Design and Fabrication of Jigs and Fixtures for Drilling Operation
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Abstract— Mass production aims at high productivity to reduce unit cost, and interchangeability to facilitate easy assembly. This necessitates production devices to increase the rate of manufacture and inspection devices to speed up inspection procedure. Jigs are provided with tool guiding element such as drill bushes. These direct the tool to the correct position on the work piece. Jigs are rarely clamped on the machine table. Fixtures hold the work piece securely in the correct position with respect to the machine/cutter during operation. Fixtures are often clamped on the machine table. The use of “JIGS AND FIXTURES” can avoid all geometrical errors which will occur in tool and work piece. Our aim of the project is to overcome the difficulties of drilling and to reduce the time with good accuracy.

Key words: Jigs and Fixtures, Drilling Machine, Accuracy

I. INTRODUCTION

The management of Jigs system in machining remain relatively stagnant especially the progress of technology development. This condition governs to the needs of scientifically-based management of model formalization which can give significant contribution to the development of jigs systems. CAD/CAM/CAE software’s can be used for designing jigs. When assembling jig in a machining process, the Work piece position, tool movement, pin/locator flexibility have to be considered so that the elements of jig and fixture will be interchangeable and reusable. Designing and assembling of jig and fixture can be carried out using finite element method. Carbon fiber composite has been used as the material of jig and fixture in car assembling. In this project Jigs are designed mainly to save manufacturing time and for each type of work where quantity of production is desired, to maintain consistency in dimensioning, and to facilitate quick and easy assembly and also to reduce cost of manufacturing. Holes may be drilled at the same relative positions on each of the identical work pieces, without marking the work individually. The work is clamped below the Jig and holes are located. The drill bushes provided on the jig plate guide the drill. When the work is completed, the second work is clamped as per the procedure and process is again repeated.

II. PROBLEM IDENTIFICATION

Manufacturing in its broadest sense is the process of converting raw material into products. It encompasses the design of the product, the selection of raw materials and the sequence of processes through which the product will be manufactured. Manufacturing is the backbone of any industrialized nation. Its importance is emphasized by the fact that, as an economic activity, it comprises approximately 20% to 30% of the value of all goods and services produced. Manufacturing also involves activities in which the manufactured product is itself used to make other products. For this project it is focus on the drilling machine usually used in industrial fields. The problem here in the drilling machine is holding the rectangular work piece and to perform the accurate drilling operation is quite difficult. It is possible to overcome from this problem by designing a new product of jig and fixture for drilling machine.

III. WORKING PRINCIPLES OF JIGS AND FIXTURES

The successful designing of a jigs or a fixture depends upon the analysis of several factors which must be carefully studied before the actual work is taken in hand.

The following are the essential factors which must be considered in designing a jig or a fixture.
1) Study of the component.
2) Study of the type and capacity of the machine.
3) Study of the locating elements.
4) Study of the loading and unloading arrangement.
5) Study of the clamping arrangement.
6) Study of the indexing devices.
7) Study of the tool guiding and cutter setting elements. Study of the ejecting devices.
8) Study of the safety devices.
9) Study of the table fixing arrangement.

IV. DESIGN and CALCULATIONS

The pivoted clamp eliminates the use of spanner for clamping purposes. The work can be gripped quickly by rotating the screw which actuates a pivoted clamp on the face of the work. The springs illustrated guide the clamp of the same type in horizontal position when the work is unloaded.

A. Drill Bushes:

Drill jigs use bushes to guide drills, reamers and other cutting tools to the work piece. Bushes are made of water hardening carbon steel with 0.85-1% carbon and manganese, and are hardened to RC 60-64 to minimize.

Wear due to contact with hard, rotating tools. Bushes are generally finished by grinding the inside and outside diameters within 0.001mm concentricity. The inside diameter is ground precision running fit (F7) with the drill/reamer which needs to be guided whereas the outside diameter is made press fit (p6), precision location fit (h6) or
B. Press Fit Bushes:
Press fit bushes are the most common type of bushes and are pressed interference fit in the bush plates also referred to as jig plated.

Headed bushes are preferable to headless bushes because the collar provides positive stop against the jig plate. Moreover, it is found that the chances of bush getting loose in the jig plate and sliding axially with the drill are lesser in the collared bushes.

C. Base Plate:
Mild steel (plain carbon steel) C45 is used as fixture material. From Design Data Book Page. No: 1.1
Specific weight of M.S = 0.07835 N/cm³
Specific weight (W) = Weight / volume
W = w / v
Mass × gravity = l × b × t × density
3.5 × 9.81 = 0.165 × 0.127 × t × 7850

\[ t = \frac{0.2087m}{20.87mm} \]
\[ t = 25mm \text{ (standard)} \]

D. Stud:
Studs are used to hold the work piece with base plate. Threads are provided on both sides so that while clamping it holds plate as well as the work piece tight. It also arrests the degrees of freedom. Studs are in different size as per the fixture is concerned. Studs used in this design is 60mm length and pitch is M12.

VI. MATERIAL SELECTION

<table>
<thead>
<tr>
<th>S.NO</th>
<th>PART</th>
<th>QUANTITY</th>
<th>MATERIAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Jig plate</td>
<td>1</td>
<td>C45</td>
</tr>
<tr>
<td>2</td>
<td>Bushes</td>
<td>5</td>
<td>M.S</td>
</tr>
<tr>
<td>3</td>
<td>Pillar</td>
<td>4</td>
<td>M.S</td>
</tr>
<tr>
<td>4</td>
<td>Clamp</td>
<td>2</td>
<td>M.S</td>
</tr>
<tr>
<td>5</td>
<td>Stud</td>
<td>2</td>
<td>M.S</td>
</tr>
<tr>
<td>6</td>
<td>Dowel pin</td>
<td>4</td>
<td>M.S</td>
</tr>
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</table>

VII. CONCLUSION
From this explicit we made our drilling operation in the work piece as very easy and comfortable and without geometrical error occurring while drilling and it avoids human error also.
It provides more accuracy in the work piece while drilling operation. It is really a very good experience for every one of us, by successfully accomplishing this project. In addition to theoretical experience, we had a very good practical experience by doing this project. We hope that this project will be very economical and a useful product for customers. We are sure that there will be a great demand if it is introduced in the market.

REFERENCES


