A Review on Optimization and Analysis of Machining Process for Differential Case

Hardik K. Bhatt[1] Prof. Jay K. Pandya[2] Prof. Hitesh L. Jadav[3]
[1]P.G Student [2,3]Assistant Professor
[1,2,3]Department of Mechanical Engineering
[1,2,3]HJD-Institute of Technical Education and Research, Kera- Kachchh-370430 (India)

Abstract— Differential casing is an important component of an automobile. It is first casted with sand casting and then two machining process (i.e.) milling and turning are carried out on it. In this project the machine development process is introduced. In which the milling and turning operation are combined together to form a same differential. As a result of which the production will be increased, reduce loading/unloading time, reduce lead time, increase surface finish and reduce cost per component of differential case.For this combined machining operation a new design of fixture is designed for the ATM machine with same operational sequence with turning and milling machining operations which results in optimum machining time. Compare the old machining cycle time with the new developed machining cycle time.

Key words: Accuracy, Cycle Time, Differential Case, Fixture Design, Machining Operation

I. INTRODUCTION

These are Differential Cases which house the Side Gear and Pinions. Two sizes of differential pinion and side gear are used in the cases. These are SG Iron casting procured from of the most reputed foundries in India & China and machined to extremely close tolerance.

Machined from nodular cast iron and housing the vehicle differential gear assemblies, differential housings present difficulties in terms of interrupted cuts during roughing passes. Surface finishes and tolerances must be held to customer standards, and machining operations involve custom combination tooling such as turning heads, drills and reamers.

A. Types of Differential Housing:

Four rear axle housings are used in the early Falcons. Three different size ring and pinion gear sets. The 6 3/4-inch gear is used only with the 2 and 4 door sedans, with the144 cid. The 7-inch gear is used only in taxis, Rancheros, and station wagons with 144 cid. All models with the 170 cid used the 7-1/4 inch gear. The sedan uses a 2.440" wheel (axle) bearing diameter. Taxi, Ranchero, and station wagon had a 2.677" wheel (axle) bearing diameter. Three types of differential case are used.

1) One-window case:

The one-window case and the two-piece case are used in all four housings in all combinations with various ratios.

2) Two-Window Case:

The two-window type is used only in 2 and 4 door sedans with the 144 cid, and is used in this housing only with a 3.10:1 ratio.

3) Two-Piece Case:

The one-window case and the two-piece case are used in all four housings in all combinations with various ratios.

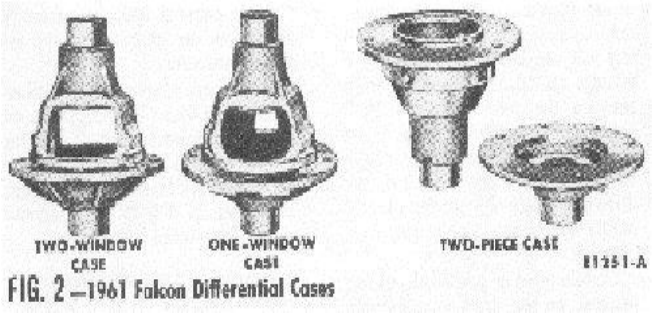


Fig. 1: Various Types of differential Housing

B. Machining Process:

There are mainly two types of machining process used for differential casing are given below.

1) CNC Milling Machining:

CNC milling uses commands or G codes to program machinery. Each alphanumeric codes has a designated functions to be performed by the machine

The drill and turn along axis to cut and shape metal and wood.

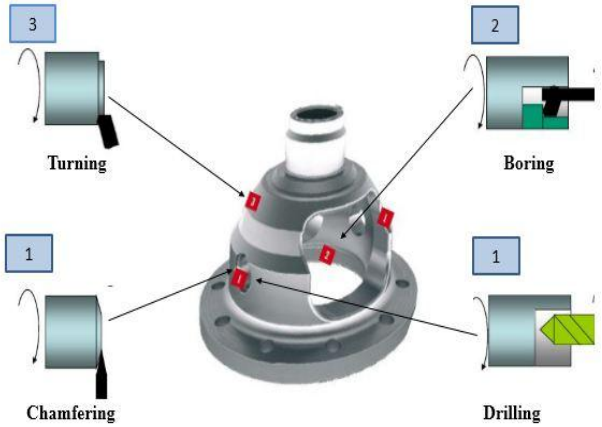
X and Y axis are labeled to complete vertical movements and Z axis are labeled to perform horizontal machine movements.

