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International
Journal
Of Modern Engineering Research (IJMER)

Design of Fixture for Cross Hole Drilling of Flange-Yoke

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Abstract:- Flange Yoke is a part of Propeller Shaft which is required when power is to be transmitted from engine to differential gear box of an automobile. A flange yoke is used to joint two fork halves; each comprising a base component and a bearing component. During cross hole drilling on the flange, vibrations takes place and it leads to tool breakage. Therefore the tool interchangeable time is increased. Thus there is a need to design a fixture to nullify the problems. We have designed such a fixture which will carry out the drilling operation efficiently. The newly designed fixture uses a drill bit which removes the material as per requirement, which reduces the vibrations and tool breakage and finally reduces the tool interchangeable time.

Keywords:- component; designing; formatting; styling

I. INTRODUCTION

1.1 Flange Yoke

A flange yoke for a universal joint comprises of a first and a second joint fork half which are joined to form the flange yoke. Each joint fork half having an element for receiving a pin and the element has a pin axis comprises of a base component and a bearing component. The base components of the first halve and the second joint fork being so shaped that they form a locking system connected to form a flange. Flange Yoke 1130 is a part of propeller shaft assembly which is connected to the engine and differential. This flange is used in ambassador cars.

1.2 Fixture

A fixture is a work-clamping or supporting machine used in the manufacturing industry. A fixture is a device used to “fix” (constrain from all ends) raw-material in a given coordinate system relative to the cutting tool. Fixtures are used to safely locate (position in a required location or orientation) and support the work, ensuring that all parts manufactured using the fixture will maintain accuracy and interchangeability. Using a fixture improves the economy of production by allowing rapid operation and quick replacement from part to part, reducing the requirement of skilled manpower by simplifying how workpieces are placed, and increasing conformity across a production run. The purpose of this machine is to reduce revenue, and so they must be developed in such a way that the cost reduction outweighs the cost of assembling the fixture. It is always profitable, from an economic standpoint, for a fixture to result in a large cost reduction for a process of mass production, than for a large cost reduction for a process used only occasionally. Each component of a fixture is manufactured for one of the objective: location or support.

Location: Locating object ensure the physical stability of the raw material. They confirms that the workpiece rests in the correct position and orientation for the operation by constraining all the degrees of freedom the workpiece possesses. For locating workpieces, fixtures employ locator (or pins), clamps, and faces. These components ensure that the workpiece is positioned accurately, and always in the same position throughout the operation. Surfaces provide support for the piece, pins allow for accurate position at minimum surface area, and clamps allow for the workpiece to be interchange or its location adjusted. Locating component tend to be developed and built to very tight specifications. Any rectangular body many have three axis along x-axis, y-axis and z-axis. It can more along any of these axes or any of its movement can be adjusted to these axes. Simultaneously the body can also rotate about these axes too. So total degree of coordinate of the body along which it can adjust is six. For processing the body it is required to restrain the entire coordinate (DOF) by arranging suitable positioning points and then clamping it in a fixed and required position.

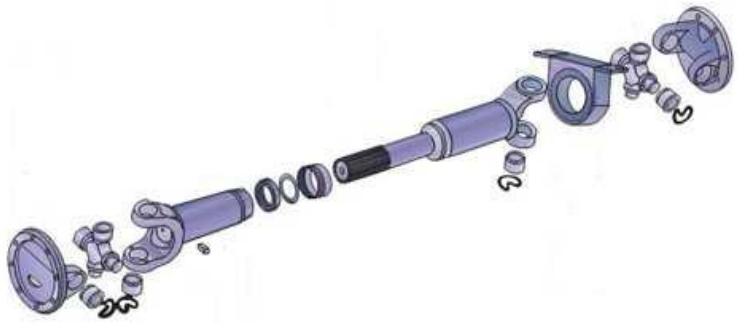


Fig.1 Propeller shaft

Fig.2 Flange Yoke 1130

Support: In developing the positioning component of a fixture, only the directions of forces applied by the operation are considered, and not their numerical value. Locating parts hold the raw material, but do not take into account the power of forces applied by the operation and so are usually insufficient to actually secure the work piece during operation. For this outcome, support parts are used.

