THE DRILL BIT SHARPENING DEVICE

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ABSTRACT
The present innovation provides a drill bit sharpening device, for use with a support carrying a rotatable grindstone and having pivot arm retaining means. The device comprises a drill bit jig having clamp means for releasable retaining drill bit in position where in the drill bit axis extends forward from the clamp along a corresponding clamp axis. Whereas, my project will be ‘Drill Bit Sharpening Machine’ which is focused in the safety purposes where the aim is to protect from any external injuries as well as able to sharp the blunt drill bits providing safe distance from the rotating grindstone while holding it. Our design of machine is focused on to sharpen a drill bit to its right angle which could be set and adjusted through the machine easily to revolve the correct angle. In addition, the cost of buying a new drill bit can be reduced by using this machine and can prolong the lifespan of the drill bit. However, ‘Drill Bit Sharpening Machine’ 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.

Keywords: Drill, Drill Bit Sharpening machine, Twist Drill Bits, Chuck, Brushless AC Motor

1.0 INTRODUCTION
Drill bits are cutting tools used to create cylindrical holes, almost always of circular cross-section. Bits are held in a tool called a drill, which rotates them and provides torque and axial force to create the hole. There are several types of drill bits are used currently such as Spade, lip and spur (brad point), masonry bit and twist drill bits. Our focused will be on standard size Twist Drill Bits. Twist drills become dull and must be sharpened. The preferred method of sharpening a twist drill is with the drill grinding machine which is done manually by holding and feeding the blunt drill bit on to the rotating grindstone, but this machine is not always available in field and maintenance units, so the offhand method of drill sharpening must be used (Figure 1). The offhand method requires that the operator have knowledge of the drilling geometry (Figure 2).

Figure 1: Offhand method of drill  
Figure 2: Drilling geometry point
So in order to improve the usage of twist drill bits, we have to give priority on the sharpening angle of the bits. We have to input some alternative helps on sharpening drill bits manually. For example, technology input to invent a machine for sharpening the bits. Thus, ‘Drill Bit Sharpening Machine’ which uses mechanical parts to sharpen the bits. After researching and identifying the problems, we invented an idea that to create the ‘Drill Bit Sharpening Machine’. This machine can upgrade the capability of human to sharpen twist drill bit easily into the correct angle and increase its life span. The design of ‘Drill Bit Sharpening Machine’ uses the rotating diamond shrill to sharpen the blunt twist drill bits. Diamond shrill is assembled and joined to the brushless dc motor through a shaft which is powered by electric power supply (AC-110/220) and the speed of the motor is constant that is 5000 rpm. The working (grinding area) which is the separate part of the body consists of the chuck assembly which is to hold the drill bit. The chuck assembly is adjustable to hold and tight up twist drill bit that will be sharpened using specified collect sizes. Then it is set according to the required angle of its muzzle. Alignment assembly, where the distance of drill bit is set to be in correct distance to be feed onto the rotating diamond shrill. The machine’s motor is turned on. Finally, the chuck will be inserted on the grinding frame, twisted 45 degree to left and right while the blunt drill bit will hit the rotating diamond wheel and sharpened to its angle.

2.0 METHODOLOGY
The most common problem arising from drill bit sharpening a condition called negative relief. This occurs when the material taken off the trailing edge of the bit surface (also called the heel), is insufficient, and the trailing edge is at the same level or higher than the cutting edge. 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, the type of drill bit being sharpened, a dirty chuck, or by incorrect technique. This manually sharpening method is crude at best and relied on the eye of the operator to place the correct angle on the drill bit. Often, the two sides of the drill bit were sharpened at different angles, making drilling straight through a work piece a very difficult and often impossible task. The drill bit was also frequently over-heated, creating a drill bit that would lose its sharp edge almost instantly once started through a work piece hence it’s dangerous to the person who handles it. Thus, in our new invention the vice will be holding the drill bit in a locked position, our drill bit sharpening machine ensures that both faces of a drill bit are sharpened at precisely and the correct angle. For existing equipment on the market it require highly skilled operators to sharpen a drill bit with the manual method. Produce a machine drill bit sharpener that cost-effectively in terms of handling.

