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Development of Multioperation Fixture for Reduction in Setup Time

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ABSTRACT

Industries required the jobs to be done with extreme accuracy and within stipulated time period. Hence industries demand multiple operations to be done simultaneously. But practically some things not possible to attend. So, if we able to provide some sort of solution like reduction in loading and unloading time of component will reduces set up time and worker fatigue. A fixture is a work-holding or support device used in the manufacturing industry. Fixtures are used to securely locate and support the work, ensuring that all parts produced using the fixture will maintain conformity and interchange ability. The basic design consideration of this work is to secure the workpiece without damaging it. Also, the loading and unloading time of the workpiece must be as low as possible. The components must be produce economically using this fixture. Another tough requirement while using this fixture is also satisfied as any unskilled labor can also operate this fixture. It is usually better, from an economic standpoint, for a fixture to result in a small cost reduction for a process in constant use, than for a large cost reduction for a process used only occasionally. This manufacturing fixture helps to reduce the manufacturing lead time with reduction of the worker fatigue.

Keyword: - Fixture, Cost Reduction, manufacturing lead time

I. INTRODUCTION

From past decade, manufacturing has made tolerable progress. New machine tools, high-performance cutting tools, and modern manufacturing processes enable today's industries to make parts faster and better than ever before. The work holding methods have also modern considerably, the basic principles of clamping and locating are still the same. Mass production methods demand a fast and easy method of positioning work for accurate operations on it. Fixtures is production tool used to accurately manufacture duplicate and interchangeable parts. Fixtures is specially designed so that large numbers of components can be machined or assembled identically, and to ensure exchangeable of components. The economical production of engineering components is greatly facilitated by the

provision of fixtures. The use of a fixture makes a fairly simple operation out of one which would otherwise require a lot of skill and time. Fixtures position components accurately; and hold components rigid and prevent movement during working in order to impart greater productivity and part accuracy. Fixtures hold or grip a work piece in the prearranged manner of firmness and location, to perform on the work piece a manufacturing operation. A fixture is designed and built to hold, support and locate every component (part) to ensure that each is drilled or machined within the specified limits. The correct relationship and alignment between the tool and the work piece is maintained.

Fixture is used to holds and assist the work securely so that related machining operations can be perform precisely. Some type of set blocks and feeler or thickness gauges are used along with fixtures to reference the cutter to the work-piece. A fixture should be properly fastened on the table of the machine upon which the work is done. It is largely used on milling machines, fixtures are also to do this, a fixture is designed and built to hold, support, and locate every part to ensure that each is drilled or machined within the specified limits. The difference is in the way the tool is guided to the work-piece. Fixtures vary in design from relatively simple tools to expensive, complicated devices. Fixtures also help to clarfy metalworking operations performed on special equipment. Fixture design plays an important role in the setup designing stage. Proper fixture design is difficult for developing product quality in different terms of accuracy, surface finish and precision of the machined parts. The costs associated with fixturing can account for 10–20% of the total cost of a manufacturing system. These costs relate not only to fixture manufacture, assembly, and operation, but also to their design.

II. LITERATURE REVIEW

Soosung Kim et al [1], designed and developed optimum welding equipment and detailed drawings obtained in this study will be applied to the end-plate welding process. A performance test using remote welding equipment shows satisfactory results in access ability, master-slave manipulation, and the replacement of some parts. Furthermore, to establish the reliability of remote operations using resistance welding equipment, it was necessary to carry out a welding sample test using the end-plates for nuclear fuel bundle manufacturing in a mock up facility. Kulkarni Kaustubh A. [2] studied that the fixture is required in various industries according to their application Design of new fixture is a modified over the old fixture due to some drawback. Naveen A M et al [3] designed the welding fixture for Motor casing assembly successfully and in this process of designing the modeling of each part of the Motor casing assembly and the welding fixture is carried out for the better visual realization of the components, the modeling of the parts is modeled using the software package UNIGRAPHICS NX 8.0. This method of modeling the parts evolves the better analysis towards the tolerances and helps in keeping in-tact with the specified tolerance on the parts and also the fixture design. The collapsible mechanism of the weld backup tool with the purging facility is provided to have a sound and quality on the weld. The optimum shaft/support pipe of outer diameter 200mm and 184mm inner diameter has been derived from the theoretical calculations and the same has been subjected to analysis and the stress and deflection error was found to be 5.6% and 4.94% respectively. The calculations using the thermal aspects of the arsenic copper and the maraging steel enables one to arrive at the optimum mass of the back-up support bar, which was found to be 2.5325kg and this ensures that the heat evolved during the welding of the joint is absorbed towards the backup support ring and the mass of this back up support is calculated in order to

