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DESIGNING OF HYDRAULIC FIXTURE FOR GEAR HOUSING FOR VMC

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ABSTRACT

The fixtures are work holding device used to locate and fix the position of work pieces for machining, assembly, inspection, and other operation. A fixture consists of a set of clamps and locators. Locators are used to determine the orientationand position of a workpiece, and clamps exert clamping forces on the workpiece sothat the workpiece is pressed against locators and resting pads. The recent trends inindustry are towards adopting the hydraulic and pneumatic techniques, because it savetimegeneratesaccuracy and it is havingsomeflexibility.

The hydraulic fixture is designed for gear housing to perform "drilling andboring" operations using Vertical machining centers(VMC). Computer aided fixture design of fixture assembly is carried out using Solid Works software.

In machining fixtures, minimizing workpiece deformation due to clamping and cutting forces is essential to maintain the machining accuracy. The recent trends in industry are towards adopting the hydraulic techniques, because it save time generates accuracy and it is having some flexibility. Hydraulic Fixture is major application in the field of designing, where in several software's are available for the purpose of design.Hydraulic lift housing is engine part of an agricultural tractor which plays an important role in application of lifting trolley of tractor and machining of hydraulic lift housing is a important task.

This project deals with ***" Design and Manufacturing of Hydraulicfixturefor"GEARHub"*** *The Fixture isdesignedbyapplying properdesignprocedure.*

1. INTRODUCTION

A fixture is a device used to locate, clamp and support a workpiece during machining, assembly or inspection. The most important criteria's for fixturing are workpiece stability, position accuracy and workpiece deformation. A good fixture design is one thatminimizes workpiece geometric error. Workpiece location principles are defined in terms of 3-2-1 fixturing which is widely used workpiece location method for prismatic parts. Force analysis is concerned with checking whether the forces applied by the fixture and clamping are sufficient to maintain static equilibrium fixtures must correctly locate a work piece in a given orientation with respect to a cutting tool or measuring device, or with respect to another component, as for instance in assembly or welding. Such location must be invariant in the sense that the devices must clamp and secure the workpiece in that location for the particular processing operation. There are many standard work holding devices such as

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jaw chucks, machine vises, drill chucks, collets, etc. which are widely used in workshops and are usually kept in stock for general applications. Fixtures are normally designed for a definite operation to process a specific workpiece and are designed and manufactured individually .

Fixture is a work piece-locating and holding device used with machine tools.Fixture does not guide the cutting tool but is always fixed to machine or bench. Byusing fixture, responsibility for accuracyshifts from the operator to the construction of machine tool. When a few parts are to be machined, work piece clamp to the machine table without using fixture in many machining operations. However, whenthe numbers of parts are large enough to justify its cost, a fixture is generally used forholding and locating the work. We must design the fixture for milling machine to holdthe componentproperly.

OBJECTIVES

1. To ensure high accuracy of parts produced without any manufacturing defects.
2. Reduce quality control expenses.
3. To provide safety at the work point.
4. To achieve zero rejection rate.

2. DESIGN MECHANISM OF HYDRAULIC FIXTURE

Design Of Hydraulic Fixture

The general rules for designing of fixtures are as follows

a) Compare the cost of production of work with present tools with the expected cost of production, using the tool to be made and see that the cost of buildings is not inexcessof expectedgain.
b) Decide upon locating points and outline clamping arrangement.
c) Make all clamping and binding devices as quick acting as possible.
d) Make the fixture foolproof.
e) Make some locating points adjustable.
f) Avoid complicated clamping arrangements.
g) Round all corners.
h) Provide handles wherever these will make handling easy.
i) Provide holes ones capes for chips.
j) Locate clamps so that they will be in best position to resist the pressure of the cutting tool when at work.
k) Place all clamps as nearly as possible opposite some bearing point of the work toavoid springing action.

3. MATERIALS AND METHODS

Material used

- EN8.
- 20MnCr5.