Reduce the cost of buying a new drill bit. If using manual grinding method, the angle on the drill bit is inaccurate. From a safety factor design, manually grinding tool bit will potentially cause injury to the operator. The scope of our project is mainly on sharpening drill bits. There are several types drill bits such as Auger Bits, Spade Bits, Spur Point Bit, Forstner Bit and so on. In our project we focus on Twist Drill Bits, which commonly used in machining process. Drill bit geometry has several aspects: Twist bits are probably the most common drilling tools used by the handyman with either a hand or electric drill. The front edges cut the material and the spirals along the length remove the debris from the hole and tend to keep the bit straight. They can be used on wood, metal, plastics and similar materials. Most twist bits are made from either. High speed steel’ (HSS), these are suitable for drilling most types of material, when drilling metal the HSS stands up to the high temperatures. Carbon steel’, these bits are specially ground for drilling wood and should not be used for drilling metals, they tend to be more brittle, less flexible than HSS bits. Twist bits are also available coated with Titanium nitride (TiN); these are easily identified by the gold like color. This coating increases the hardness of the bit and adds a self-lubricating property. The coating is only really effective when metal is being drilled, it has little effect when working with other materials Twist drills are usually available in sizes 0.8-12 mm plus. They are designed for drilling relatively small holes; they sometimes tend to clog quickly
especially when the wood is ‘green’ so when drilling deep holes (especially in hardwood) the bits should be withdrawn regularly to remove the waste. Special care is required when using the smallest sizes since these bits are thin and brittle. Always hold the drill square to the work and apply only light pressure when drilling. Whereas the scope of sharpening of our machine is to sharp twist drill bits from 3mm – 8mm. It has potential to sharp high speed steel bits, carbon steel bits, and the most effective will be the carbide bits because our machine uses rotating diamond grinding wheel which is produced using the hardest material (diamond).

3.0 PROJECT PROTOTYPE

Drill Bit Sharpener Machine is a machine for sharpen drill bits with the method easier and more effective than using the manual method. The purpose of using this sharpener machine operator is to obtain the accuracy of the angle on the drill bit. The machine uses the concept where it uses rotating diamond shrill to sharpen the blunt twist drill bits. Diamond wheel is assembled and joined to the ac brushless motor through shaft which is powered by electric power supply and the speed of the motor is constant on the size of the drill bit that will be sharpened. These parts are assembled at the base level of the machine. The grinding level which is the outer fit of the body consists of the grinding area (grinding frame), which is fixed beside the motor assemble, chuck assemble is inserted with collect inside to hold the drill bit according to its size. The chuck assemble is adjustable to hold n tight up twist drill bit from the size of 2.5mm, 3.0mm, 3.5mm, 4.5mm, 4.8mm, 5.0mm, 5.5mm, 6.0mm, 6.5mm, 7.0mm, 7.5mm, 8.0mm which are the standard sizes used in the workshop. After tighten up the specified drill bit which going to be sharpened onto the chuck, its then have to be set according to the required angle of its muzzle. After the angle of sharpening is set according to center point (alignment), the machine’s motor is turned on. Finally, the chuck will be inserted onto the grinding frame (hole) twisted and the drill bits move 45 degree left and right touching the rotating diamond shrill.

