Abstract

Background/Objectives: Gear measurement is an important as well as critical step and it is done in bench centers by using instruments which have a gear with mandrel. However, this method is found to be time consuming. In addition it is very difficult to execute this process without additional man power. Methods/Statistical Analysis: In the existing method of measurement using bench centers includes a surface table which contains head, dead center. In this proposed measuring machine we introduced a digital dial indicator arrangement to measure whole depth of the gears. Findings: It reduces the measuring time as well as man power required. In this proposed research work, an attempt has been made to reduce the time taken in measuring the whole depth, face out and run out in gears from 10 minutes to 7 minutes that is 30% reduction. Application/Improvements: Thus proposed method would be well matches for modern gear manufacturing industries to obtain micron level measurement in terms of time as well as man power consumption.

1. Introduction

Productivity as well as quality is the main concern in the division of manufacturing. In view of obtained high productivity the efficient process or else activities must be carried out in the industrial organisations. Also, Productivity could be enhanced through minimizing overall manufacturing time in addition merging various operations involved in the production and so on. Developments of particular essential machines are the most excellence method for improving the rate of production along with better quality. The anchor head for a specific size, machine process is carried out via CNC three- axis milling machine (Fanuc control). The machined job through designed jig has high accuracy, surface finish, reduced cost of manufacturing, increasing company’s productivity rate and quality. The application of Value Stream Mapping (VSM) in detail by identifying the waste and its sources the present and future states of value stream maps are developed to improve the production. This improvement technique focuses the
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The productivity of the specific company has improved by using line balancing technique. It is acts as a simulation tool to find the solution for Small Medium Enterprise (SME) incapable of competing with large companies manufacturing plant, assembly line with Low skill and knowledge in management. By defining the problem that may happen in the exiting line and give alternative of new assembly line, the problem is solved. The automated drilling machine is mainly designing for drill the required hole automatically according the depth of the drill. The main purpose of the automatic drilling machine is to drill the jobs frequently at the various depths with maintaining the process sequence. In the automatic drilling machine motor has been controlled accurately. All manufacturing defects in gear and defects in the torque with load and varying surface smoothness of mass-produced gear mounting in the assembly are more apparent at higher speeds with an increase in speed viscous lubricants cause a greater increase in friction torque.

Takt time derivates from the German word “Taktzeit”. The definition of takt time is the time sandwiched between the duration of the unit output regarding the production due to the demand by the customer. It may be derived through dividing the current rate of production divide by product demand for that particular period. It requires a balanced distribution of job. The important benefits of the takt time control as understand the shortage and it’s dependable at the entire period of production. It also gives performance response instantaneous as consider as the incentive advantage. The restraint imposed through lean manufacturing philosophy make simpler the control of manufacturing method that offer inspiration to decrease variability in manufacturing system. A process for new model is designed for achieving customer’s intention. Novel manufacturing goods is an assembly elementthrough spot welding about 192 welding points as well as by arc welding 12 arc seams. A component has been assembled with 24 elements by means of the process of spot welding and 96 welding points as well as arc welding 8 arc seams. The missing component assembly of 22 elements including spot welding and 96 welding point with arc welding 4 arc seams.

Measurement of the whole depth of gears is an important as well as critical step it is done in bench centers using an instrument which have a gear with mandrel. However, this method is found to be time consuming. In addition it is very difficult to execute this process without additional man power.

With the aim of reduce the takt time required for measuring whole depth, faceout and runout in gears with accuracy, we introduced a digital dial indicator arrangement through this research work.

2. Transmission of Power

The formal definition of power in the system of international is the units of energy per unit time. Although the growth of technology and power transmission as well as system of storage have been comprised in huge attention towards the technologists along with technology user.

2.1 Gear Box

The gearbox consists of input shaft, the output shaft the counter shaft, 6 pair of gears and shifter of rods/linkage assembly. The power from the engine come from input shaft and directly attached to gears A, means gear A, is rotating same rpm with the engine. The power is transferred to gear B, gear B, will be rotating at different speed and opposite direction of gear A and so is the whole counter shaft, which means gear B,D,F,H,L is all rotating same rpm with gear B.

