Design And Manufacturing of Hydraulic Fixture For Trip Cover Plate

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Abstract- *The fixtures are the economical ways to produce a component in mass. So, fixtures are used and serve as one of the most important facility of mass production system. These are special work holding device. Quality of the performance of a process largely influced by the qulaity of fitures used for this purpose. What makes a fixture unique is that each one is built to fit a particular part or shape. The main purpose of a fixture is to locate and in the cases, hold a work piece during an operation.*

Keywords- Work hold device, link and component cylinders. Rest pad, clamp arm, dead stopper. Hydraulic pushing cylinder.

I. INTRODUCTION

Fixtures are of great use in the manufacturing process. Especially if we consider CNC, VMC, HMC, etc. the cycle time reduces if one uses the fixture. The fixture can be divided into sub parts as a. Manual Fixture, b. pneumatic fixture and c. Hydraulic fixture. Under this project our group will design and develp a hydraulic fixture. Manual fixture consumes more time compared to hydraulic fixture. A fixture is a work-pice loading and holding device used with machine tools. It is also used in inspection welding and assembly.

The fixture is a device which sets workpice in proper position during manufacturing operation. Fixture is widely used in the industry practical production because of feature and advantages. To locate and immobilize work pieces for machining, inspection, assembly and other operations fixtures are used.

A fixture consists of a set of locators and clamps. Locators are used to determine the orientation and position of a workpiece is pressed firmly against locators. Clamping must be appropriately planned at the stage of machining fixture design. The design of a fixture is a highly complex and intuitive process, which rquire knowledge, Fixture design plays an important role at the setup planning phase. Proper fixture design is crucial for developing product quality in different terms of accuracy. Surface finish and precision of the machined part.

II. LITERATURE REVIEW

1. Shailesh S Pachbhai :-

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 that minimizes 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.

2. Chetankumar M. Patel,Dr.G.D.Acharya :-

There is an increasing need for improved methods of determining the reliability and predicting the lifetime of machines and production systems more accurately. The paper presents unique design of & manufacturing of 8 cylinder hydraulic fixture for boring YOKE on VMC – 1050 with expanding customized collet.

3. Abhijeet Swami& Prof. G.E. Kondhalkar:-

A fixture consists of a set of clamps and locators. Locators are used to determine the orientation and position of a workpiece, and clamps exert clamping forces on the workpiece so that the workpiece is pressed against locators and resting pads. The recent trends in industry are towards adopting the hydraulic and pneumatic techniques, because it save time generates accuracy and it is having some flexibility. Designing of hydraulically clamped fixture was considered to be lengthy and complicated procedure. Because it needs a good knowledge about, dimensioning and tolerances, manufacturing processes, clamping and cutting forces during operations.

4. Sagar P. Durge, Dr. S. B. Jaju :-

All manufacturing industries uses automatic system to reduce the manufacturing time and resources. Wearer using hydraulic fixture to automate the clamping. More parts will fit within machine and it uses high pressure liquid to fix parts in proper location with small hydraulic components hence get more productivity. For controlling hydraulic system, it uses actuator. An actuator is used in hydraulic system for moving and controlling system, for example by opening a valve.

5. Komal Barge, SmitaBhise :-

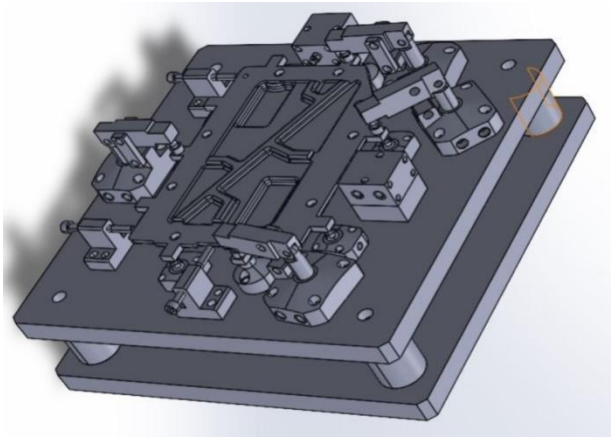
Fixtures are one of the mean that it accomplishes this need effectively. Fixture is a special purpose tool which is used to facilitate production (machining, assembling and inspection operations) when workpieces are to be produced on a mass scale. Fixtures provide a means of manufacturing interchangeable parts since they establish a relation, with predetermined tolerances, between the work and the cutting tool.