<p>| PARTS LIST |</p>
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<tr>
<th>ITEM</th>
<th>QTY</th>
<th>PART NUMBER</th>
<th>DESCRIPTION</th>
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<td>MAIN MACHINE BASE</td>
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<tr>
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<td>1</td>
<td>TRANSFORMER BASE</td>
<td>ACRYLIC</td>
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<td>3</td>
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<td>COLLECTS PLACEMAT HOLDER</td>
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<td>4</td>
<td>1</td>
<td>TRANSFORMER COVER</td>
<td>ACRYLIC</td>
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<tr>
<td>5</td>
<td>1</td>
<td>CHUCK HOLDER</td>
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<td>6</td>
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<td>GRINDING WHEEL COVER</td>
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<td>7</td>
<td>1</td>
<td>MOTOR HOLDING PLATE</td>
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<tr>
<td>8</td>
<td>1</td>
<td>GRINDING FRAME</td>
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<tr>
<td>9</td>
<td>1</td>
<td>BRUSHLESS MOTOR</td>
<td>AC 220V-110V</td>
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<td>1</td>
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<td>110V-250V</td>
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<td>14</td>
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<td>DIAMOND WHEELS</td>
<td>CUBIC BORON NITRIDE (CBN)</td>
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<tr>
<td>22</td>
<td>1</td>
<td>SET CENTER</td>
<td>ADJUSTABLE SCREW</td>
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Figure 3: Drill bit sharpening machine
4.0 DATA ANALYSIS

Calculating Motor Speed: A squirrel cage induction motor is a constant speed device. It cannot operate for any length of time at speeds below those shown on the nameplate without danger of burning out. To calculate the speed of an induction motor, this formula is used:

\[
\text{Srpm} = \frac{120 \times F}{P}
\]

Srpm = synchronous revolutions per minute.
120 = constant
F = supply frequency (in cycles/sec)
P = number of motor winding poles

\[
\begin{align*}
\text{Srpm} &= \frac{120 \times 167}{P} \\
\text{Srpm} &= \frac{120 \times 167}{4} \\
\text{Srpm} &= \frac{20040}{4} \\
\text{Srpm} &= 5010 \text{ rpm}
\end{align*}
\]

Calculating Braking Torque: Full-load motor torque is calculated to determine the required braking torque of a motor. Torque is the force that produces rotation. It causes an object to rotate. Torque consists of force acting on distance. Torque, like work, is measured in pound-feet (lb-ft). However, torque, unlike work, may exist even though no movement occurs.

\[
T = \text{full-load motor torque (in metric Nm)}
\]
\[
5252 = \text{constant (33,000 divided by 3.14 x 2 = 5252)}
\]
\[
\text{HP} = \text{motor horsepower}
\]
\[
rpm = \text{speed of motor shaft,}
\]

25 HP, 240V motor rotating at 5010 rpm?

To calculate motor full-load torque, apply this formula:

\[
T = \frac{\text{HP} \times 5252}{\text{rpm}}
\]
\[
T = \frac{25 \times 5252}{5010}
\]
\[
T = 26.21 \text{ Nm}
\]

Connecting Shaft (Torsion) a shaft was made by using conventional lathe machine. The material used is also mild steel, same as all of the other parts of the project. By using the lathe machine, the piece of cylinder mild steel is cut to the desired shape and size. The shape and size was calculated to make sure that the shaft is able to support and able to hold the diamond sharpening wheel when it rotates. The calculation result is shown below.

P = load
L = length between support
I = moment inertia of the cross section of the beam
E = modulus of elasticity of the beam
\[ y = \frac{PL^3}{107EI} \]
Ek = 200GN/m²
I = BH³/12
H = 6 mm
Length of the Shaft
B = 5 mm
Moment Inertia of the Cross Section of the shaft
I = \frac{5(6)^3}{12} \times 10^{-12}
= 9.0 \times 10^{-11}

4.1 Linkage
A mechanical linkage is an assembly of bodies connected together to manage forces and movement. The movement of a body (motor and diamond grinding mill), link, is studied using geometry so the link is consider to be rigid. The connections between links are modeled as providing ideal movements, pure rotation or sliding for example and these are called joints. Linkage modeled as a network of rigid links an ideal joint is called as a kinetic chain. These rigid bodies, connected together to produce a desired motion for performing a particular task. For example, in cars linkage mechanism form a lot of parts for the car, such as the suspension system, windscreen wipers and windows regulator. In fact, the linkage mechanism is one of the most commonly used of the mechanism in a wide variety of mechanism.