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- Case hardening steel grade EN32A
- Mild steel
- 1) EN8:

1.EN8:

EN8 is a very popular grade and is readily machinable in any condition. It can be further surface-hardened to produce components with enhanced wear resistance, typically in the range 50-55 HRC through induction processes. It is also available in free-machining versions, EN8DM and EN8M (212A42)EN-8. Crank shafts, automobile axle beams, connecting rods, lightly stressed gears. Generally used for moderately stressed parts of Motor Vehicles and general engineering works.

2.20MnCr5:

20MnCr5 is a case-hardening steel with low carbon content but good hardenability reaching good wear resistance due to high surface hardness after hardening. The small grain size benefits in good ductility and fatigue strength. Suitable for gearboxes and axle gears.

3) Mild Steel:

Mild steel is the most widely used steel which is not brittle and cheap in price. Mild steel is not readily tempered or hardened but possesses enough strength. Mild steel is the most commonly used steel. It is used in the industries as well in the different everyday objects we use. Even the pans and spoons of the kitchen are sometimes made of mild steel. The main target of this article is to discuss about different mild steel properties. The mild steel is very important in the manufacturing of metal items. Almost 90% steel products of the world is made up of mild steel because it is the cheapest form of steel.

4. Case Hardening Steel EN32A :

This steel is an unalloyed low carbon grade. Components when carburised have a core strength range of 430-490N/mm² with a hard wear resistant surface case .EN32A is a high quality low carbon steel .After forming ,carburizing or nitriding process and quenching or other heat treatment, a structural part with wear-resistant surface and tough core can be achieved.

