capable only of grinding the twist drill bits not for all the other drill bits.

Nikhil G. Lokhande and C.K.Tembhurkar (2012) [5], designed an angular drilling fixture and they also analyzed the cutting forces during the drilling operation. They have done CAFD (Computer Aided Fixtures Design) methods in order to design the fixtures. They encrypted the use of the fixtures for the drilling operations. They also did an angular drilling which was drilled by using a different form of fixture. They performed the analysis test on the drill bits based upon the forces acting on it. They collected a summary about the various forces which were acting along the drill bits by using the ANSYS software.

3. PROBLEM IDENTIFICATION

We identified that the drill bits which have been re-grinded manually, may exhibit some imperfections .These imperfections are due to improper grinding of drill bits with respect to their lip angle and relief angle .This leads to a problem called negative relief which affects the drill bits life. It also impacts on economic factors.

Usually a common problem which arises from drill bit sharpening will be called as negative relief. This negative relief will occurs when the material is taken from the trailing edge of the bit surface. This trailing edge will be at the same stage or higher than the cutting edges. The sharpening wheel creates a flat cutting surface on the point of the bit, but this must be "trimmed" in order for the cutting surface on the bit to work correctly. Negative relief can be caused by a broken or worn sharpening tube. It also depends on the type of drill bit being sharpened, a usage of dirty chuck, or by incorrect technique. This manually sharpening method is raw at best and it is mainly depend on the eye of the operator to place the correct angle on the drill bit. In a drill bit, usually the two sides were sharpened at various angles. Also drilling straight through a work piece is a very difficult and impossible task.

4. CAD MODELLING

Design process was carried out using Solidworks software and the drafting process is carried out using AUTOCAD software. The design of components started from scrap defining dimensions for each and every component. A number of models were developed before actually confirming the final design. Due to several reasons such as material wastage, cost effectiveness, time involved in fabrication, difficulties in manufacturing a number of design changes were made and obtained as final model as shown in the figure 1 and 2.

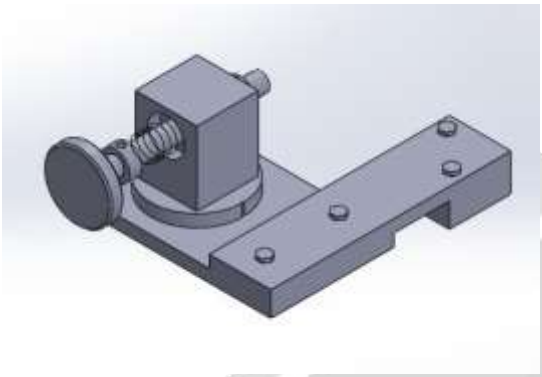

Fig-1 Isometric view

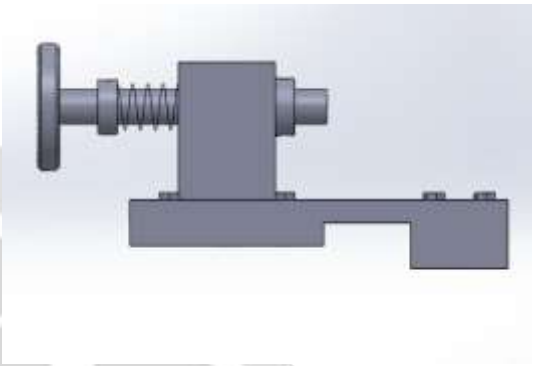

Fig-2 Side view

5. WORKING

Drill bit which has to be grinded is fitted in the 1/2"inch chuck by means of the chuck key. The required helix angle for the particular drill bit will be noted down. Then the circular plate is loosened by means of the Allen key, such that it can be rotated and kept to a suitable lip angle. Then the circular plate with the rectangular block was tightened to that required position. Here, the handle and the connecting shaft were connected by grub screws as shown in the above figures. This grub screw is used to maintain a spring action for the forward and backward movement of the handle. By pressing the handle, the drill bit along with chuck will be moved towards grinding wheel.

This makes the contact of the grinding wheel with the drill bit. The handle is gradually rotated in order to grind the drill bit. After finishing the grinding operation, the handle will come back by means of spring action which is provided beneath the rectangular block. Again the handle is rotated to grind the other end of the drill bit. Then the handle is pressed and the tool is grinded. Suitable relief angle was provided by adjusting the clamping screw at the connecting point of the bench grinder and the fixture.

