International Journal of Electrical and Electronics Engineers
Vol. No. 8, Issue No. 02, July-December 2016
ISSN (O) 2321-2055
ISSN (P) 2321-2045

A NEW MODEL OF CORDLESS HAND DRILL DESIGNFOR THE AUTOMOTIVE INDUSTRY BY USING 3DSOFTWARE

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ABSTRACT

The objective is to develop a new model of cordless hand drill that can be adapted for use in the automotive industry as well as other applications was met. The design is portable, easily adaptable and trendy. The model was made using 3D software to show exactly how it would look. The cordless hand drill is perfectly suited for use in industry because of its size, simplicity and versatility. The removable handle, along with other features which make it unique would make it tool that every engineer and DIY enthusiast needs to include in a toolset.

Keywords: Automotive, Cylindrical, Conceptualization, Hand Drill

I. INTRODUCTION

A drill is cylindrical end-cutting tool used to originate or enlarge circular holes in solid material [1]. A cordless hand drill uses energy supplied by a battery installed in it to rotate a drill bit or screw bit at very high speeds to complete the task at hand. There are different types of cordless hand drills which can be used in different ways. Some common uses of a cordless hand drill are; as a high-speed screw driver, drill fine holes in wood, concrete or metal, and during dry wall installation. The purpose of this paper is to explain and identify the design structure of a new cordless hand drill design in detail, explain and identify the application and limitation of the cordless hand drill, develop and assemble the components in the completed 3D assembly drawing and exploded view drawing.

1.1 Design Conceptualization

Almost all contemporary tools and electronics seem to be built with one thing in mind: size. The engineering world is especially concerned with how to make things smaller yet still practical enough to complete the given task. This idea was the driving force behind this design;a cordless hand drill with all the basic parts, that is, chuck, power button, forward/reverse switch, battery and speed selector all assembled on one surface of a simple body structure that is not longer than 250 mm. This design also has an additional optional handle which can be assembled and tightened easily per the user's preference. A sketch of the design is shown in the "Fig.1".

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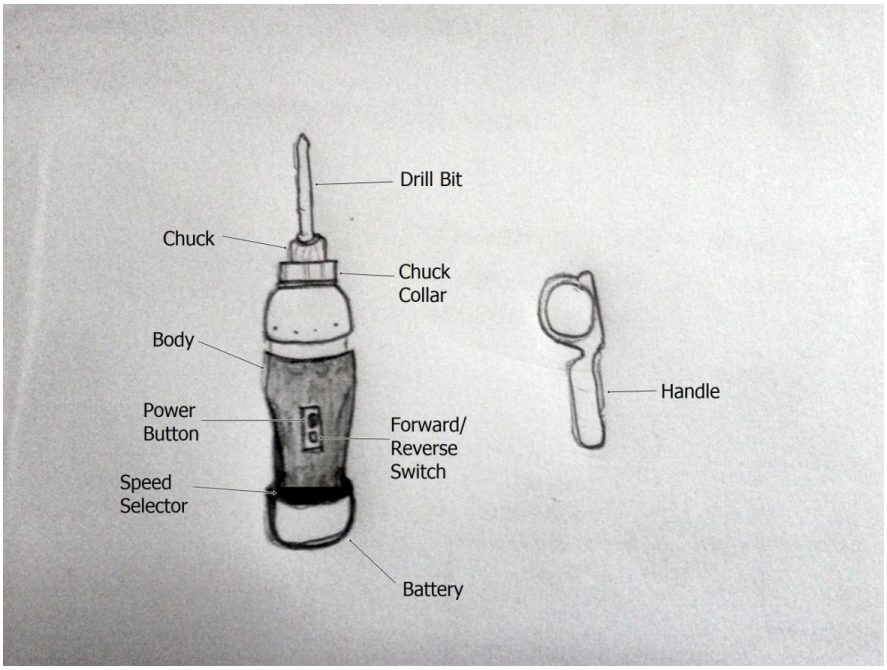

Figure 1–Sketch of Cordless Hand-drill Design

II. CORDLESS HAND DRILL STRUCTURE

The cordless hand drill is designed to be a portable, convenient and adaptable tool that is readily available to an engineer in the workshop. For this reason, a typical hand drill weighs between 3kg and 7kg depending on the complexity of its design. The part to part specifications of this design are further explained below:

2.1 Body

The body is made to fit in the hand of an average size user in a way that is comfortable and convenient enough to apply a force in the direction of drilling without easily losing hold of it. The body of the drill is where all the parts are assembled and fitted into. It is made from steel, which is the best material because is tough, strong and durable yet not too heavy because it is assembled in sheets to increase its malleability. Electroplating the body with copper makes it more resistant to corrosion and improves it appearance. The "Fig.2" below shows the design for the body and also in "Table.1" shown parts of the drill body.

