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AERONAUTICAL AND MECHANICAL ENGINEERING****Reduction of Chamfer Variation in Deburring Operation****S.Rajkumar¹, M.Karpagaraj², S.Poornakumar², R.Silambarasan²**

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Abstract

Conventional automobile power steering consists of rack tube. In manufacturing of rack tube the first machining process is drilling. After the completion of drilling operation, burrs develop in the rack tube which has to be removed. The deburring operation is accomplished with the help of deburring machine. After fixing the job in deburring machine a sudden impact is produced on the rack tube, by a spring actuated slotter which results in offset from the center point. After a detailed investigation over the method of fixture, the modification of fixture set up was done. Instead of controlling the fixture by spring a hydraulic actuator is replaced. After replacing the spring by a hydraulic actuator the sudden impact on the rack tube is avoided and hence the smooth operation and accurate diameter is obtained after the deburring process.

Keywords—Actuator, Drilling, Diameter, Fixture, Rack tube.

1. Introduction**1.1 Deburring**

Metal burr extending beyond the edge of the cut this piece, when view on the cut face top and from the bottom. A burr is a raised edge or small pieces of material remaining attached to a work piece after a modification process.

It is usually an unwanted piece of material and when removed with a deburring tool in a process called 'deburring'. Burrs are most commonly created after [machining](#) operations, such as [grinding](#), [drilling](#), [milling](#), [engraving](#) or [turning](#). It may be present in the form of a fine wire on the edge of a freshly sharpened tool or as a raised portion of a surface; this type of burr is commonly formed when a [hammer](#) strikes a surface. Deburring accounts for a significant portion of manufacturing costs. The finishing operation is a critical step in the manufacturing of parts from hard metals. By automating the finishing and chamfering processes, tolerances could be held to less than 0.08 mm(0.003 in), the finishing costs could be reduced as much as 50%, and the rework rates could be nearly eliminated [6]. Figure 1.1 shows the Burr Forming.



Figure-1.1 Burr Forming

1.2 Types of Deburring Methods

- Manual deburring
- Electrochemical deburring
- Thermal energy method
- Cryogenic deburring

1.2.1 Manual Deburring

Manual deburring is the most common deburring process because it is the most flexible process. It also only requires low cost tools and allows for instant inspection [1]. Figure 1.2 shows the Manual Deburring.



Figure-1.2 Manual deburring

1.2.2 Electrochemical Deburring

Electrochemical deburring (ECD) is the use of [electrochemical machining](#) to deburr precision workpiece and edges that are hard-to-reach, such as intersecting holes. The process uses a salt or [glycol](#) solution and electricity to dissolve the burr.

1.2.3 Thermal Energy Method

Thermal energy method (TEM), also known as thermal deburring, is a deburring process used to remove hard-to-reach burrs or burrs from multiple surfaces at the same time. The process uses an explosive gas mixture to provide thermal energy to burn off the burrs. It is the fastest burr removal process, requiring only 20 milliseconds to remove a burr.

1.2.4 Cryogenic Deburring

Cryogenic deburring is a [cryogenic](#) process used to remove burrs and [flash](#) from [plastic](#) and [die cast](#) workpieces. The process works by tumbling or abrasively blasting the workpieces at cryogenic temperature levels. This process has been around since the 1960s to deflash plastic and rubber. Common materials that are

typically cryogenically deburred with blast media include PEEK, nylon, Teflon, Delrina, polypropylene, polycarbonate, acetyl, PTFE, PET, HDPE, PVC, ABS and many others [1].

1.3 Mechanical Deburring Processes

Mechanical deburring encompasses many types of processes, including:

- Cutting processes
- Power brushing
- Bonded abrasive finishing
- Mass finishing
- Abrasive blasting

1.4 Chamfer Operation

A chamfer is a [beveled](#) edge connecting two surfaces. If the surfaces are at right angles, the chamfer will typically be symmetrical at 45 degrees. (By contrast, a [fillet](#) is the rounding off an interior corner and a rounding of an exterior corner is called a round or radius). Chamfer is a term commonly used in [mechanical](#) and [manufacturing engineering](#). Special tools such as [chamfer mills](#) and [chamfer planes](#) are available. In tile work, or furniture such as counters or table tops, an edge or [arras](#) that has been eased by rounding instead of chamfering is called a [bull nose](#). Where a chamfer does not go to the end of the piece, but lifts out in a smooth curve, the end is called a lark's tongue [5].

