DESIGN AND DEVELOPMENT OF JIG FOR AN AUTO PART

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Abstract*— there are many types of jigs and fixtures are used in industries. Jig is device which is used to hold the work piece or fix the work piece and guide the cutting tool. The purpose of the jigs is to provide strength, holding, accuracy and interchangeability in the manufacturing of product. The objective of this project is to design and development of drill jig. We found that there is problem in auto part which required three holes of diameter 8.05mm at 120° with the help of drilling manually. It is time consuming process. Also skills and accuracy is required. So with the use of jig time consumption for drilling three holes is less. Drilling jigs make possible the drilling of holes at higher speed with greater accuracy and with less skilled worker.

Index Terms*— jig and fixture, holding devices, drilling machine. Plate etc.

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1. INTRODUCTION

Minimatic Machine is a SSI unit based established in the year 1984 at Rajkot, which is catering to the needs of OE as well as ancillary units located in this region. The main thrust of the activity of the unit basically is to provide difficult to manufacture Jigs, Fixtures & Measuring Instruments in the workshop of the OE suppliers. A complete Tool Room type setup has been completed by Minimatic Machines at their factory site.

The name of the industry is Minimatic Machines. The owner of the industry is Mr. Jaysukh Nagewadia. The industry manufactures CNC turning machines. Types of the turning centers are MGT50, MGT100, and MGT200. Also they manufacture VMC200. Industry also manufactures special purpose machines, measuring instruments and different auto parts. Special purpose machines like abrasive belt grinder, bench center and measuring instruments like cam profile checking unit, comparator stand, dial calibration stand, run-out checking instruments are made.

2. INTRODUCTION OF JIG

It is a work holding device that holds, supports and locates the work piece and guides the tool for a very specific operation. Increasing the productivity and accuracy are the two basic aims of mass production. As we know the solution to this is by reducing the set up cost of the machine and also reducing the manual fatigue. In this case the device that caters our needs is the use of jigs. Let us take one example. Let us consider that one gets an order of say 1000 products. There need to be three holes drilled on this product. Accuracy is the main problem in such cases. In doing so it increases the work load on the operator. Hence using of jig to position and guide the tool to its right path is preferred rather than using scribers, square, straighteners or center punch etc. Thus the productivity is increased which is done by eliminating individual positioning, marking and frequent checking. Interchangeability is the chief advantage here. All the parts fit in properly except only the similar components are interchangeable. One does not need to repeatedly clamp and unclamp the object for various purposes like positioning as the locating, clamping and guiding of the tool is done by the jig itself. Bushing which is a tool guiding tool is used. So it reduces the presence of skilled laborer. Drill jig helps to drill, ream and tap at a much faster speed and with great accuracy as compared to holes done conventionally by hand. In case of a drill jig bushings are used. These drill bushings guide the drill bit during the drilling operation. Generally work piece is held by a fixture and the fixture is arranged in such a way that the loading and unloading of the job is quick.

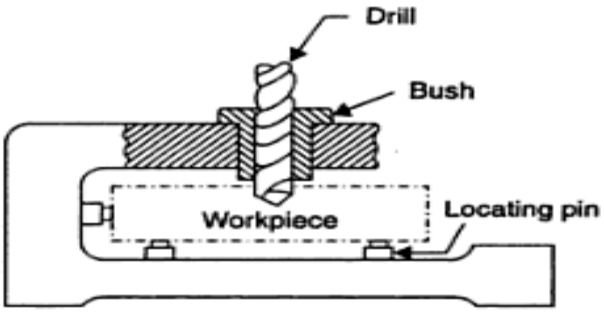

Fig. 1 jig

2.1 PROBLEM SUMMARY:

Today's business scenario is characterized by increase demand of product, faster response and mass production. To meet the current challenges it has become imperative for companies to increase the production rate. Industry manufactures pressure plate. In the manufacturing of pressure plate different operations and process like casting, inspection, drilling, chamfering is done. In drilling

operation, marking and punching are done manually. So more time is required for marking and punching. . Moreover the setting and holding of job during machining is difficult and time consuming task. Also more time required for inspection of bore diameter.