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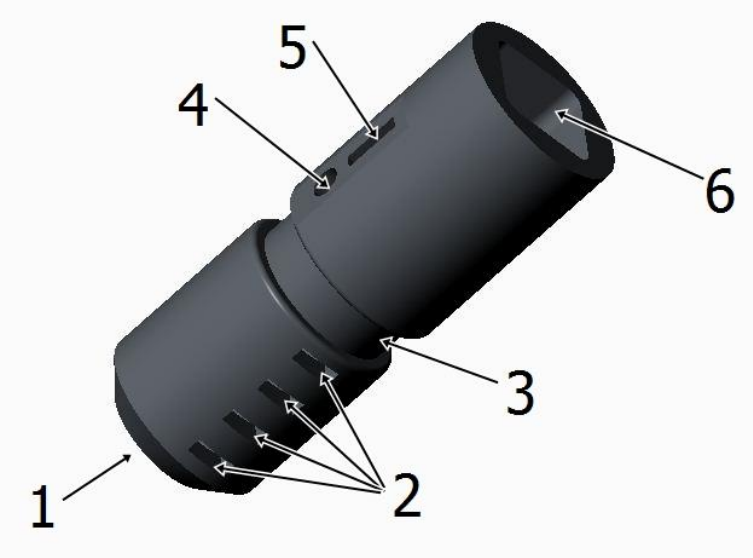

Figure 2 - Drill Body

1	Hollow where Motor is inserted		4	Hollow for power button/torque selector assembly
2	Air vents		5	Hollow for forward/reverse switch assembly
3	Where the handle is attached		6	Hollow where battery is inserted

Table 1 - Parts of the Drill Body

Compared to most drills on the market, this drill is designed to be small and lightweight. The length of the body is only 165 mm and width is 60 mm. This was deliberately done to increase its portability and usability.

2.2 Battery – the battery is fitted into the bodyand can be released either for charging or replacement. The introduction of the lithium-ion battery several years ago, which combine a huge energy density with light weight [2] is essentially what popularized the use and manufacture of cordless hand drills. A high speed- high torque drill would be mostly required in the automotive industry. For this reason, the battery of this drill is an18-volt battery lithium-ion battery which by itself adds about 3kg to the drill [3]. It is held together in a battery pack which is made to fit perfectly into the body.

On the surface of the battery pack is the point where the charger is connected. Once the charger is connected, a charger indicator light turns on automatically to verify that the battery is charging and turns off automatically when charging is complete or when the charger is disconnected. In a regular drill, a trigger is used to turn the drill on and offand to vary the torque delivered by the drill bit. In this design, a Power Button instead of a trigger is used. The power button is located on a panel on the surface of the drill right next to the forward/reverse switch which has the function of changing the direction of rotation of the drill bit. The normal use of a cordless hand drill involves turning it on and off to drill at different places or drill more accurately or simply, to save battery energy. There is also a need to regularly alternate the direction of rotation from clockwise to

anticlockwise especially when screwing and loosening screws and nuts using a screw bit.Another important component of the cordless hand drill is the Speed Selector. A good drill should be able to reach speeds of up to 2000 RPM. The drill designed for use in the automotive industry has a speed selector to vary the speed of revolution to encompass a wide range of uses. The speed selector is also fitted to the body and is made of steel to match the body.Speed is adjusted by turning the speed adjuster either clockwise or anticlockwise around the body.

At the front end of the drill is the Chuck which holds the Drill bit or Screw bit in place. It does this using adjustable jaws which can be loosened or tightened to accommodate drill bits and screw bits of up to 13 mm diameter. Older models of drills needed a key to be turned in adjusting the jaws but newer versions such as this one can be adjusted by grasping the Collar of the chuck in one hand and using the other hand to screw the chuck. Because of this, it is called a Keyless Chuck. The part to which the keyless chuck is attached is called the Chuck Collar. The chuck collar is made from steel. It holds the chuck in place and assists in the removal of the drill bit. It is also attached to the motor whose main function is to convert electrical energy from the battery into mechanical energy in the form of rotary movement of the drill or screw bit. The figure below shows a combination of the chuck collar and the motor.The Drill bit is the most active part in the drill because it rotates at extremely high speeds. It is made from High Speed Steel (HSS) which is a special type of carbon steel that can withstand high temperatures while maintaining its structure. Temperature is raised by high speed turning but High Speed Steel can undergo these types of drillings. It is coated with titanium nitrate, which give the drill bit better lubricity, decreasing friction and helping to extend the bit's life [4]. If the task required to be completed is screwing and not drilling, a screw bit can be used instead. A screw bit is basically a screw driver that can be mounted on a drill for faster and more efficient screwing.