III. DESIGN AND METHODOLOGY

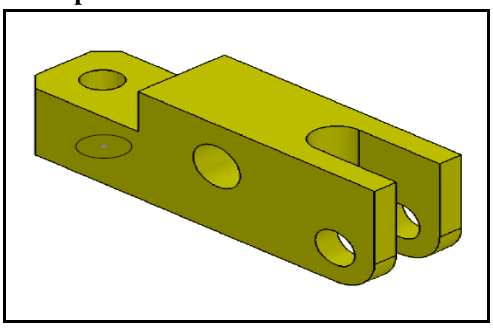
The designed of any fixture using manual or hydraulic clamps is the same. The structure of the fixture is sufficiently rigid and heavy to avoid deformities and vibrations due to machine movements and clamping forces. The unprocessed component is initially be positioned, support and clamped only at three fixed points. When the work piece is clamped on these three field points its position is staticaly determined. I compare the with the stability of a table with three legs. Three functions : Any work holding fixture is fulfill three basic functions.

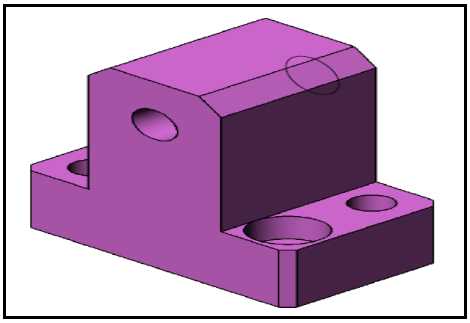
a) Positioned the component accurately.
b) Support the component adequately
c) Clamped the component securely for machining.

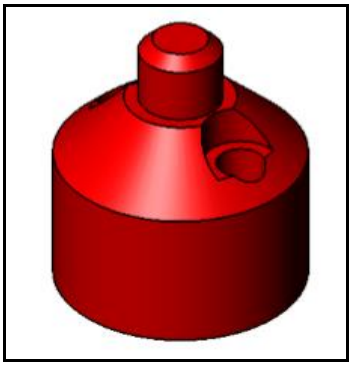
Design of trip plate on solidworks :

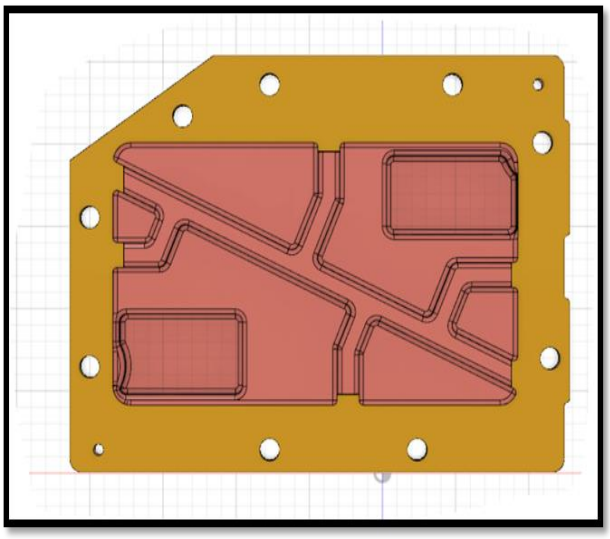


Images of component :









The general rules for designing are as follows :

a) Component the cost of production of work with present tools with the expected cost of production using tool to be made and see that the cost of buildings is not in excess gain.
b) Decided upon locating points and outline clamping arrangement.
c) Model all clamping and binding devices as quick acting as possible.
d) Made all the fixture tool proof.
e) Made some locating points adjustable.
f) Avoid complicated clamping arrangements.
g) Round all corners.
h) Provided handless wherever these are made handling easy.
i) Provided holes on escapes for chips.
j) Located clamps so that they are in best position to resist the pressure of the cutting tool when at work.
k) Placed all clamps as nearly as possible opposite some bearing point of the work to avoid springing action.

IV. RESULTS AND DISCUSSION

- Diameter of the cutter: - 30mm
- Revolution per minute: - 1500 rpm
- Cutting speed(v)

$$v = \frac{\pi Dn}{1000} = \frac{\pi \times 30 \times 1500}{1000} = 141.37 \approx 142$$

$$v = 142\ m/min$$

- Feed per tooth (Sz) = 0.35 mm/tooth
- Number of teeth = 4
- Feed per minute (Sm)

$$Sm = Sz \times Z \times n$$
$$= 0.35 \times 4 \times 1500$$
$$Sm = 2100\ mm/min$$