2.2 INDUSTRIAL PROCESS (PRESSURE PLATE):

- The pressure plate which is made with the help of casting process. Sand casting is used for manufacturing pressure plat.
- After casting process, rough machining process is done with the help of different tools.

Fig. 2.1 Pressure plate (3D)

Fig. 2.2 Pressure plate (3D)

- After completion of the rough finishing process, final finishing processes like filing and polishing are done.
- Then inspection is carried out on the part. In the inspection process, checking the internal and outside diameter is carried out.
- After completion of the inspection, drilling operation is carried out for drilling 3 holes (120 degree) on the part.

Fig. 2.3 Side of Pressure plate

- After drilling operation, chamfering on the holes is carried out and also final inspection of the part is carried out.
- After chamfering, final inspection, plating and painting are done.

Fig. 2.4(Chamfering)

Fig. 2.5(Chamfering

3. PROBLEM SPECIFICATION:

- In drilling, marking and punching are done manually for drilling 3 holes (Ø 8.10mm) at 120 degree.

- So more time is required for marking and punching at 120 degree angle and pitch circle diameter of 261.5mm.
- Also more time required for inspection of bore diameter.

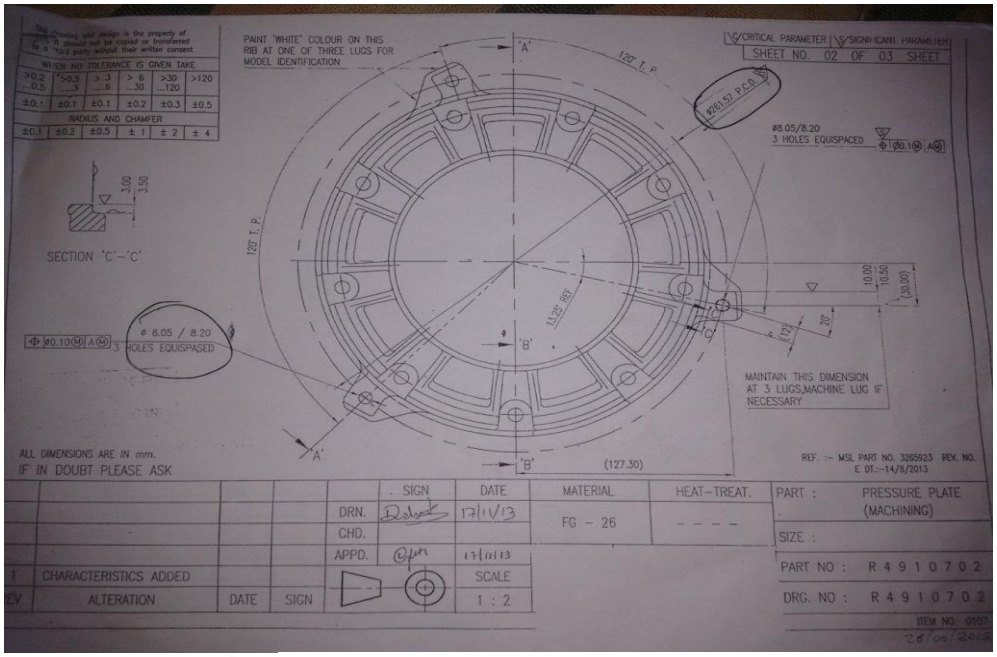

Fig. 3.1 Pressure Plate top view (2D)

4 CLAMPING DEVICES

There are different types of clamps which help in clamping of the jig at the required position. Clamps hold the work piece firmly. This helps in better engagement of job during the operation. Various forces develop during the cutting operation. The clamping should be such that it will sustain these forces during the operation. At the same time if clamping is so tight that it damages the work piece then it must be avoided. The timing required for clamping and unclamping of the device should be as less as possible. These clamping must also restrict vibrations and chatter during the cutting operation.

4.1. TYPES OF CLAMPS:-

1. Screw Clamps:

These are widely used for jigs and fixtures. These have lower costs. However, their operating speed is quite slow. The basic screw clamp uses the torque developed by a screw thread to hold a part in place. This is done by direct pressure or by acting on another clamp.