The screw bit is made from low carbon steel which is not as strong as high speed steel used for the drill bit; it need not be because its usage is not as rigorous as the drill bit. It can be used manually even when the drill does not get any power from the battery. Low carbon steel is also cheaper to manufacture and buy.The final component of the drill is the handle. Most conventional drills have a fixed handle at the end of the drill which acts as a battery pack yet for my design, the handle is an additional option. With a body width of only 60mmthe drill is small enough to fit well in the hands of a user. If, however, there is need for extra grip and force, the user may attach the handle to the body. It is made from steel but can be covered in rubber to make it easier for a user to hold.

When all these parts are assembled, the complete drill as seen from different views looks as follows in "Fig.3 and Fig.4":

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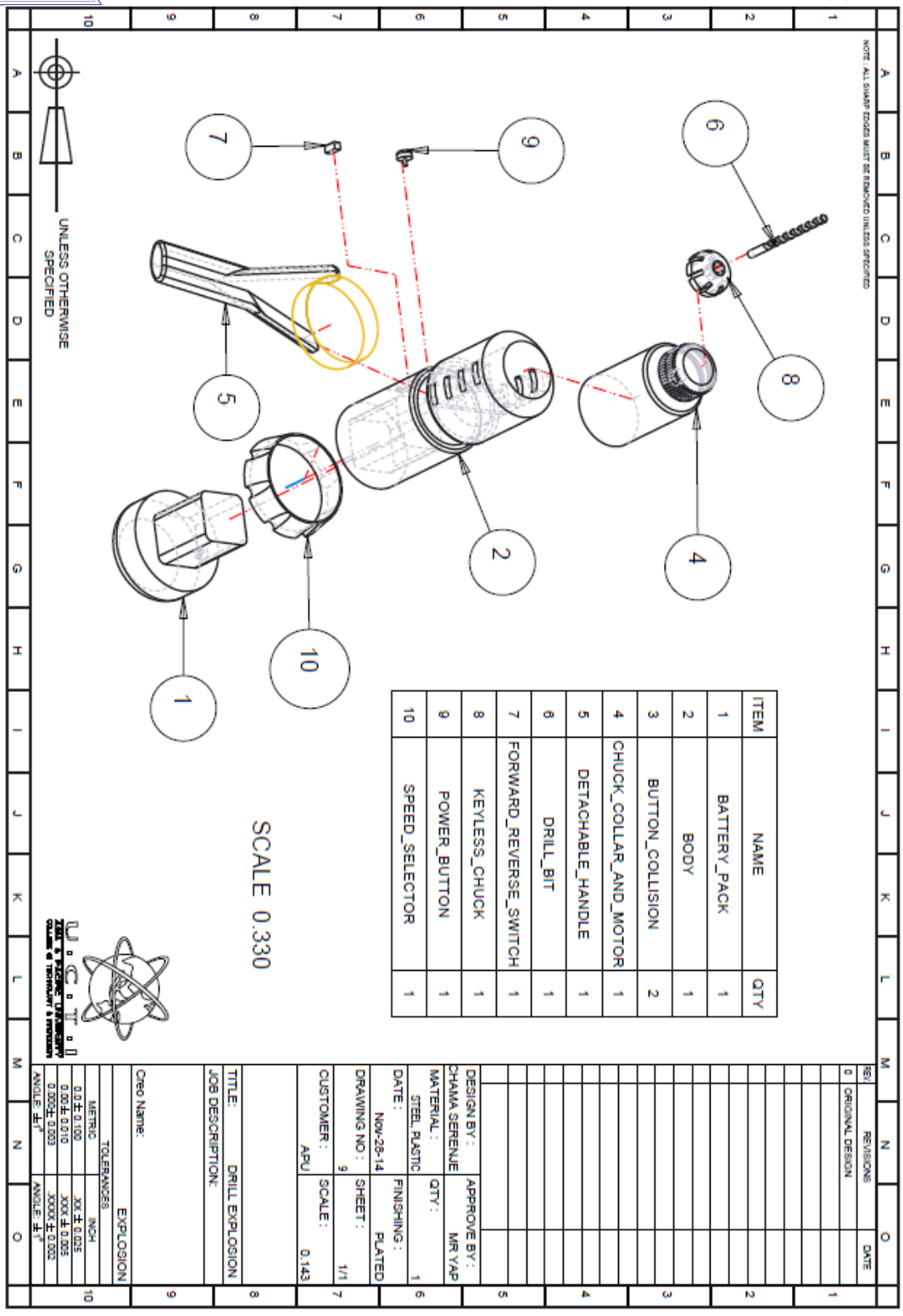

