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Design and Manufacturing Fixture of Flange Lube Oil Pump Filter

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ABSTRACT- Fixtures are the special production tools which make the standard machine tools, more versatile to work as specialized machine tools. They are normally used in large scale production by when interchangeability is possible. Various areas related to design of fixture are already been very well described by various renowned authors, but there is a need of couple and apply all these research work to an individual application. This paper on "Design and manufacturing fixture of Flange Lube oil pump filter" which integrates all these aspects and the evolutionary function approach of designed fixture is proved from the fact that the real industrial component is considered for fixture designing. In addition to this, fixture is made by wear in house material without consuming much cost for production. The fixture shows great time saving for the production.

Key Words: Fixture design, Vertical Milling Machine, Flange Lube Oil Pump Filter, Drilling, milling, reaming, chamfering, Run Chart.

I Introduction

A fixture is a mechanism used in manufacturing to hold a work piece, position it correctly with respect to a machine tool, and support it during machining. Fixture is a device for locating, holding and supporting a work piece during a manufacturing operation. Fixtures are essential elements of production processes as they are required in most of the automated manufacturing, inspection, and assembly operations.

Fixtures must correctly locate a work piece in a given orientation with respect to a cutting tool or measuring device. They are normally designed for a definite operation to process a specific work piece and are designed and manufactured individually. Widely used in manufacturing, fixtures have a direct impact upon product quality, productivity and cost.

Traditionally, the design and manufacture of a fixture can take several days or even longer to complete when human experience in fixture design is utilized. And a good fixture design is often based on the designer's experience, his understanding of the products, and a try-and-error process. Therefore, with the increasingly intense global competition which pushes every manufacturer in industry to make the best effort to sharpen its competitiveness by enhancing the product's quality, squeezing the production costs and reducing the lead time.

There is a strong desire for the upgrading of fixture design with the hope of making sound fixture design more efficiently and at a lower cost. Many academic and applications papers have been published in this area. In this paper, we will focus on a fixture design research. The following sections will give a survey on the state of the art of these researches.

II Related Work

Over the past ten years, the traditional machines have been used to produce the various features and shapes of the parts. Skilled operator and cutting parameters are the key components of the operations to obtain high quality of the part and to minimize reproduced part. For a complex shape, repositioning the part on the platform is required and it is very time consuming since setting up and calibrating the machine and cutting tool are required for every operation .

R. Monroe Et. Al shows casting process for quick generation of the part through casting technique. In this process, the metal is melt and then poured into the provided mould which should be perfectly dried and be able to withstand the heat of the metal. In fact, the casting process provides less surface accuracy and it cannot control burr on the cast part. It spends very long time to get one product. When the errors are found, all steps are repeated starting from the beginning. [1]

M. S. Lou Et.al proposed the surface roughness prediction technique for vertical milling centre end milling to easily cut and obtain high surface accuracy. The extra component of the cutting machine called metal working lathe was invented for holding the work piece during the operation. After the traditional period, the rapid-improvement machines have become as new solutions for supporting the operation of several shapes of the work piece over the casting processes. [2]

Alpha Lehigh Et. al has shown the path for drilling, turning, milling, and grinding machines which has to be applied for easily adjusting the cutting parameters and also providing sharp-edge shapes and these machining processes require low set-up cost and time comparing to forming, molding, and casting processes. However, these machining processes are more expensive for high volumes where skilled operator is required for reducing wastes and producing high tolerance on dimensions and surface finishes. [3]

K. Monkova Et. al proposed the method of numerical control program creation in order to reduce processing time, cost for the waste material and human-labor required, vertical milling Centre machines have been introduced as the technology for producing the product due to the commands obtained from the computer analysis. [4]

The two main objectives of applying Vertical milling Centre machine in cutting operation are to eliminate human errors, and provide high surface accuracy of the part. The input of this vertical milling Centre machine operation is three dimensional computer aided design model programming which is then used for analyzing, calculating, and generating the tool paths. After obtaining the program, the vertical milling Centre machine works by reading the thousands of bits of information stored in the program computer memory. To place this information in the memory, the programmer creates a series of instructions or commands where the machine can understand.[11]

III Statement of Problem

"Design and manufacturing fixture of Flange Lube Oil Pump Filter". The operation to be performed is drilling, milling, reaming, chamfering. Productivity is to be improved and loss due to inadequate square ness, blow holes is to be reduced by using wear in house material for fixture manufacturing with reduction in non-production time.