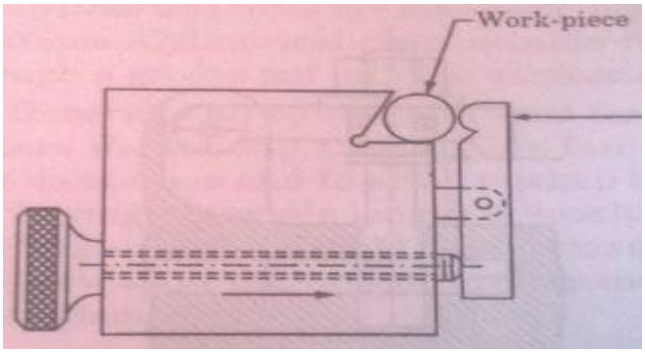

Fig. 4.1 Screw Clamp

2. Cam-action Clamps:

Cam-action clamps, when properly used, provide a fast, efficient, and simple way to hold work. Due to their construction and basic operating principles, the use of cam-action clamps is limited in some types of tools.

3. Hinged Clamps:

These utilize hinged lids for loading and unloading the components. Generally the clamp is made integral with the hinged lid. The figure shows that an arrangement using combination of hinged clamp is often required when it is necessary to move both the clamp and the bolt completely out of the way for the loading of component. The jig casing is designed such that the lugs are provided for locating the hinge pins.

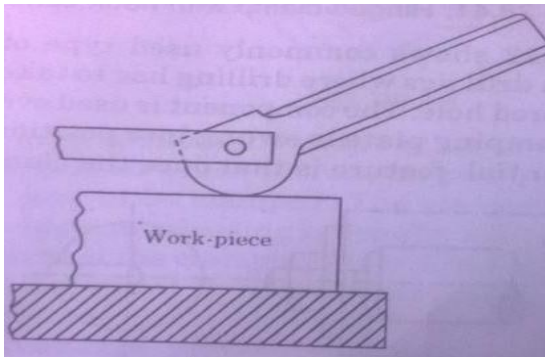

Fig. 4.2 cam action Clamp

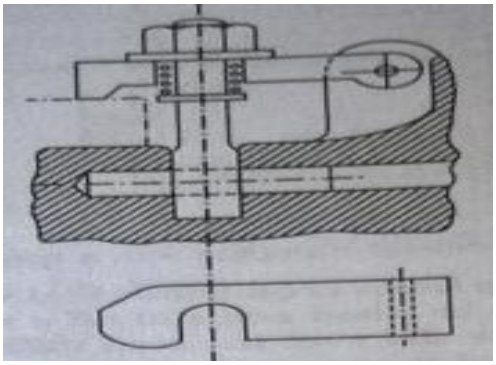
Fig. 4.3 hinged Clamp

5. OUTLINE OF THE SOLUTION:

In the manufacturing of pressure plate different operations and process like casting, inspection, drilling, chamfering is done. In drilling operation, marking and punching are done manually. So more time is required for marking and punching. . Moreover the setting and holding of job during machining is difficult and time consuming task. Also more time required for inspection of bore diameter.

So we have suggested and design a JIG for drilling process.

5.1. DESIGN PROCESS OF JIG:

- **RAW MATERIAL:-**
  Base plate (310*20 mm)
  Square bar (180*40*20 mm)
  Square bar (180*40*8 mm)