In neutral position all gear rotating only output shaft and synchro ring X, Y, Z is not spinning. In 1st gear synchro ring Y slides to gear E. In 2nd gear synchro ring Y slides to gear G and hence the output shaft spins same rpm with gear G, other gears are also spinning but they don’t have effective since they are not locked. Number of teeth gear B divides by no of teeth gear A ratio is 1 and number of teeth gear G by number of teeth gear H ratio is 2. Then the ratio 1 and 2 is multiplied together, we get ratio and the gear ratio is always output teeth over input teeth. In 2nd gear synchro ring Y is slide to gear E. In 3rd gear Synchro ring X slides to gear C. In 4th gear synchro ring X slides to gear A (direct drive), ratio 1:1.5th gear synchro ring Z slides to gear K and reverse gear synchro ring Z slides to gear L. The image of the input shaft is shown in Figure 1.

Figure 1. Input shaft of the gear box.
To calculate ratio of each gear, same as how to calculate 1st gear, but each gear must be respective to each pair, 2nd gear pair, 3rd gear to 3rd gear pair and so on.

The torque ratio between the engine and wheel has to be rapid acceleration and for climbing gradients. It provides means of reversal of vehicle motion. Transmission can be disconnected from engine by neutral position of gear box. In progressive type gear box passes through the intervening speeds while shifting one speed to another. These gear boxes are a combination of sliding and constant mesh gear boxes. In epicyclic or planetary type gear box have refusal sliding gears to engage but different gear speeds are obtained by merely tightening brake bands on gear drums. The planetary gear set consist of ring gear, sun gear, planet gears with carrier. To obtain various speeds, any of the three units can be held from rotation by means of brake bands. In selective type gear box the transmission in which any speed may be selected from the neutral position. In this neutral position has to be obtained before selecting any forward or reverse gear. Some of selective gear box are Constant mesh gear box with positive dog clutch and Constant mesh gear box with synchromesh device.

2.2 Nomenclature of Gear

The Inspection of the gear is very much important than other components in transmission system. The inspection of the gear must be accurate. The imaginary straight line of the axis is passing via object center. Backlash is the exceed gap between thickness of the teeth and its mating gear face. The base circle is in the form of involutes curvature which is unwound in a spiral shape.

Bevel gear has cone shaped tooth with its perspective. It is very much useful in the angular gear train. Circular pitch is defined as the circular point of distance between the two adjacent teeth. Face of the gear is located between pitch and addendum circle which called gear teeth surface. Pitch circle along with addendum circle makes flank of gear in between its. The power of transmission depends on the gear ratio that is the number of teeth in the designed gears.

Spur gear is one kind so as to have straight, flat-topped tooth set and parallel with its shaft. It is widely employed in general industrial gear. Torque is a force which produces rotational power. The torque could be made high or low as the requirement by using these components of power transmission.

3. Defect Analysis and Interface of Existing Method

The existing bench centers as shown in Figure 2 include a surface table which contains head, dead center. In this method a digital dial indicator arrangement is used to measure whole depth. However, this method is found to be time consuming as well as man power consuming. Additionally, the production loss from quality control team cannot to be avoided as this whole depth measurement process consumes time.

3.1 Measurement of Whole Depth using Plunger Gauge

Range is 0–12mm; Made by Mitutoyo (Japan) and least count is 0.01mm.

3.2 Measurement of Run out Face out using Lever Gauge

Range is 0–3mm; Made by Mitutoyo (Japan) and least count is 0.001mm.

4. Proposed Methodology and Recommendation

In order to overcome the aforementioned issues Goulder micron machine has been introduced to measure the whole depth of the gears.