sustain this hot gas without much of a thermal expansion. The analysis of the clamps has concluded the use of M10 stud would have a effective clamping force transfer through the finger clamp that has been used in this design. The sequential weld setup gives a clear focus on the process of the weld to be carried out in the welding fixture. To minimize the deflection on the shaft as well as the motor case assembly the roller support assembly is used and i t also enables to rotate the whole assembly while welding operation is in process. The designed welding backup, Optimum shaft size, clamping system in action, locators provided in the welding fixture enables to achieve the required tolerance on assembly and quality on the weld. Kiran Valandi et al [4] aimed at designing a fixture used for performing machining operations at certain angle (102.5 degree) on the Crank case used in commercial vehicles. Kumara B et al [5], Design of new fixture is a modified over the old fixture due to some drawback. The old fixture is not suitable for drum having slot on top face c urrent fixture is complicated in design and there is more work in fitting the button to fixture ring. Aditya Rao et al [6] provided a solution on a solution to the difficulties faced in making keyways in various types of gears: Spur, Helical, and Bevel. It focuses on developing an adjustable fixture mechanism which incorporates versatility as its main feature. Gopal Bharat Patil [7] reduced the weight of suspension components also improves the vehicle's handling performance. Therefore, topology optimization should be implemented to obtain a minimum weight with maximum or feasible performance. Among the vehicle structural components, the steering knuckle is prominent part in the suspension system which plays major role in many directions control of the vehicle linked with other linkages and supports the vertical weight of the car. N. P. Maniar et al [8] reviewed some of the developments in fixture design and proposes directions for future research initiatives. With growing need of fast production to meet the requirements of industry, mass production machines are conceived. Ranjot Singh et al [9] studied on the defects of the steering nut which was rejected due to incorrect setting up of machine tool on special purpose machine and mishandling of component during heat treatment stage. M. Fathil

C. Ibrahim [10] presented the capability of 3D software to assist in generating and improving innovative product. This work helped the mechanics to remove pin component; distributor pin and piston pin. Apoorva M.V. [11] studied that fixture is required in various industries according to their application. This can be achieved by selecting the optimal location of fixturing elements such as locators and clamps.

III. SYSTEM MODELING

Fixture modelling must assure proper seating for the square cross section. Also, in single pass both drilling operations must be carried out. Parallelism of the part must be maintained. Development steps involved part drawing and base plate drawing. After this the clamping arrangement need to be fixed. The company is engaged with such scenarios where job of square cross section needs to be manufactured. The separate workstations are required for manufacturing of these components. This requires more manpower, machines, space requirements, set up time for performing the activities. Any such system like assembly fixture which will reduce the worker fatigue, reduces space requirements and set up time prove to be beneficial to the industry and it creates opportunity to compete the current manufacturing problems.

3.1 Fixture Requirements

[1] Base of the fixture should be such that it must accommodate square rod

[2] Its base plate must be flat and tough

[3] Base plate must be rigid

[4] Easy to construct with less cost

[5] Loading and unloading of the component must be easy
[6] Less number of steps needs to be required for loading and unloading
[7] Fixture must be economical in use and maintenance
[8] It should be handled by any operator and should not require training to use it

3.2 Fixture Development

The task is to build a model of fixture which will satisfy all the requirements of the component which is to be assembled.
[1] According to component base of the fixture must design.
[2] Also it must ensure blank fitment
[3] Fool proof arrangement must be provided so as to obtain rejection free output
[4] It should accommodate and make arrangement for both drill operations

[A] Base Plate is the foundation of fixture which is attached to rectangular fixture plate for its rigidity
[B] Supportive Plate is attached to the base plate in such a way that it can restrict movement of the component in x and y direction
[C] Side plate gives support to the heaviest part
[D] clamping pin holds the workpiece securely

IV. PERFORMANCE ANALYSIS AND TESTING

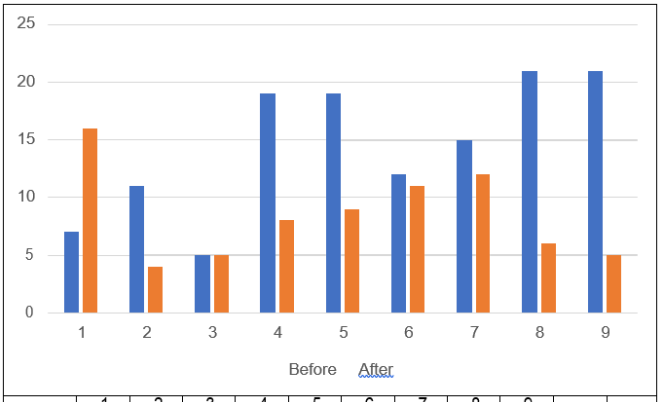
Work-study forms the basis for work system design. The purpose of work design is to identify the most effective means of achieving necessary functions.

Table No.1.1: - Time Study for New Method.

Sr. No.	Motion Sequence	Time Required (Seconds)
1	Loading of workpiece	10
2	Machining of one side	25
3	Drilling operation	45
4	Chamfering	20
5	Form cutting operation	85
6	Sizing	15
7	Final Inspection	10
	Total	210 Sec (3 min. 30 Sec)

V. RESULTS AND CONCLUDING REMARKS

The manufacturing time and rejection quantity required for earlier was of quite large and due to introduction of the fixture for the same it substantially reduced. The overall time is reduced by reducing loading and unloading time. Also the material stays at single workstation for all operation.



	1	2	3	4	5	6	7	8	9		
Before	7	11	5	19	19	12	15	21	21		
After	1	4	5	8	9	11	12	6	5		

Graph No.6.1:- Comparison between Before and After Number of Activities

From this comparison it is clearly seen that number activities after implementation of the fixture is reduced substantially. Also the Time require after fixture implementation is reduced.
As the numbers of activities are reduced company gets the indirect benefits such as
[1] Manufacturing lead time reduced [2] Worker fatigue reduced [3] Better ergonomics is achieved
[4] Worker's efficiency is increased [5] Rate of rejection also reduced

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