- **PROCEDURE:-**

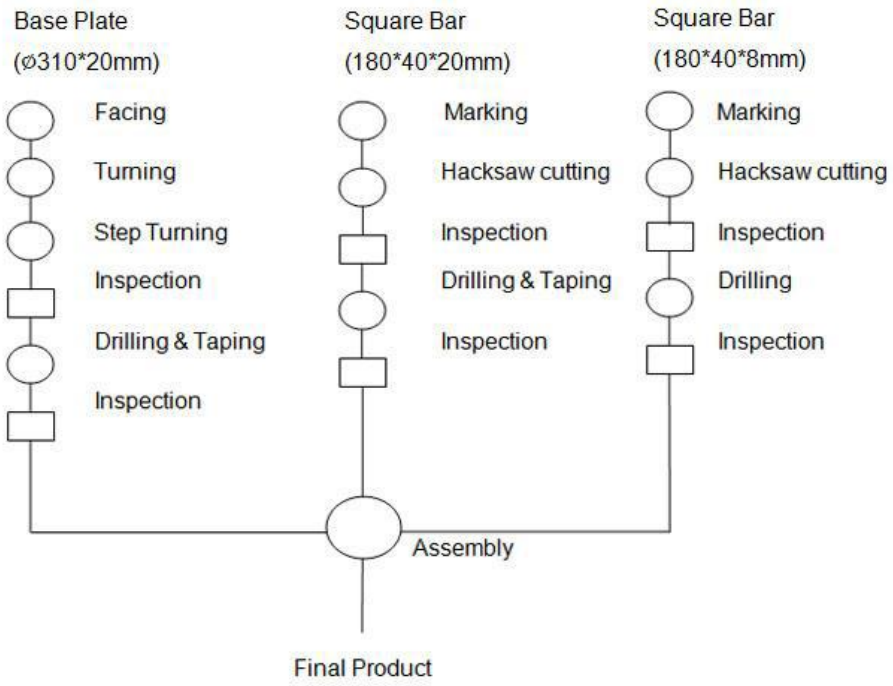

FIG. 5.1 Design Procedure of Jig

- **BASE PLATE:-**

- First take base plate of dia. 310 mm *20 mm. Facing and turning operation is carried out on the base plate for straightness. Then step turning of dia. 150.1 mm is done.
- Drilling of dia. mm is done at the center of the base plate.
- Then drilling two holes at the bottom of the base plate as per the marking which is carried out with the help of pressure plate. After that the tapping is done.

FIG. 5.2 Base Plate

➢ **SQUARE BAR:-**

- First take square bar of 180*40*20 mm. marking at length of 30mm, 60mm and 90mm is carried out consequently. Then the cutting operation of two square bar is carried out with the help of hacksaw cutting machine as per the Marking.
- Then drill two holes (as per size of bolts) at the bottom of the First square bar with the use of base plate and also tapping of the holes are carried out.
- After that drill two holes of same size at top of that first square bar and also on the second square bar as per the first square bar. Then joint two square bar with the help of l & key bolt.
- Drill one hole of dia. 8 mm on the top of that plate with the use of pressure plate.
- Same procedure is done for the remaining two holes of the pressure plate.