To secure work pieces and prevent motion during operation, support components usually use two methods: positive cease and friction. A positive cease is any fixed components (such as a rigid surface or screw) that, by its location, physically prohibit the motion of the work piece. Support parts are more likely to be adapted than locating parts, and normally do not press tightly on the raw material or provide absolute placement. A support part usually absorbs the blow of the forces delivered during the operation. To reduce the probability of failure, support components are usually not also developed as clamps.

1.2.1 Types Of Fixture Machine

I. Milling Fixtures: Milling works tend to involve large, straight cuts that produce bulk of chips and involve variety of force. Positioning and supporting areas must usually be large and very rigid in order to accommodate milling work; strong clamps are also a requirement. Due to the vibration of the machine, positive cease are promoted over friction for securing the raw material. For high-volume automated processes, milling fixtures usually involve hydraulic or pneumatic clamps.

II. Drilling Fixtures: Drilling fixtures cover a wider range of different designs and development than milling fixtures. Though workpiece holding for drills is more often provided by jigs, fixtures are preferred for drilling works. Two most important elements of drilling fixtures are the hole and bushing. Holes are often developed into drilling fixtures, to allow place for the drill bit itself to continue through the workpiece without harming the fixture or drill hole, or to give direction to the drill bit to the appropriate point on the workpiece.

III. Modular Fixtures: Modular fixtures provide many of the benefits of a permanent tool using only a temporary setup. Modular work holders combine opinion and component of both permanent and transitory work holding to make inexpensive-yet-durable work holders. The basic benefit of modular fixtures is that a tool with the advantage of permanent tooling (setup reduction, interchangeability, better productivity, and reduced skilled operator) can be built from a set of standard components. The fixtures are disassembled when the operation is complete, to allow the reuse (durable) of the components in a different fixture. After many use the original can

be rapidly reformed from drawings, procedure, and photographic records. This reuse enables the construction of a complicated, highly accurate tool without requiring the corresponding dedication of the fixture components.

1.2 Propeller Shaft:

The function of propeller shaft in any vehicle is the object that "propels" the vehicle, or makes it move. A propeller shaft on a heavy vehicle joints differential and transfer case. The engine essentially moves the gears in transmission which simultaneously rotates the propeller shaft, or the gears in the transfer case, which also rotates the propeller shaft. The shaft then turns the gears in the differential. The gears in the differential gear box then rotate the axle, which rotates wheels, move (propel) the vehicle. As for an airplane, a propeller forces air in the direction backward to the plane thrusting (propelling) the plane forward. Same idea with a boat only it forces water in rear direction causing the boat to be thrust forward.

A drive shaft, propeller shaft or Cardan shaft is a mechanical device for transmitting torque and rotation, usually used to connect other devices of a drive train that cannot be connected because of distance or the need to allow for relative movement between them. Drive shafts are carriers of power: they are subject to torsion and shear stress. They enough strong to bear the stress, while avoiding very much more weight as that would in turn increase their inertia. To allow for variations in the accuracy and distance between the driving and driven components, drive shafts frequently incorporate one or more jaw couplings, universal joints, and sometimes a prismatic joint.

II. DESIGN OF FIXTURE

The newly designed fixture is a Cross-Hole Drilling fixture. The drilling operation is performed on the flange yoke with the help of carbide insert drill bit. The tool is 3 point 4 insert cutter. The tool is mounted vertically in the spindle of the head stock. Cross-Hole Drilling fixture is holding on the worktable of conventional radial drilling machine with the help of bolts. The component i.e. the flange yoke is forged first. After the forging operation, the component goes through other operations like drilling, cross hole boring.

The final operation carried out on the newly designed fixture is a drilling operation. To begin with the operation the component is mounted on the locator. The swing bolts are then placed into the slots of the mandrel which is used to hold the job on the locator. The mandrel is passed through the cross holes of the component. Then the fixture is checked for number of degrees of freedom. After giving the appropriate speed and feed to the machine, drilling operation is carried out. The operation is carried out on the arm of the flange. One side drilled in one pass. The Drilling operation is done twice on the component. As drilling work is the last operation carried out on the flange yoke, after the last operation the component is ready for dispatch.