IV Fixture Design

Fixture planning is to conceptualize basic fixture configuration through analyzing all the available information regarding the material and geometry of the work piece, operations required, processing equipment for the operations, and the operator. The following outputs are included in the fixture plan:

i. Fixture type and complexity
ii. Number of work pieces per fixture
iii. Orientation of work piece within fixture
iv. Clamping surfaces and Support surfaces, if any

The following design criteria must be observed during the procedure of fixture design:

- Design specifications
- Factory standards
- Ease of use and safety
- Economy

The clamping system should be strong enough to withstand forces developed during operation. At the same time, the clamping force should not dent or damage the work piece. Speed of operation, operator fatigue and strategic positioning are other important considerations for contriving a clamping system.[8]

Figure No:4.1 Top view of previous fixture

Figure No: 4.2 Front View of previous fixture

The fixture shown in the fig no 4.1 represents the top view of single job fixture of flange lube oil pump filter, while fig no 4.2 represent the front view of the same. These fixture were used to manufacture the work piece which is represented below in fig no 4.3.

Figure No: 4.3 Flange Lube Oil Pump Filter

4.1 Design Procedure

In the design of a fixture, a definite sequence of design stages is involved. They can be grouped into three broad stages of design development.

- Stage one deals with information gathering and analysis, which includes study of the component which includes the shape of the component, size of the component, geometrical shape required, locating faces and clamping faces. Determination of setup work piece orientation and position.[10]

- Stage two involves product analysis such as the study of design specifications, process planning, examining the processing equipment's and considering operators safety and ease of use. Determination of clamping and locating position. In this stage all critical dimensions and feasible datum areas are examined in detail and layout of fixture is done.
- Stage three involves design of fixture elements such as structure of the fixture body frame, locators, base plate, clamping and tool guiding arrangement.[12]
- Stage four deals with final design and verification, assembly of the fixture elements, evaluation of the design, incorporating the design changes if any required and completion of design.[13]

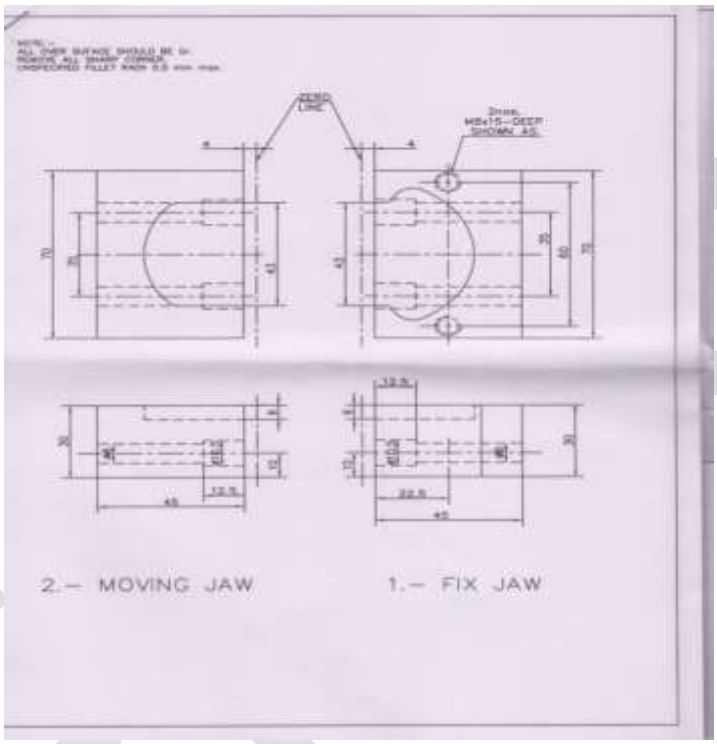

Figure No: 4.4 New Fixture Design

4.2 Design of Fixture – location and clamping consideration

In machining, work holding is key aspect, and the fixtures are the element responsible to satisfy this general goal. Centering, locating, orientation, clamping, and supporting can be considered the function requirement of fixture. In terms of constraints, there are many factors to be considered, mainly dealing with shapes and dimensions of the part to be machined, tolerance, sequence of operation, machining strategy, cutting force, numbers of set ups, set up time, volume of material to be removed, batch size, production rate, machine morphology, machine capacity, cost, etc. At the end the solution can be characterized by its simplicity, rigidity, accuracy, reliability, and economy. [5]

S. K. Hargrove [6], recognized four requirements of fixture: (i) Accurate location of work piece, (ii) Total restraint of work piece during machining, (iii) Limited deformation of work piece, (iv) No machining interference. In addition, as set forth by R. T. Meyer [7], dynamic machining condition occur when a work piece is subjected to machining force that move through the work part or along its surface. A viable designed for a work piece experiencing dynamic machining must ensure: the work piece is restrained for all time, the clamping forces are not too large not small, deterministic positioning, accessibility, stability of the work piece in the fixture while under no external force, and positive clamping sequence.[9]