2. PROBLEM IDENTIFICATION AND METHODOLOGY

2.1 Problem in Deburring

The figure 2.1 shows the problem in drilling. After completing the rack tube drilling process, having burr in the rack tube. Rack tube having burr



Figure-2.1 Burr Removing for Rack Tube

Component is placed in the Deburring machine. In the Deburring process burr has been removed but the problem is having chamfer variation and change in diameter.

2.2 Process of Manufacturing Rack Tube for Steering

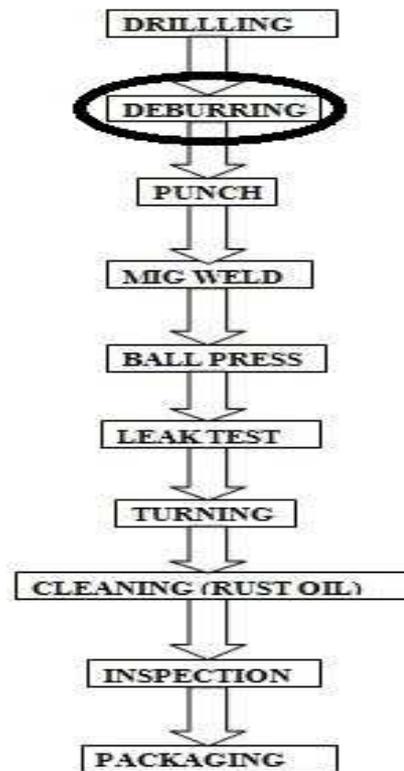


Figure-2.2 Flowchart of the Manufacturing Process of Steering

MATERIALS

Materials used for steering Tractor are AL307 and L90.

Drilling

A drill is a tool fitted with a cutting tool attachment or driving tool attachment, usually a drill bit or driver bit, used for drilling holes in various materials or fastening various materials together with the use of fasteners.

Deburring

Metal burr extending beyond the edge of the cut piece, view on the cut face (top) and from the bottom (bottom). A burr is a raised edge or small pieces of material remaining attached to a work piece after a modification process.

Punch

Punch was done for the checking process of manufacturing the steering. Example: PM00001, it shows the P- Year, M- Month, 00001- Number of component manufactured.

MIG weld

Welding means joining of two metals, MIG welding is particularly used for some type of special components.

Ball press

Ball pressing is used to give the accurate thickness and diameter of the rack tube.

Leak test

Leak test is done for the checking the material while leaking or not. This test was done through the water or normal fluids.

Turning

Turning is two types. Such as ID (Inside Diameter) and OD (Outside Diameter) turning. It was done through the required dimensions.

Cleaning

Cleaning is used for cleaning the oil, wastes, etc., in the rack tubes. Rust oil is mainly used for the cleaning purpose.

Inspection

Inspection is done for checking the components have any crack, leakage, bend, etc.

Packaging

After the completion of inspection process, the manufactured components are packed to the required customers and market.

3. EXPERIMENTAL SETUP

Components

- Electric motor, Double Acting Cylinder, Drill Tool, Pressure Relief Valve, Belt and Pulley, Drill Pushing

3.1 Electric Motor

An electric motor is an electric machine that converts electrical energy into mechanical energy. In normal motoring mode, most electric motors operate through the interaction between an electric motor's magnetic field and winding currents to generate force within the motor. In certain applications, such as in the transportation industry with traction motors, electric motors can operate in both motoring and generating or braking modes to also produce electrical energy from mechanical energy.

3.2 Double-Acting Cylinder

Figure 3.1 shows the view of double-acting cylinder is a cylinder in which the working fluid acts alternately on both sides of the piston. Double-acting cylinders are common in steam engines but unusual in other engine types. Many hydraulic and pneumatic cylinders use them where it is needed to produce a force in both directions [4].

