

Design of Fixture for Manufacturing of Pitman Arm

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Abstract- Pitman Arm is very important part of Steering system. It should be accurately machined with the acceptable tolerance. At present scenario productivity and economics of machining work pieces in a large quantity is greatly affected with the use of work holding devices like fixtures. This device reduce the production cost and ensure interchangeability of machined work pieces This project is about the design and fabrication of fixture which is used in the manufacturing of Pitman Arm of steering system. The design of fixture is done by using software CATIAV5R21.The purpose of the fixture is to provide strength, holding, accuracy and interchangeability in the manufacturing of product. The main purpose of a fixture is to locate and in the cases hold a work piece during an operation. Our research methodology aims at optimal design and fabrication of fixture. The fixture is designed and fabricated mainly to get the dimension of work piece within tolerance limit.

Keywords: - fixture, CATIA, Pitman Arm, Clamps, Locators, Supports

1. INTRODUCTION

1.1 Pitman Arm

The pitman arm is also called steering arm, it is a linkage which is attached at one side to the steering box (through sector shaft) at the bottom of the steering wheel shaft and on the other side to the track rod which is attached at the other end to the idler arm. When the steering wheel is turned left or right, a worm gear at the bottom of the steering shaft turns a set of teeth. That action moves a gear that activates the pitman arm, causing the steering linkage to move the wheels. [8]

The steering arm is part of an older recirculating ball steering system which is still used primarily in some full-size SUVs and trucks as compared with the smoother-handling rack and pinion steering mechanism more commonly used in automobiles. A properly functioning pitman arm, 1) precisely directs the movement of all the other steering links, 2) limits wheel wobble on bumpy surfaces, 3) assures full wheel turning radius and 4) helps to reduce steering wheel vibration. [8]

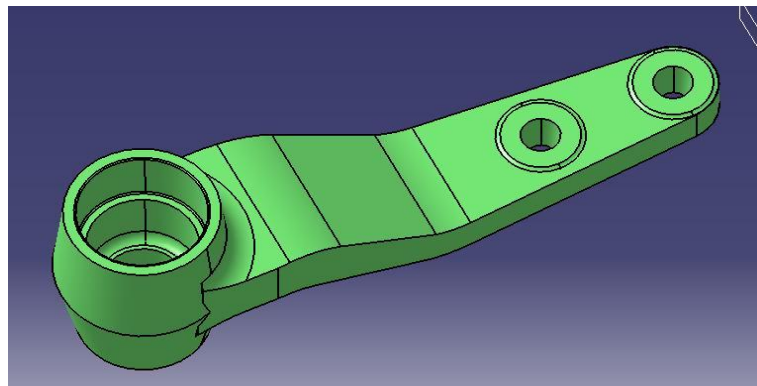


Fig.1 Pitman Arm

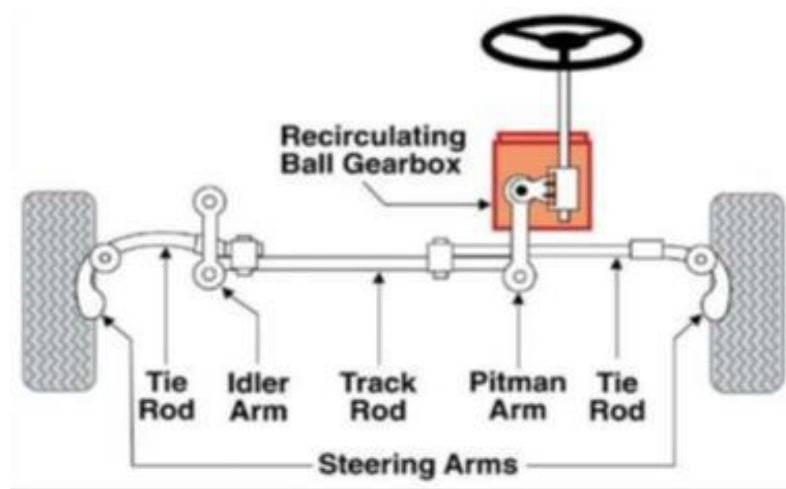


Fig. 2 Steering System [7]

1.2 Fixture

Fixtures may be defined as devices used in manufacture of duplicate parts of machines and intended to make possible interchangeable work at a reduced cost, as compared with the cost of reducing each machine detail individually. Fixtures serve the purpose of holding and properly locating a piece of work, while it is machined & are provided with necessary appliances for guiding supporting, setting, gauging the tool in such a manner that all the work produced in same fixture will be alike in all respects even with the employment of unskilled labour.[2]