4.1 Installation

Initially, Goulder Mikron machine leveling has been done. Then, replacement of dead center has been carried out following this replacement gear mounting has been
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replaced. After that, stem has been fixed to mount the digital dial indicator. Next the stem has been fixed with digital dial indicator in centre line. It is also necessary to check whether the center of digital dial and dead center are perpendicular to each other. Finally, a light has been fixed to view the setup exactly.

4.2 Implementation

Usually, In GoulderMikron method, the gear is fixed in between head and dead center to measure the whole depth however, it is found to man power as well as time consuming so we have made the following changes in GoulderMikron machine to overcome these issues. Initially, change the length of dead center from 6 to 12 Inches then replaced the role test mandrel or gear mounting mandrel with a stem which support a digital dial indicator. The major objective of this conversion is to prevent the placing gear between the head and dead centers. In addition this conversion prevents the production loss due to the time consumed for whole depth measurement checking. The proposed GoulderMikron Machine is shown in Figure 3.

4.2.1 To Find Face Out and Run Out and Whole Depth

In this machine special attachment has been added for finding the run out and face out of the gears which has been used in the gear box. The lever gauge range from 0 to 3mm and the least count is 0.001mm. This implementation reduces the lead time in the production. Digital dial gauge has been used for inspecting the run out and face out. By this changes man power reduces from two to one.

By placing the plunger gauge in the steam facilitate to inspect the whole depth of the gear accurately. The dimensions of steam for dial gauge and tail stock center are shown in Figure 4 and 5 respectively.

The applying plunger gauge range from 0 to 12mm and the least count is 0.001mm.

With this implementation it becomes possible to avoid defect in the next steps such as heat treatment process, boring process gear grinding process. Both this operation has been done within seven minutes in studied of take ten minutes.

5. Results and Discussion

The input shaft of the gear box tested and the result of the experiments are tabulated in Table 1.

The input shaft tested for gear box after installing special attachment as a result of this experiment 1 input shaft out of the 8 has been completely deemed as creating noisy while a few were perfectly okay and the others have accepted conditionally. With this modification check the different types of hobbing process of gears and verify this new process and got same results. With this implementation it becomes possible to avoid defect in the next steps such as heat treatment process, boring process gear grinding process. In addition, this step avoids damage in grinding wheel and disc by exactly measuring the whole depth.
depth. 30% of process time can be reduced using special attachment (steam for dial gauge) in GoulderMikron machine. By using this special attachment we can able to reduce the work for employee and skilled employees are not required.

\[ T = \frac{T_a}{D} \]

Where, \( T \) is takt time (work between two consecutive units), \( T_a \) is net time to work (work time per period) and \( D \) is Demand (customer demand) that is units required per period.

The Net available time is defined as the amount of time available for work to be done. Cycle time means time of overall process. It comprises the process time as well as delay time that is waiting time of work for process.

5.1 Time Study

5.1.1 Existing Bench Center Method

Time taken for placing the gear or shaft is 3.5 minutes.

Time taken for checking the gear or shaft is 6.5 minutes.

Total time taken for working in the bench center method is 10 minutes.

5.1.2 Proposed Method

GoulderMikron method (using various components).

Time taken for placing the gear or shaft in GoulderMikron method is 2.5 minutes.

Time taken for checking the gear or shaft in GoulderMikron machine is 4.5 minutes.

Total time taken for working the GoulderMikron method is 7 minutes.

Time difference is 10 – 7 = 3 minutes.

Hence 30% of time reduced using in GoulderMikron method.

As this method matches the expectation of the company in terms of time as well as man power consumption, it has been accepted by the firm.

6. Conclusion

Measuring the whole depth of gear is a critical step as it is necessary to have an exact whole depth in order to prevent damage in grinding wheel and disc.

In this project, changes have been made in the Goulder micron machine with an attempt to overcome the issues in whole depth measurement of gear in the existing method.

The results have been compared with that of the existing method and it has been observed that 30% of Takt time reduction is possible with the new method.

In addition, this method can be carried out without additional man power and this way production loss can also be avoided.

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