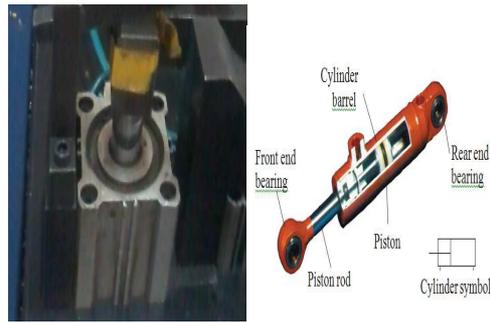


Figure-3.1 Double-Acting Cylinder

3.3 Drill Tool



Figure-3.2 Drill tool

Figure 3.2 shows the view of Drill tool. A drill is a tool fitted with a cutting tool attachment or driving tool attachment, usually a drill bit or driver bit, used for drilling holes in various materials or fastening various materials together with the use of fasteners

3.4 Pressure Relief Valve

Figure 3.3 shows the view of Pressure Relief Valve and Symbol. The relief valve (RV) is a type of valve used to control or limit the pressure in a system or vessel which can build up by a process upset, instrument or equipment failure, or fire [2].

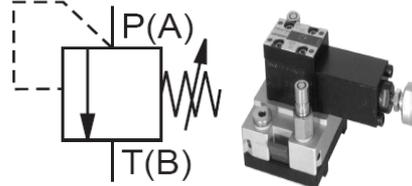


Figure-3.3 Pressure Relief Valve and Symbol

3.5 Belt and Pulley



Figure-3.4 Belt and pulley

A belt and pulley system is characterized by two or more pulleys in common to a belt. This allows for mechanical power, torque, and speed to be transmitted across axles. If the pulleys are of differing diameters, a mechanical advantage is realized. Figure 3.4 shows the view of Belt and pulley.

3.6 Drill Bushing

A drill bushing, also known as a jig bushing, is a tool used in metalworking jigs to guide cutting tools, most commonly drill bits. Other tools that are commonly used in a drill bushing include counter bores, countersinks, and reamers. They are designed to guide, position, and support the cutting tool. Figure 3.5 shows the view of Drill Bushing. The two types of bushings are press-fit bushings (wearing bushings) and renewable bearings (liner bushings).



Figure-3.5 Drill Bushing

4. RESULT

4.1 Deburring Machine

The above problem has been solved by the using of double acting cylinder and machine tool. Double acting cylinder is used for the smooth moving operation instead of spring. Machine tool for the purpose of removing the burr in the rack tube. Figure 4.1 and 4.2 shows the view of Deburring Machine.

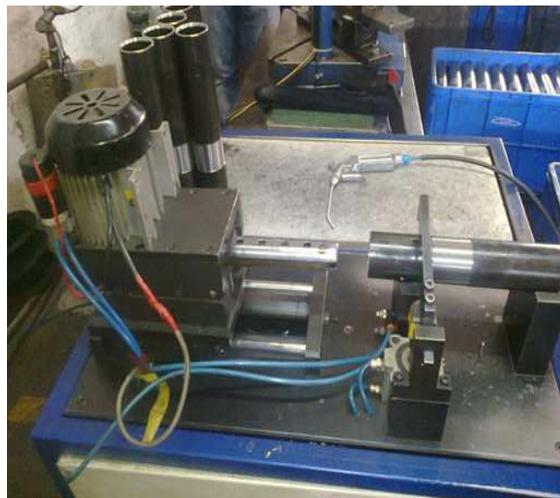


Figure-4.1 Deburring Machine

4.2 Work piece



Figure-4.2 Work piece

Operations : Main bore and cross holes intersection deburring

Quality : Basic acceptance as per functional check and technical specification

5. CONCLUSION

Conventionally automobile power steering consists of rack tube. In manufacturing of rack tube the first machining process is drilling. After the completion of drilling operation, burrs develop in the rack tube which has to be removed. After fixing the job in deburring machine a sudden impact is produced on the rack tube, by a spring actuated slotter which results in offset from the centre point. After a detailed investigation over the method of fixture, the modification of fixture set is to be done. Instead of controlling the fixture by spring a hydraulic actuator is replaced. After replacing the spring by a hydraulic actuator the sudden impact on the rack tube is avoided. Hence the smooth operation and accurate diameter is obtained after the deburring process. So, by replacing the spring actuator by a hydraulic actuator in a deburring machine the operation can be made smoother and the offset can be avoided, resulting in accuracy.

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