4. FIGURES AND TABLES

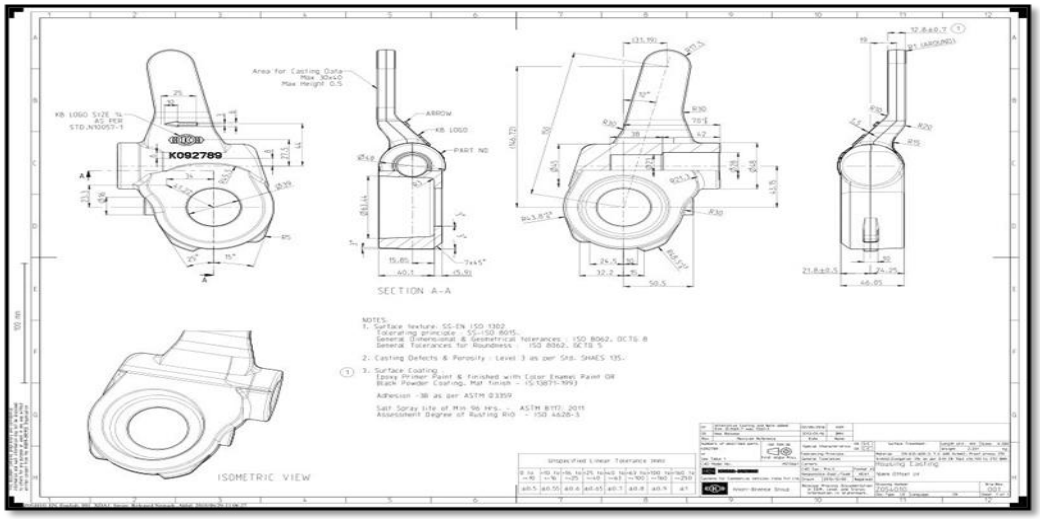

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FIG. 2D Casting Drawing

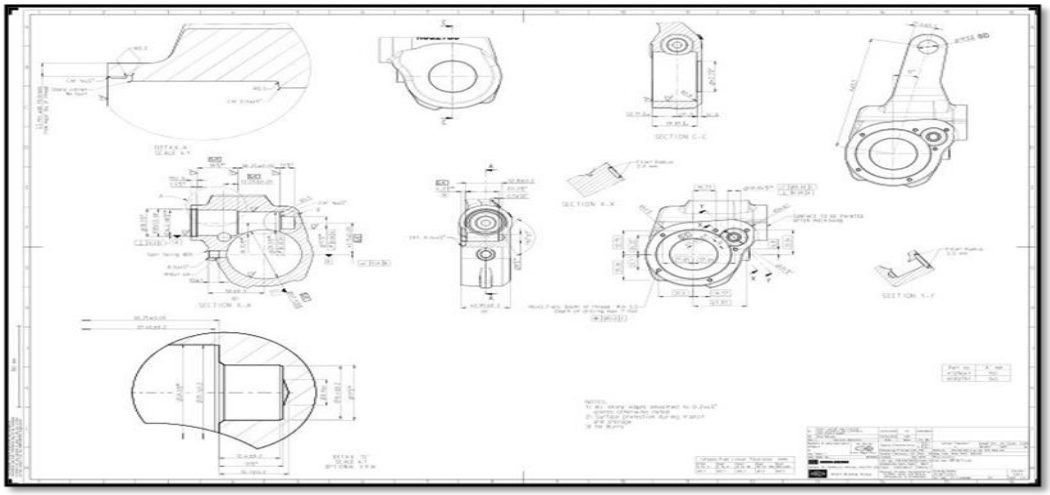

FIG. Machining Drawing

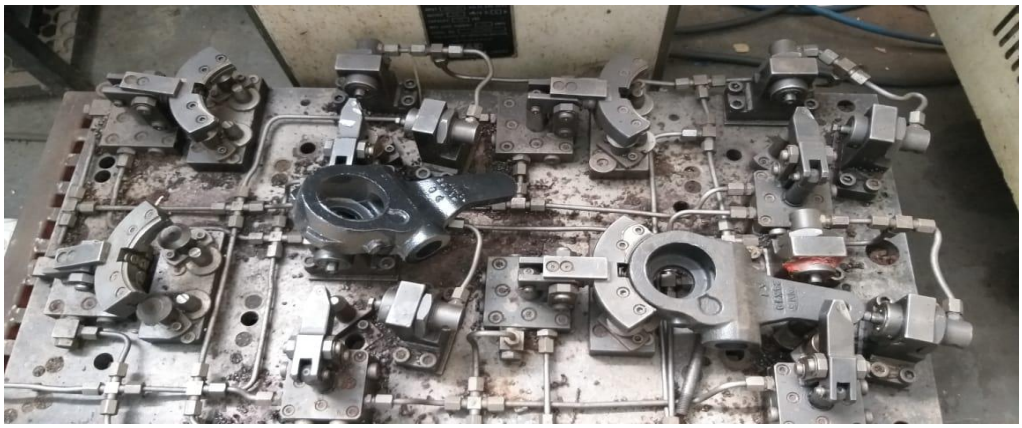

FIG. Setup of HydraulicFixture

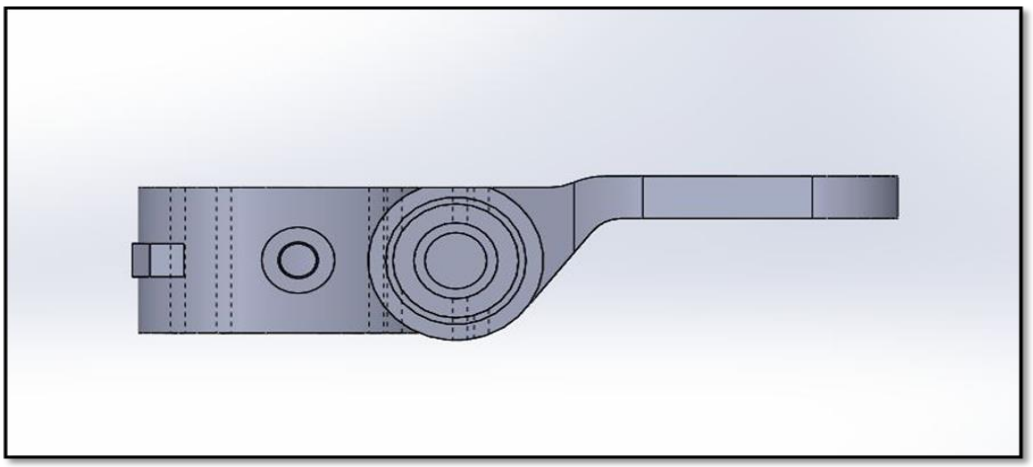

FIG. Operation on workpiece

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5. CALCULATIONS

For selection of hydraulic clamping cylinder, we required to calculate cutting force $F_t = \sigma \times A \times Z_c \times E_F \times T_F$ A = Cross section area of cut chip

$$A = a_p \times f$$

a_p= axial depth of cut.

f=feed per tooth.

$$\sigma = \text{Ultimate tensile strength}$$

$$Z_C = \text{Number of teeth engaged to work piece}$$

$$Z_C = Z \times \alpha \div 360$$

Z=no of teeth of cutter.

α=engagement angle.

The engagement angle depends upon the radial width of cut .If radial width of cut equal to milling cutter diameter then angle is 180°.

$$E_F = \text{engagement factor}$$

It is related with tangential cutting force with ratio radial of the width of cut to cutter diameter.

$w \div D$

$$W = radial\ widt\ of\ cut$$

D=cutter diameter.

T_F = cutting tool wear factor.

Milling Operation	Axial DOC (mm)	Feed Per Tooth(mm)	Cutting Tool Wear factor
Light	0.5 to 2.50	0.08 to 0.15	1.1
Medium	2.5 to 5	0.15 to 0.25	1.2
Heavy Duty	5 to 10	0.25 to 0.50	1.3

6. RESULT AND DISCUSSION

RESULTS

The results are based on sample components manufactured by the industry:

1.As a result, the rate of manufacturing of the component increased because of the reduction in cycle time.

2.Rate of Rejection totally become zero like shifting hole.

3.By using this fixture cycle time reduced by 9 minute. Cycle time on manual fixture was 40 min because the loading and unloading condition is manually.

4.Soreducing the production time.

DISCUSSIONS

1.We all know using the manual fixture consumes a lot of time. This affects the production rate.

2.This traditional manual fixture is replaced by a hydraulic fixture. The hydraulic fixture reduces the cycle time which ultimately results in higher productivity.