5.1 Design Calculation

5.1.1 Cutting Speed Calculation

Cutting speed, $v = \frac{\pi * d * N}{1000}$

Where, d - diameter of grinding wheel = 200 mm

N - Speed of grinding wheel = 2500 rpm

$$v = \frac{\pi * 200 * 2500}{1000}$$

$$v = 1570.79 \text{ m/min}$$

5.1.2 Specification Of The Spring

SPRING SPECIFICATION:

Length of the spring, L = 37.5mm

Wire diameter, d = 1.5mm

Coil diameter, D = 22mm

No of coil, n = 5

Maximum deflection of the spring, δ = 12.5mm

5.1.3 Calculation Of Load Acting On The Spring

$$\text{Deflection of the spring, } \delta = \frac{8 * P * D^3 * n}{G * d^4}$$

$$12.5 = \frac{8 * P * 22^3 * 5}{81370 * 1.5^4}$$

$$12.5 = \frac{425920 * P}{411935.625}$$

LOAD APPLIED P = 12.08 N

5.1.4 Calculation Of Stiffness Of The Spring

$$\text{STIFFNESS , } S = \frac{\text{LOAD (P)}}{\text{DEFLECTION (} \delta \text{)}}$$

$$S = \frac{12.089}{12.5}$$

STIFFNESS OF THE SPRING, S = 0.967 N/mm

5.1.5 Angle Specifications

HELIX ANGLE SPECIFICATIONS = α [We know that α = θ/2]

For conventional twist drills ($\theta = 118^0$) = $\alpha = 59^0$

For split drills ($\theta = 135^0$) = $\alpha = 67.5^0$

For counter sink drills ($\theta = 82^0$) = $\alpha = 41^0$

RELIEF ANGLE SPECIFICATION = β

For all the types of twist drill Relief angle = $\beta = 6^0 - 15^0$

6. FINAL ASSEMBLY OF FIXTURE

Fig-3 Final Assembly

Fig-4 Final Assembly Attached With Bench Grinder

6.1 Advantages

1. It reduces drill tool failure due to improper grinding.
2. It is very economic when compared to CNC drill sharpener.
3. Not only twist drills; split and counter sink drills can be ground.
4. Suitable and cost efficient for small scale industries.
5. Time consumption is less.
6. An unskilled operator can also operate.
7. Safety of the operator is ensured.

6.2 Applications

1. This project suits well applicable in production and manufacturing industries.
2. Mainly it can be used in small scale industry.
3. Serves more efficiently in mass production areas.

7. CONCLUSION AND FUTURE SCOPE OF THE PROJECT

Thus the fixture was fabricated. The scope of this project lies in fully determining and understanding the functioning of fixture and exploring the different possibilities of utilizing the fixture for different processes, etc. This project has addressed the most common problem arising from drill bit sharpening called negative relief, thus redefining the conventional drill bit re-conditioning techniques. Thus this fixture will not only serve as an effective and efficient means, but also it will ensure the safety of the operating personnel.

We can further develop more features in this fixture. We can encrypt the idea of multi chuck arrangement similar to lathe machines, so that we can grind drill bits with diameters more than 12mm as we were using a ½ inch chuck in this fixture.

Some changes in the clamping arrangement can also be made in order to fix this fixture not only with bench grinder but also with tool and cutter grinder, as this fixture was a portable one. We can improve the clamping arrangement in order to provide suitable relief angle for with respect to the type of grinder.

8. REFERENCES

[1] P.Stephen Antony Predeep, S.Sivason Raja, C.Rammurugan, R.Senthilkumar (2015), 'Optimizing the method of Work holding device- Drill Jig with Adjustable Drill Bush', International Journal Of Innovative Research In Science, Engineering And Technology, Vol. 4, Special Issue 6, May 2015, pg 561-564.

[2] Dhanraj Patel and Rajesh Verma (2015), 'Analysis of Drilling Tool Life', International Journal Of Mechanical Engineering and Robotics Research,

[3] B.Suresh kumar and N.Baskar (2014), 'Surface roughness model of drilling in titanium alloy', International Journal of Advanced Manufacturing Technology.

[4] Mohd Najib Bin Talibin and Haji Mohd Mahadi Bin Haji Mydin (2014), 'The Drill Bit Sharpening Device', Journal of Mechanical Manufacturing.

[5] Nikhil G. Lokhande and C.K.Tembhurkar (2012), 'Advanced Fixture for Angular Drilling on Cylindrical Objects', International Journal Of Engineering Research and Applications.

[6] Michael Stampfer, (2008) 'Automated setup and fixture planning system for box-shaped Parts', International Journal of Advance Manufacturing Technology.

[7]Joshi P.H., 'Design of Jigs And Fixtures', Third Edition, Tata McGraw-Hill Education.

[8]Cecil J., (2008) 'A Clamping Design Approach for Automated Fixture Design', International Journal of Advance Manufacturing Technology.

[9]Edward Hoffman, 'Jigs and Fixtures Design', Fifth Edition (2004).

[10]Colvin, Fred H., Haas, Lucian L.,(1938) 'Jigs and Fixtures', A Reference Book, McGraw-Hill Book Company.

[11]Henriksen, Erik K.,(1973) ' Jig and Fixture Design Manual', New York, N.Y: Industrial Press Inc.