A fixture's primary purpose is to create a secure mounting point for a work piece. Which in turn acts as a support during operation and increased accuracy, reliability, interchangeability and precision in the finished parts. This also serves to reduce working time by allowing quick set-up and by smoothing the transition from workpiece to workpiece. [4] It frequently reduces the complexity of a process, which allows for unskilled workers to perform it and effectively transferring the skill of the tool maker to the unskilled worker.[3] These Fixtures also allow for a higher degree of operator safety by reducing the concentration and effort required to hold a piece steady.[4]

Fixtures must always be designed with cost effectiveness in mind. The main purpose of these devices is to reduce costs, so that it can be designed in such a way that the cost reduction outweighs the cost of implementing the fixture. This is usually much better, from an economic standpoint for a fixture to result in a small cost reduction for a process in constant use, compared for a large cost reduction for a process used only occasionally. [5]

1.3 Elements of Fixtures:

Locators: A locator is usually a fixed component of a fixture. It is used to establish and maintain the position of a part in the fixture by constraining the movement of the part. For work-pieces of greater variability in shapes and surface conditions, a locator can also be adjustable. [6]

Clamps: A clamp is a force-actuating mechanism of a fixture. The forces exerted by the clamps hold a part securely in the fixture against all other external forces. [6]

Supports: A support is a fixed or adjustable element of a fixture. When severe part displacement/deflection is expected under the action of imposed clamping and processing forces, supports are added and placed below the workpiece so as to prevent or constrain deformation. Supports in excess of what is required for the determination of the location of the part should be compatible with the locators and clamps. [6]

Fixture Body: Fixture body, or tool body, is the major structural element of a fixture. It maintains the spatial relationship between the fixturing elements mentioned above, viz., locators, clamps, supports, and the machine tool on which the part is to be processed. [6]

2. RESEARCH METHODOLOGY:

2.1. Modelling and Design:

2D & 3D modeling was carried out in CATIAV5R21 Software.

1. Fixture 3D model

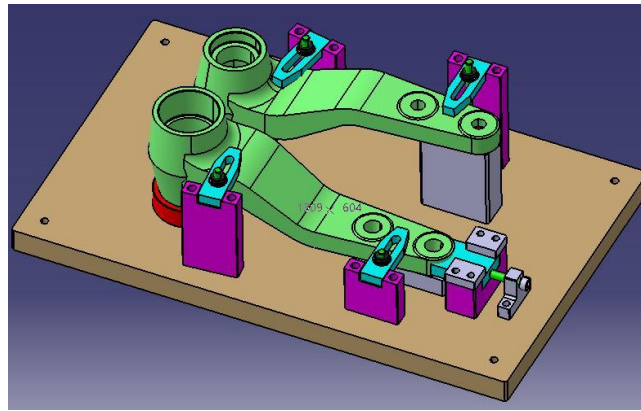


Fig.3 Fixture 3D model.