III. MANUFACTURING

A] Part List

Table No:1.1 Part List

SR no.	Part Name	Material	Quantity
1	Base Plate	M.S.	1
2	Vertical Plate	M.S.	3
3	Top Plate	M.S.	1
4	V-Locator	OHNS	1
5	Mandrel	N31	1
6	Support Block	OHNS	1
8	Top Bush	OHNS	1
9	Bolts	LN	8
10	Job Support	OHNS	1
11	Stopper	LN	1

B] Selection Of Materials:

1.0 Mild Steel:- Mild steel is considered the most common type of steel. The cost is relatively small so it is used when large amounts of are needed. M.S is also referred to as low carbon steel. It contains 0.3% carbon. One property of mild steel (M.S.) is that it is malleable as it can be forced and pressed into any shape. Thus we have used mild steel for base plate, vertical plate and support plate.

2.0 Ohns (Oil Hardening Non Shrinking Tool Steel):-

This contains 0.9 -1.1% carbon, 0.5-2% tungsten and 0.45-1% manganese. This are used for fine parts such as taps, hand reamers, milling cutter, locators, which cannot be ground after hardening(RC62)

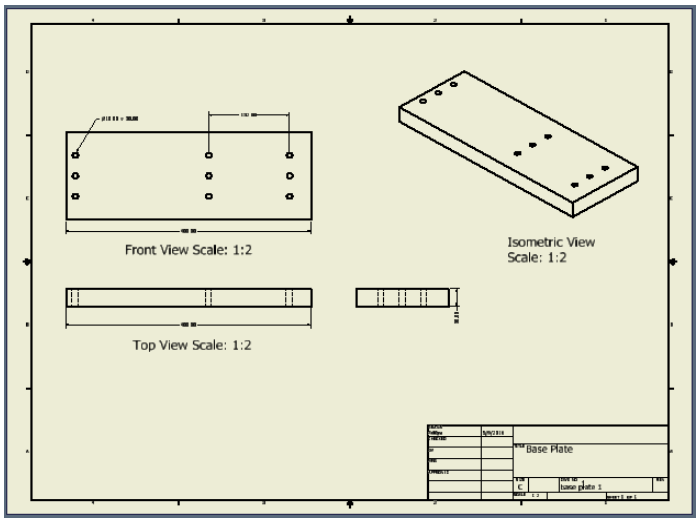
3.0 N-31:- N31 is a nickel silver with excellent machining properties making it possible to pursue high strength. It has good hot working properties; complicated shapes of finished products can be realized during extruding already. It contains 7% Ni,3% Pb, 2% Mn 0.3% C.It is highly suitable for producing many variety of sections, accurately turned and hot stamped parts requiring higher mechanical strength and corrosion resistance than for brass.

C] Process Sheets And Part Drawing

PROCESS SHEET – 1
COMPONENT NAME: - Base Plate
RAW MATERIAL: - M.S.
RAW MATERIAL SIZE: - 402mm X 152mm X 32mm
QUANTITY: - 1.

Table No. 1.2 Process sheet of Base plate

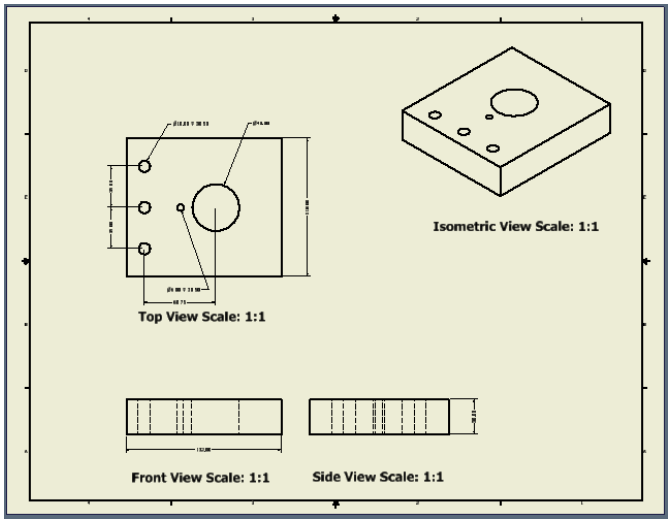
OPERATION	MACHINE	TOOL USED	TIME
Grinding (Top and Bottom surface grinding)	Grinding machine	Ø180 (46 X 54 grade)	1 Hrs 15 mins
Milling(4 sides) Right angle milling	Milling machine	Face milling cutter ISO30 Ø80 Carbide insert	45 mins
Drilling and Tapping (9 counter bore)	Drilling machine	HSS Drill Ø 10 Tap M10	25 mins
		Total Time	2 Hrs 25 mins



