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Development of Gear Hobbing Fixture Design for Reduction in Machine Setting Time

Amar Raj Singh Suri*, A.P.S. Sethi**

* Mechanical Engineering Department, Shoolini University, Solan, H.P., 173229, India
** Mechanical Engineering Department, B.B.S.B.E.College, Fatehgarh Sahib, 140407, India

Abstract- The design of a fixture depends a lot on the designer's expertise and experience and hence no solution is optimal or near optimal for a given workpiece. For a Gear hobbing fixture also there are multiple designs possible. This paper is about redesigning of a hobbing fixture to make it common for the other gears' manufacturing and reduce the no of settings of the fixture on the hobbing machine. There by, reducing company's cost & time**.** The design was checked and validated for safety under the action of cutting forces.

Index Terms- Fixtures, Gear Hobbing, Hobbing fixtures

I. INTRODUCTION

Gear hobbing is a widely applied manufacturing process for the construction of any external tooth form developed uniformly about a rotation center. It is an advanced metal removal process as compared to conventional machining, such as turning and milling [1]. For the hobbing on gear hobbing machine properly designed hobbing fixtures are needed. Design of such fixtures is complex and numerous plausible designs are possible for a single work piece [2]. S. Vishnupriyan et al. [3] suggested that fixtures form an integral part of the manufacturing process and are required to hold the work piece in the desired position. The fixture design should aim at restraining unwanted movement of the work piece under the action of cutting forces through- out machining. Fixtures are work holding devices, which are used in most of the manufacturing operations such as, machining, assembly, inspection, etc. [4, 5]. Fixturing systems, usually consisting of clamps and locators must be capable to assure certain quality performances, besides of positioning and holding the workpiece throughout all the machining operations. [6]. such location must be invariant in the sense that the devices must clamp and secure the work piece in that location for the particular processing operation. Fixtures are normally designed for a definite operation to process a specific work piece and are designed and manufactured individually. Michael Yu Wang [7] stated that fixture layout is the fundamental task of fixture design, to determine the number, type, and location of the basic fixturing elements of locators, supports, and clamps, as opposed to the detailed design of the fixture assembly.

II. PROBLEM FORMULATION

Fixture forms an important factor in traditional and modern manufacturing systems, since fixture design directly affects manufacturing quality and productivity. Since the total machining time for a workpiece includes work-handling time, the methods of location and clamping should be such that the idle time is minimum. The design of fixture should allow easy and quick loading and unloading of the workpiece. This will also help in reducing the idle time.

During manufacturing of gears on Hobbing machine, the time taken for the setting of the hobbing fixture was very high. Whenever a gear of a new Root Diameter is to be manufactured, old fixture has to be removed & the relevant new fixture has to be installed. For changing of the fixture on the gear hobbing machine the time required was found out to be approximately 145 Minutes. This includes the time required in setting up of a new fixture and unloading an old fixture. The data was collected for 6 months pertaining to the number of settings done in each month on 8 hobbing machines. The number of settings came out to be 578. This was considerable amount of wastage of time and money for the company. This wastage was due to the changing of fixture every time a gear of new root diameter was to be manufactured. The type of fixture used and redesigned had locating mandrel, face clamping for disc type of gear blanks having bore.

III. REDESIGNING OF THE HOBBING FIXTURE

- Detailed analysis of the present design
- Making the bore in all the gears same so that the mandrel remains same while hobbing gears of different root dia.
- Making the base of the fixture common for all.
- Designing the mandrel and other parts of the fixture such that the gears of different Root Diameter can be manufactured without changing it time & again. This will reduce the setting time.
- Planning of types & position of locators, clamps & supports.
- Detailed design of locators clamps & supports.
- Fixture body design.
- Evaluation, approval & completion of design.

The design of the locating mandrel was such that it had to be removed along with the base. The gear blanks' resting was fixed with the locating mandrel and clamping cup was removable. In the new design resting was made removable by making it like a bottom cup and clamping cup i.e. top cup was already removable. The base of the fixture was made common as during the loading of the fixture on machine its centre has to be

aligned with the machining centre, the commonization has reduced this time also.

IV. RESULT AND DISCUSSION

The new fixture was designed and implemented, the number of machine settings reduced from 578 from Jan'11 to Sept'11 to 129 from Dec'11 to Mar'12. The average number of settings per machine ranged from 11.3 in Mar'11 to 14.6 in May'11, when the old fixture was used and during the period between Dec'11 to Mar'12 when the new was used the average number of settings ranged from 3.7 in Jan-12 to 4.3 in Mar' 12 as can be seen in Fig 1.The number of settings reduced from 12 per month per machine to 4 per month per machine.