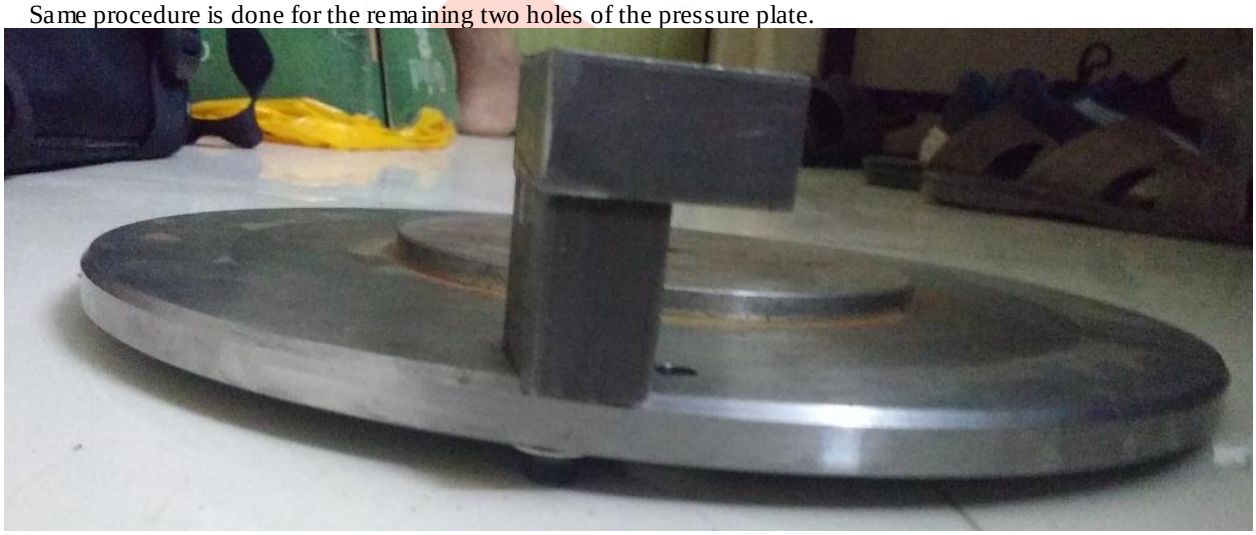

FIG.5.3 Square Bars

6. SUMMERY OF RESULT

6.1. TIME ANALYSIS:-

CALCULATIONS:-

Drill Size : 8mm or 5/16 Inch
Feed Rate : 0.123 mm / rev
FOR 610 RPM:-
1) Material Removal Rate
MRR = Π* D2 *f*N/4
= Π*(8)2 *0.123*610/4
= 3771.4 mm3 / min
2) Total Depth
Total Depth L = Total height + 2*0.29*D
= 20 + 2*0.29*8
= 24.64 mm
3) Drilling Time
Drilling Time T = L/N*f
= 24.64/610*0.123
= 59.112 sec
4) Loading And Unloading Time = 51 sec
5) Total Time

Total Time = Loading and Unloading Time + Drilling Time for Drill 3 holes
= 51 + 59.112*3
= 231 sec
FOR 912 RPM:-
6) Material Removal Rate
MRR = Π* D2 *f*N/4
= Π* (8)2 *0.123*912/4
= 5638.58 mm3 / min
7) Total Depth
Total Depth L = Total height + 2* 0.29* D
= 20 + 2*0.29*8
= 24.64 mm
8) Loading and Unloading Time = 51 sec
9) Total Time
Total Time = Loading and Unloading Time + Drilling Time for Drill 3 holes
= 51 + 39.5377*3
= 171 sec

OPERATION	EXISTING SOLUTION	PROPOSED SOLUTION (USING JIG)	
		By standard table	By measurement
Marking and punching	690 sec	------	------
Loading and unloading time	20 sec	51 sec	51 sec
Drilling time	40 sec	60 sec	40 sec
Total time	750 sec	231 sec	171 sec

Table No.:- 6.1 Time analysis

7. CONCLUSION:-

After this project we conclude that operation time reduces, accuracy increases and also production rate increases.

Productivity: Jigs and fixtures eliminate the individual marking, positioning, and frequent checking. This reduces operation time increases productivity.
Interchangeability: Jigs and fixtures facilitate uniform quality in manufacture. There is no need for selective assembly. Any part of the machine fit properly in assembly, and all similar components are interchangeable.
Skill Reduction: Jigs and fixtures simplify locating and clamping of the work pieces. Tool guiding elements ensure correct positioning of the tools with respect to work pieces. There is no need of skillful setting of the work piece of tool. Any average can be trained to use jigs and fixtures the replacement of the skilled work man with unskilled labor can effect substantial saving in labor cost.
Cost Reduction: Higher production, reduction of scrap, easy assembly and savings in labor costs results in substantial reduction in the cost of the work pieces produced with jigs and fixtures.

8. REFERENCES

1. Shivanand Vathare, Shrinivas L Gombi, Darshan M Katgeri, "Design and Analysis of Drill Jig for Head and Cover Part of the Actuator", (IJERT), August – 2014, Vol. 3 Issue 8, Page no.: 184 – 191. [1]
2. Hamad Mohammed Abouhenidi, "Jig and Fixture Design", (IJSER), February-2014, Volume 5, Issue 2, Page no.: 142 – 153.[2]
3. Muthukumaran, Ravi, C.Sivaram, Dinesh, P.S. Balaji, C.Sadasivam, A.Muniappan, "Design and Fabrication of Latch Jig for Contour Profile Component", (IJSR), November-2014, Volume: 3, Page no.: 199 – 201[3].
4. Sawita D. Dongre, Prof. U. D. Gulhane, Harshal C. Kuttarmare, "Design and Finite Element Analysis of JIGS and Fixtures for Manufacturing of Chassis Bracket",
5. International Journal of Research in Advent Technology, February 2014, Vol.2, Page no.: 1-3. [4]