PROCESS SHEET – 2
COMPONENT NAME: - Top plate
RAW MATERIAL: - M.S.
RAW MATERIAL SIZE: - 134mm X 120mm X 32mm
QUANTITY: - 1.

Table No. 1.3 Process sheet of Vertical plate

OPERATION	MACHINE	TOOL USED	TIME
Grinding (Top and Bottom surface grinding)	Grinding machine	Ø180 (46 X 54 grade)	1 Hrs 15 mins
Right angle milling (4 sides)	Milling machine	Face milling cutter ISO30 Ø80 Carbide insert	45 mins
Boring (1 hole)	Milling machine	Ø40H7,Eccentric chuck with boring bar and HSS tool (10 X 10)	30 mins
Drilling and Tapping (3holes)	DRO Milling	HSS Drill Ø10 mm Reamer 12mm	20 mins
Drilling and Tapping (1holes)	DRO milling	HSS Drill Ø6mm Tap M6	7 mins
		Total Time	2 Hrs 57 mins



IV. ASSEMBLY

A] Assembly Details:

Refer the assembly sheet:

□ □ Take the Base Plate (1) and keep it over the surface of table

□ □ Mount the Vertical plate (2) over the base plate (1) with the help of standard bolts.

□ □ Now place the Locator (4) over the Vertical Plate (2), fix it properly with the help of pins (3).

□ □ Fix the Swing Bolts (5) in the slots of Vertical Plate (2) with the help of Hinge Pins (9).

□ □ Insert the Grub Screws (11) in the Vertical Plate (2) up to Hinge Pin surface (9)

□ □ Place the Flange Yoke to the Locator (4) and fix it with the help of pins (3).

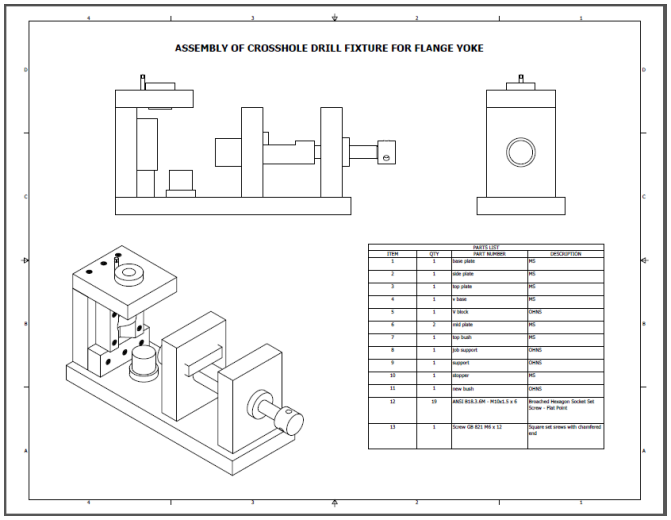
□ □ Insert the Mandrel (6) through the cross holes of the Flange Yoke

□ □ Screw the Slotted Nut (7) to the Swing Bolt up to the Mandrel Surface (6).

□ □ Weld the Support Plates (8) to the Base Plate

(1) and Vertical Plate (2).

B] Assembly Drawing



V. CONCLUSION

Hence, with the complete work on "Design of Fixture for Cross Hole Drilling of Flange-Yoke" and also after performing result analysis on it, we conclude the following:-

1. With the newly designed drilling fixture vibrations are reduced to a large extent.
2. Using insert drill bit, tool breakage is eliminated which has been used in place of spot facing tool.
3. As the problem of tool breakage is reduced machining cost is decreased.
4. Also the cycle time required for drilling of component per shift is reduced considerably

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