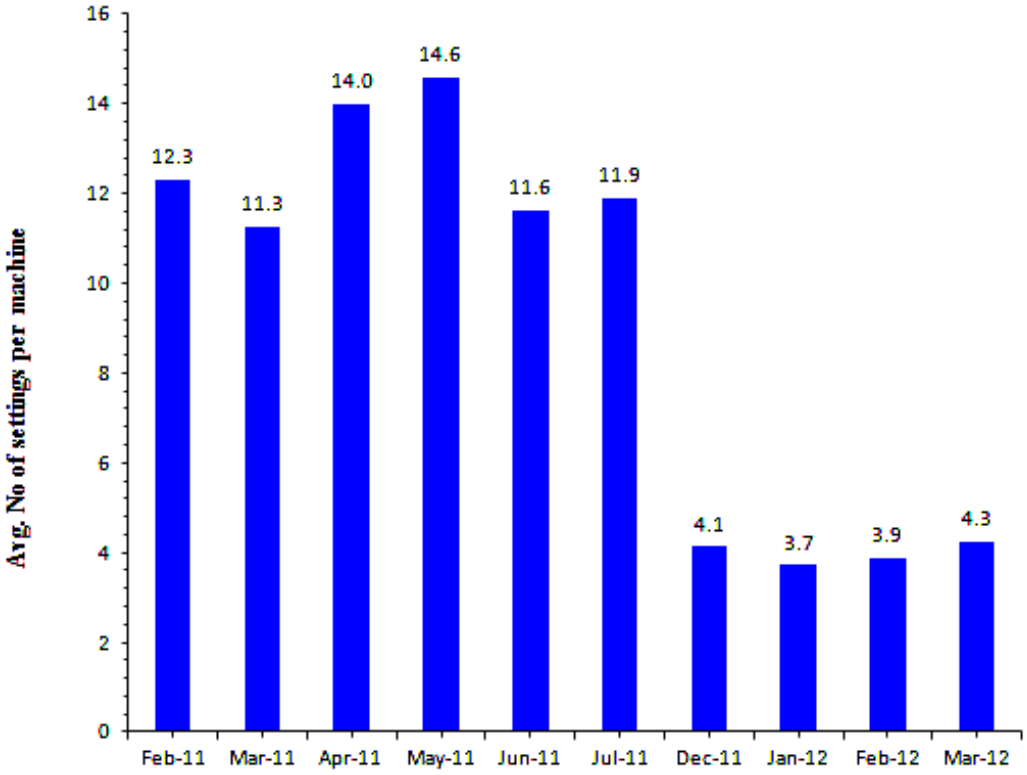

Fig. 1 Average Number of Settings Per machine

Table I Machine Running Cost for Existing Fixture

Design	Avg. Time for one setting (Tool Down Time + Tool Setting Time) Mins	No of settings	Total setting Time 6 months. Mins	Machine Running Cost/ Hr Rs	Total Running
Previous Design	145	578	578 X 145=83810 Mins or 1397 Hrs	261	3,64,617
Total Cost for 12 months = 7,29,234					

Table II Machine Running Cost for New Fixture

Design	Avg. Time for one setting (Tool Down Time + Tool Setting Time) Mins	No of settings	Total setting Time 4 months. Mins/Hrs	Machine Running Cost/Hr Rs	Total Running Rs
New Design	145	129	129 X 145=18705 Mins or 312 Hrs	261	81,432
Total Cost for 12 months = 2,44,296					
Total Savings over an Year =7, 29,234-2, 44,296=4, 84,938 Rs					

Finally it can be concluded from Table I and Table II that the cost savings to the company projected for 12 months will be Rs 4,84,938, which is a considerable amount.

V. CONCLUSION

The Present work was conducted to redesign the Gear Hobbing Fixture used in the manufacturing of gears at Mahindra &Mahindra (Swaraj Division). A lot of time was wasted in changing of the fixture earlier in changing the Hob, Changing the base and Zero dialing it. All this time which was wasted is now saved with the newly designed fixture by reducing the no of settings .It can be concluded that the amount of saving to the company is considerable in terms of time and money.

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AUTHORS

First Author – Amar Raj Singh Suri, Department of Mechanical Engineering, Shoolini University, Solan (H.P.)-173229.
Second Author – A.P.S. Sethi, Department of Mechanical Engineering, B.B.S.B.E. College, Fatehgarh Sahib (Pb)-140407.