2) CNC Turning Machining:

CNC turning refers to the automated machining process of shaping material such as metal, wood of plastic, Using CNC machine.

During the CNC process a work piece of material is rotated and a cutting tool is moved parallel to the axis of rotation to produce precise diameters and depth

It can be performed on outside on W/P or the inside to produce tabular component to various geometries.



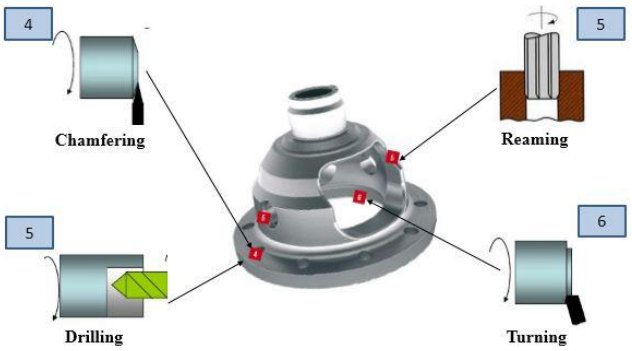


Fig. 2: Machining Process

II. LITERATURE SURVEY

Time rolls on and shadow falls but the work carried out by the eminent personalities will always be the stepping-stone for the future revelations. As the saying in all matters success depends on preparation; without preparation there will always be failure. This section briefly discusses about the previous work carried out by the researchers in the various fields which are related to topic and helped one gain to build platform for my work.

Ishwar Bhiradi et al. [1] derived that, before conducting time study, it is very much necessary to consider the motion study also. Hence motion study can be considered as a basis for time study. In this study Basic time has been calculated for each element and then analyzed the obtained data for changes to be implemented on machine. Then the new work method is developed by eliminating hydraulic setup and the change is horizontally deployed on the work station to get the tangible benefit of time study. To eliminate the observer's errors in collection of time data, one can implement the automation using handheld computers or video recorders. By this work measurement method productivity got improved 35% without investing extra resources. This approach explains the best way of increasing productivity by eliminating the ineffective efforts by the operators and the machine shop as well.

N. P. Maniar et al. [2] has adopt an integrated approach of design and mass balancing of rotary fixture in this work. Here the research work of this paper is proved 10 million rupees are straight away saved in machine installation cost. In HMC, a tool rotates and component remains stationary, vice versa for CNC turning centre. A designed fixture has the important novel characteristic of performing all operations in a single set up with component rotating and tool stationary, satisfying the essential requirement of CNC turning centre. A simplified, analytical method of use of creo Elements/Pro 5.0 is proposed to solve the balancing problem. By this study, conclude that the VIII Quadrant Computer Aided Mass Balancing Method is found more accurate with the result of decrease in percentage error by almost 6 % in comparison to IV Quadrant Computer Aided Mass Balancing Method.

Vinay Kharche et al. [3] conclude that the purpose of the paper was used to automata the preprocessing of automotive differential case and help user to get consistent quality without any error. It helps in productivity improvement by reducing repetitive activities and performing a quality check and re meshing if quality is not good. It also enable best practice through standardizing CAE process and minimize CAE set up time. The time required in this process is reduced 30 % of manual process.

Richard A. James et al. [4] design a lightweight aluminum differential housing to replace the cast-iron housing used in the Torsen® T-1. The redesigned housing was destined for use in the 2004 MIT Formula SAE vehicle, a small high-performance formula-style car. The maximum input torque available was calculated from the capabilities of the FSAE vehicle which determined the ultimate magnitude of the internal forces within the housing.

Goutham.N et. al [5] had taken into account the work piece location, clamping stability under dynamic machining and frictional conditions at the interface between jigs and fixture elements and work piece. Concluding contributions of this paper in the area of jigs and fixture design are Fixture design under machining effect, and its manufacturing considerations Necessity of clamping location, tool guiding and work piece mounting with respect to machine co-ordinate Various aspects of layout design and planning of jigs and fixtures Brief on necessity of automation on jigs and fixture design.

III. CONCLUSION

Today, there are various technique available for improve the machining operation for manufacturing of differential case. The purpose of the paper was used to automata the preprocessing of automotive differential case and help user to get consistent quality without any error. It helps in productivity improvement by reducing repetitive activities and performing a quality check and re meshing if quality is not good. It also enable best practice through standardizing CAE process and minimize CAE set up time. The time required in this process is reduced 30 % of manual process.

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