Figure.3 Assembly drawing

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Figure.4 - Cordless hand drill structure

III. APPLICATION OF THE CORDLESS HAND DRILL

The hand drill that designed is made for use in the automotive industry, however, it can be extended to fit other uses. The main applications identified are during the manufacturing process and aftermarket procedures.

3.1 Drilling holes on the Chassis of a vehicle being manufactured.

As previously mentioned, some automobile manufacturers choose to completely automate their car production. For example, regarding the manufacture of the BMW 3 series in a Munich plant, it is said that "Industrial robots are an integral part of chassis construction with a degree of mechanization exceeding 95%" [5]. This reduces the importance of tools such as a cordless hand drill. However, some production lines go the complete opposite direction when it comes to car manufacture. The rare and extremely pricey Ferrari 250 GT California is said to

be completely hand crafted and assembled [6]. To accomplish a task like that, a cordless hand drill is needed to drill holes through the chassis where bolts and nuts are screwed. The chassis is the skeleton of the motor vehicle to which the body and other parts are mounted. It consists of a steel frame supported by springs that hold the body. Below is a sample of the chassis of a car cabin with holes drilled in it using a hand drill.

3.2 Another application of the cordless hand drill in the automotive industry is to drill holes in the body to attach aftermarket products.

Aftermarket parts are all the parts of the vehicle that can be changed or removed after production is complete. They include parts like long antennas and power mirrors which can easily be attached on the body of a vehicle. Though the body is not usually as hard as the chassis, a cordless hand drill can still be used not only to drill holes but also to screw on nuts ad screws if a screw bit is used instead of a drill bit.The drill can also be used for simpler tasks related to automobiles and mechanics in the automotive industry. Anything from loosening screw to remove headlamps, tightening screws inside the car, removing car seats, dissembling parts of an automobile and many more. The drill can be used as a manually operated screw driver when the battery runs out or when there is no power to electrically drive the screw bit.The portability of the drill allows it to be used anywhere. There is no need for an external power supply if the battery is fully charged. Simply press the button and get to work.The simplicity of the cordless hand drill I have designed allows it to be used by anyone from an experienced mechanic to a regular automobile driver. It does not have complicated buttons or procedures for usage. It is designed specifically for simplicity and usability.

IV. LIMITATIONS OF THE CORDLESS HAND DRILL

Because of its size, the drill cannot accommodate a bigger motor or even a bigger battery. The advantages of having a bigger motor and battery are that they would collectively be able to deliver a faster torque, quicker speed and more power to the drill bit or screw bit. Another limitation of the cordless hand drill is a limitation of all battery powered devices; what to do when the battery runs out. The simple solution would of course be to charge it but charging takes some time. This means that work involving the drill would have to be suspended for the duration of changing.Furthermore, the performance of the battery deteriorates with time. At some point, it would have to be replaced which is an added expense and a burden to the user.

V. CONCLUSION

Though the cordless hand drill is tremendously useful in dynamic ways, it can also be quite dangerous if used improperly. Its power to drill through virtually anything makes it a dangerous tool if a working drill bit came into contact with skin or bones. Friction caused when drilling raises the temperature of the drill bit and the surface being drilled on which can cause harm to a user. Additionally, drilled debris can fly into the eyes of a user also causing serious irreversible damage. Extra care needs to be taken when using the drill. The objectives successfully achieved with this new model of cordless hand drill and it can be adapted in various automotive

industries as well as other automotive applications. The main feature of reliability and versatility also supported by this new model.

VI. ACKNOWLEDGMENT

The authors would like to share thanks to Mr Umapathy Eaganathan, Lecturer in Computing, Asia Pacific University, Malaysia for his constant support and motivation helped us to participate in this International Conference and also for journal publication.

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