- Depth of cut (t) = 0.5 mm
- Width of cut (b) = 22 mm
- Metal removing rate (Q)

$$Q = \frac{b.t.Sm}{1000}$$
$$Q = \frac{22 \times 0.5 \times 2100}{1000}$$
$$Q = 23.1\ cm^3/\text{min}$$

- Torque at spindle (T_s)

$$T_s = \frac{975 \times N}{n}$$
$$T_s = \frac{975 \times 0.8582}{1500}$$
$$T_s = 0.5578\ kgfm$$
$$= 5.47\ Nm$$

- Cutting force = 370 N
- Clamping force = Cutting force × Factor of safety

= 370 × 2.5
= 925 N

- Calculation for selection of clamping cylinder:

Total number of clamps = 3
∴ Force for each clamp = 925/3 N = 308.33 N

$$Pressure = \frac{Force}{Area}$$
$$10.5 \times 10^5 = \frac{308.33}{\frac{\pi}{4}d^2}$$
$$d = \sqrt{\frac{308.33 \times 4}{10.5 \times 10^5 \times \pi}}$$

d = 19.33 mm

Selecting cylinder from catalogue having piston dia., d = 22mm

Calculation for selection of work support
Work support should withstand the cutting force
∴ For calculation purpose we require the force acting on single cylinder

$$\text{Force} = \frac{370}{3} = 123.37 \approx 125\text{N}$$
$$Pressure = \frac{force}{area}$$
$$10.5 \times 10^5 = \frac{125}{d^2 \times \frac{\pi}{4}}$$
$$d = \sqrt{\frac{125 \times 4}{10.5 \times 10^5 \times \pi}}$$

d = 12.31mm

From catalogue selecting cylinder with diameter, d = 12.5mm
As a result, the rate of manufacturing of the component increased because of the reduction in cycle time.

V. DISCUSSION

All know using the manufual fixture consumes a lot of time. This affects the production rate.

1) The traditional manual fixture is replaced by a hydraulic fixture. The hydraulic fixture reduced the cycle time which ultimately results in higher productivity.
2) The efforts of the operator are also reduced with the help of a hydraulic fixture.
3) The risk of job rejection is less in hydraulic fixture as the job is positioned accurately.
4) Because of a smaller number of jobs are rejected, the company will earn more financial benefit.

VI. CONCLUSION

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. Time machining accuracy is increased.
3. Productivity is increased.
4. Because of automation cycle time is reduced.
5. We would like to express our deep and sincere gratitude to our Guide.

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REFERENCES

[1] Abhijeet Swami, Prof. G.E. Kondhalkar, Design, "Development and Analysis of Hydraulic Fixture for machining Engine cylinder block on VMC", International Research Journal of Engineering and Technology, Vol: 3, Issue: 8, Aug- 2016, pg. 463 - 469.
[2] Chetan M. Patel, Nirav P. Maniar, D. P. Vakharia, Design & Manufacturing with Modeling of Multi Component – Single Hydraulic Fixture with 10 cylinders & expandable uniforce clamp for machining earthing terminal block on CNC - VMC 430, ASME Vol: 8, Oct- 2009, pg. 118 – 123.
[3] S. S. Pachbhai and L. P. Raut, Design and development of hydraulic fixture for machining hydraulic lift housing, International journal of mechanical engineering and robotics research 149, 2014, pp. Vol. 3, No. 3.
[4] AadguleRuturaj Ramesh, Patil Aditya Ashok, Patil Aniket Anandrao, Shirke Nitin Ashok, Rawal Jayesh Mangilal, "Design and Manufacturing of Fixture for Crankcase Web with POKA YOKE", SITCOE, Shivaji University Kolhapur.
[5] Shailesh S Pachbhai "DESIGN AND DEVELOPMENT OF HYDRAULIC FIXTURE FOR MACHINING HYDRAULIC LIFT HOUSING"Vol. 3, No. 3, July, 2014.
[6] Chetankumar M. Patel,Dr.G.D.Acharya" Design and manufacturing of 8 cylinder hydraulic fixture for boring yoke on VMC - 1050" vol. 4, Pages 405-412, 2014.
[7] Abhijeet Swami& Prof. G.E. Kondhalkar"Design, Development and Analysis of Hydraulic Fixture for machining Engine cylinder block on VMC"Volume: 03 Issue: 08 | Aug-2016.
[8] Sagar P. Durge, Dr. S. B. Jaju, "AUTOMATION OF FIXTURE USING HYDRAULIC POWER PACK: A REVIEW" Volume 6, Issue 8, April-2019.
[9] Komal Barge, SmitaBhise , "Design & Development of Hydraulic Fixture for VMC" Volume 3 Issue IV, April 2015.