3. The efforts of the operator are also reduced with the help of a hydraulic fixture.
4. The risk of job rejection is less in hydraulic fixture as the job is positioned accurately.
5. Because of a smaller number of jobs are rejected, the company will earn more financial benefit.

7. CONCLUSION

In this paper, the design requirements of the fixture were studied and according to that two types of CAFD had done in CATIA V5. Verification of the fixture design is carried out using ANSYS workbench. Mean while clamping forces are calculated at 40, 50 and 60 bar hydraulic pressure by using analytical and numerical methods which are validated and are taken into consideration during the static analysis of the fixture and cylinder block, so from FEA result the 1st type of fixture assembly design is to be considered for manufacturing the final fixture system. Also the FEA results of total deformations for 1st type fixture design model are validated by comparing results from experimental tests carried on fixture cylinder block, so from validation results for total deformation by FEA and Experimental tests are nearly equals. Hence we conclude that results values of total deformations and von-mises stresses from FEA are true. Means the fixture is accurately designed, analyzed and manufactured.

1.By using the hydraulic fixture, the non-productivity time i.e. the time for clamping and de-clamping is reduced because of automatic operation.
2.The machining accuracy is increased.
3.Productivity is increased.
4.Because of automation cycle time is reduced.
5.The suggested system helps in achieving precise, reliable, safe as well as accurate production method.
6.Also ensure accurate production and efficient clamping of parts.
7. CAFD greatly reduces the time for designing the fixture which is hard to design manually.
8.The use of FEA for CAFD's environment, unnecessary and uneconomical trial and error experimentation in machine shop floor is being eliminated.
9.Hence for clamping 40 bar hydraulic pressure is preferred than 50 and 60 bar.

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