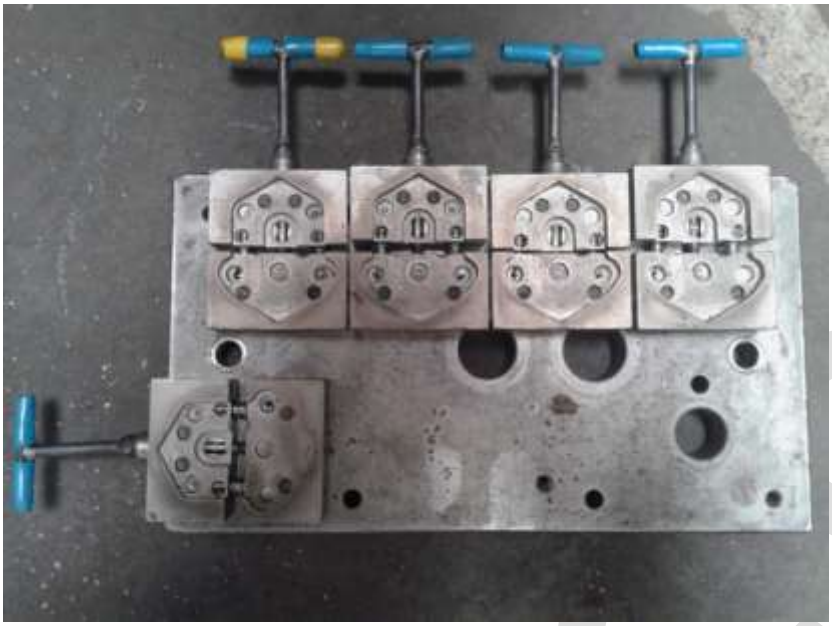

Figure No: 4.5 New Fixture implementation

The fig no 4.5 represents the new fixture designed for flange lube oil pump filter. As shown in above fig the fixture has capacity to produce multiple work pieces in a single setup. After implementation of fixture run chart was prepared to test the actual production in a prescribed time period.

Figure No: 4.6 Finished job obtained on newly fixture design

PART NAME: FLANGE LUB OIL PUMP FILTER OPERATION: DRILLING TOLERANCE LIMIT: 0.01MM
MACHINE NAME: VERTICAL MILLING MACHINE

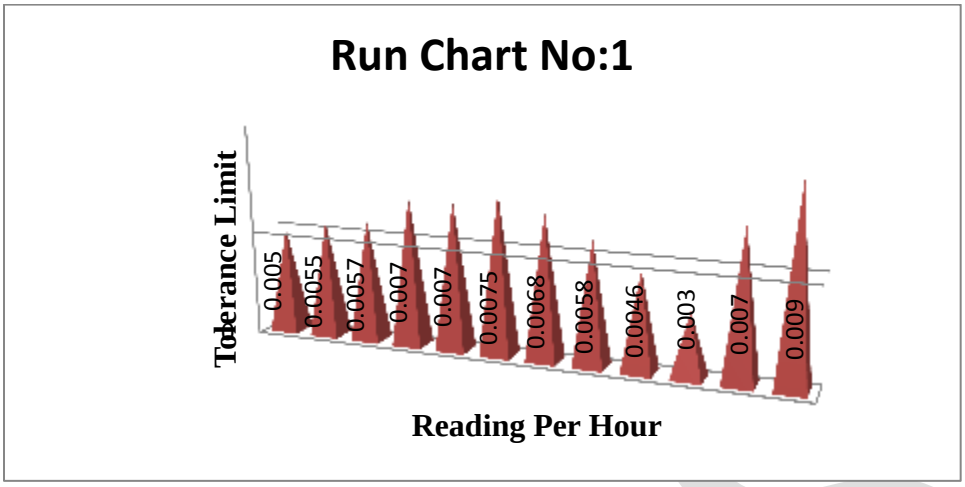

Figure No: 4.7 Run Chat

Fig no 4.6 shows finished job obtained on newly fixture design. Fig 4.7 represents the run chat with the reading obtained after implementation of newly designed fixture. In this chat each bar represents the reading obtained during the inspection of the work piece under the tolerance limit i.e. 0.01mm. Each bar limit is measured per hour.

V Acknowledgment

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VI Conclusion

Paper proves utility in fixture design in three different ways:

(i) Increases productivity with reduction in man power
(ii) Reduction in cycle time
(iii) Utilization of a single VMC instead of two.
(iv) Reduction in manufacturing cost.

(i) Increases productivity with reduction in man power

Before designing the new fixture, there were two operators for production of work piece which use to take ample of time period to complete the target. But as soon as the new fixture is implemented only one operator works to complete the target within the half of the time as before. This leads to increased in the productivity.

(ii) Reduction in Cycle time

Prior to complete a job it use to require 99 sec / job, which includes loading, unloading , clamping, unclamping of work piece & machining time. But after the implementation of newly designed fixture it requires 52.6 sec / job. The result is clear that after the automation & modification of fixture it saves almost 46.4 sec / job.

(iii) Utilization of single VMC instead of two

Previously to complete the allotted production there were two operators, which were unable to complete the work within the time period, but after the furnishing of fixture, single operator puts the allotted production out of the machine less than the intended period of time.

(iv) Reduction in manufacturing cost

As the material requires for producing new fixture is costless. All the raw material required for the production of fixture is obtained from the ware house. The machines and the equipment required for machining the raw material was from the plant itself.

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