M = 3(n – 1) – 2j
= 3(8 -1) – 2(10)
= 21 – 20
= 1

4.2 Analysis on Angle Measurement
Smaller drills may flex and vibrate when sharpening is attempted. This can cause the drill to “catch” on the wheel and brake so it isn’t a viable way to sharpen small drills. Small drills must be held closer to their point to avoid this problem but the chuck then conflicts with the wheel when inclined to the secondary relief angle. Drills down can be sharpened by grinding only the primary facets, i.e. similar to standard sharpening. A primary relief of 15 degrees works if the extension from the collet is set at 0.170" or so. This allows sharpening small drills but requires care to avoid contact with the chuck nut - it clears the wheel by only 1/16" or so. Drills bits usually have a point angle of 118° or 130°. There are also 120°, 135°, 140° and 150° point angles. Hard steel and stainless steel require larger point angles. Also aluminum is best drill with a larger point of angle. When drilling Plexiglas, the risk of cracks when the drill goes through the material is reduced with a larger point angle. Centering drills usually have a 90° point angle. A drill bit needs to have the right lip clearance angle to cut the material. The clearance angle varies from 7° to 14°. A drill with a larger clearance angle cuts more easily, but if the angle is too large, vibrations will occur and the drill will cut irregularly and quickly become dull. If the clearance angle is too small, the drill will not cut at all, but will become hot and rapidly destroyed. The optimal clearance angle for the job depends on the material – a harder material requires a drill with a smaller clearance drill while a softer material can have a larger angle. The size of the drill is also a determinant for the selection of the optimal clearance angle. A larger drill should have a smaller clearance angle while a smaller should have a larger one. Many new drill bits are ground with a basic cone point. The two cutting lips meet in the Centre and form a chisel edge, C. This point geometry is not ideal, since the chisel edge needs to be pressed into the material without
cutting. The friction of the chisel edge creates much heat, which decreases the life of the drill bit. Since the chisel edge has no tip, the drill walks when drilling a new hole, which is not pre-drilled. More expensive drill bits are ground with special points of various types. These drills must be sharpened in their original production machines or in special machines, which are available only at a few specialist sharpening shops. They can also be re-shaped to a 4 facet point with the Tormek attachment.

Drill bit with the angle 118° are used for the normal drilling material such as wood.

![Figure 4: Normal Drill](image)

Meanwhile drill bit with the angle 150° are used for harden material such as high carbonate steel.

![Figure 5: for Harden Materials](image)

Drill bit with the angle 125° are used for the alloy and stainless steel.

![Figure 6: For Alloy and Stainless Steel](image)

Lastly drill bit with the angle 90° are used for the cast iron and aluminium.
Figure 7: For Cast iron and Aluminium

4.3 Flexibility and Precision of Twist Drill Bits

Always equal cutting edges
The two cutting edges are sharpened symmetrically and work in perfect unison which prolongs the life of the drill.

Sharpens all point angles
It can be set at any angle between (135°, 125°, 118°).

Always the right clearance angle
The optimal clearance angle is to ensure the finishing of sharpening is done perfectly.

Sharpens small drill sizes
The same drill holder copes with drills from 3 mm to 8 mm. Chuck and collects required according to drill bits size.

4-Facet point
The chisel edge comes to a point and will not walk. Bores a round, straight hole with close tolerances.

Figure 8: Flexibility and Precision of Twist Drill Bits

4.4 Total Cost of Project
The total cost of the project is the counting in all the previous costs that are require to complete the project. The total cost of the project is the following:

\[
\text{Cost of mat} + \text{machining cost} + \text{Overhead cost} = RM 1119 + RM 125 + RM 12.50 = RM 1256.50
\]
5.0 CONCLUSION
The production of “Drill Bit Sharpening Machine” prevent the problem that have arisen so that various injuries can be prevented and the life span of twist drill bits, which are used in workshop can be used efficiently and longer in time span. This discussed the techniques of old problems where the most common problem arising from drill bit sharpening a condition called negative relief. This occurs when the material taken off the trailing edge of the bit surface is insufficient, and the trailing edge is at the same level or higher than the cutting edge. Thus, we have decided to invent a machine called “Drill Bit Sharpening”, to overcome the existing of the current problem.

6.0 BIBLIOGRAPHY