2. Supporting pin

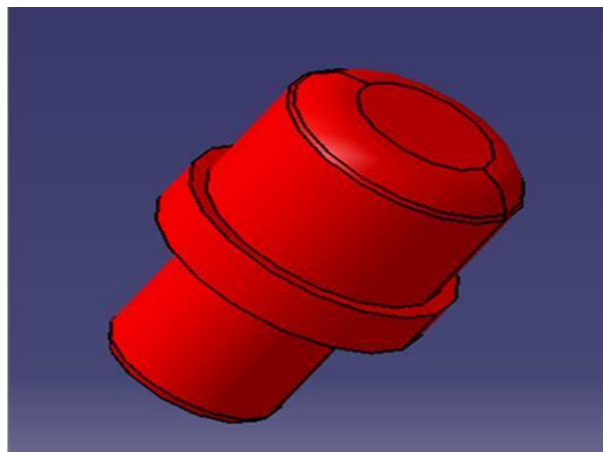


Fig.4. Supporting Pin

3. Strap clamp

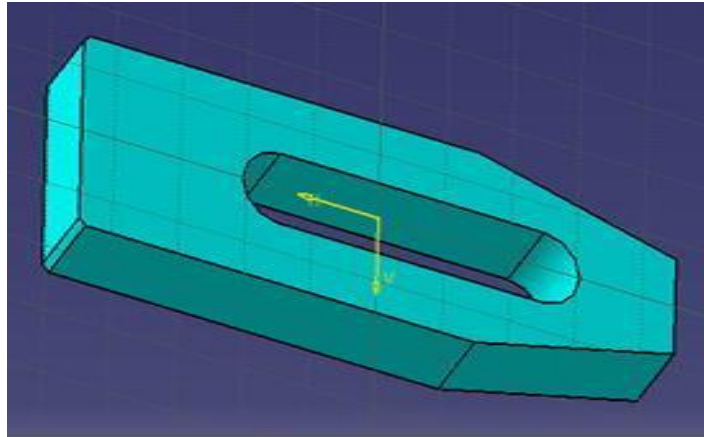


Fig.5 Strap Clamp

4. Supporting Block

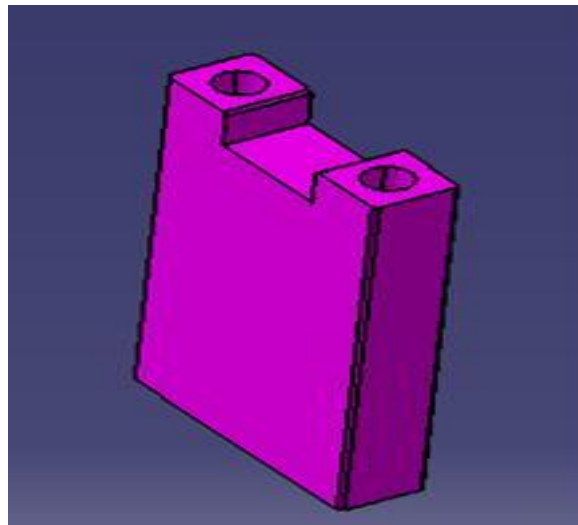


Fig.6 Supporting Block

5. U Block Support

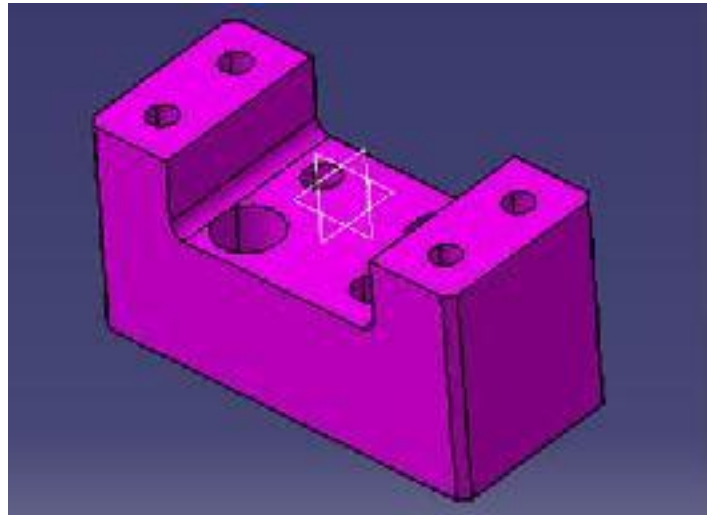


Fig.7 U Block Support

2.2 Design

2.2.1 Design criteria for fixtures

To meet all design criteria for work holder is impossible, compromise is inevitable. The most important hint of optimal design objectives is positioning, holding & supporting functions that fixtures must fulfill. [2]

2.2.2 Position location

A fixture must above all else hold the work piece, precisely in place to prevent 12 degrees of freedom, linear movement in the either direction about each axis.[2]

2.2.3 Repeatability

Identical work piece specimens should be located by work holder in precisely the same space on repeated loading & unloading cycles. It should be impossible to hold the work piece incorrectly. [2]

2.2.4 Adequate clamping forces

The work holder must hold the work piece immobile against the forces of gravity. Centrifugal force, inertia force, wetting force, milling & the design must calculate these machines forces against the fixture holding capacity. The device must be rigid: clamping forces must be maintained. [2]

2.2.5 Care during loading cycles

As the work holders usually receive more punishment during the loading & unloading cycle than during the machining operation. The device must endure impact & aberration for at least the life of the job. [2]

3. MATERIAL

EN 353 steel is the most common and cheapest steel which find its mechanical properties applicable in automobile applications such as heavy duty gears, shafts pinions, camshafts etc. It has a carbon content of 0.16%, and so it is neither too brittle nor too ductile because of its low carbon content and low hardness.[9]

Table 1. Composition of EN353[9]

Element	Percent	
	Min	Max
Carbon	0.16	0.22
Silicon	0.10	0.35
Manganese	0.80	1.10
Phosphorus	--	0.035
Sulphur	--	0.020
Chromium	0.80	1.20
Molybdenum	0.10	0.20
Nickel	1.00	1.20
Aluminium	0.02	0.05

4. FABRICATION PROCESS

Fabrication is the use of machines, tools and labour to produce goods for use or sale. The term may refer to a range of human activity, from handicraft to high tech, but is most commonly applied to industrial production, in which raw materials are transformed into finished goods on a large scale. Such finished goods may be used for manufacturing other, more complex product.[2]

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RESULTS AND DISCUSSIONS

The basic aim of the present study is design and fabrication of a fixture for Pitman Arm of Steering system. Fixture was manufactured according to the design specifications and conditions.

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