Fabrication of Fixture for Machining of DN-15 (Y Type) Nuclear Controlvalve Body

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Abstract:- **The main idea of the project is to fabricate a fixture for machining of a DN 15 Y-type nuclear valve body which is part of a CV used in nuclear applications. The Y type valve body has a configuration of 180^0 between inlet and outlet side with 45^0 at bonnet side with respect to the outlet side. The fixture aims at reducing machining time with an increase in accuracy and precision throughout the machining operations.**

Keywords : DN,CV.

I. INTRODUCTION

Over the past century, manufacturing has made considerable progress. New machine tools, high-performance cutting tools, and modern manufacturing processes enable today's industries to make parts faster and better than ever before. All the work holding methods have also advanced considerably, the basic principles of clamping and locating are still the same.

Mass production methods demand a faster and easier method of positioning work for accurate operations on it. Jigs and fixtures are production tools used to accurately manufacture duplicate and interchangeable parts. Jigs and fixtures are specially designed so that large no of components can be machined or assembled identically and to ensure interchangability of components. The economical production of engineering components is greatly facilitated by the provision of jigs and fixtures. The use of jigs or fixtures makes a fairly simple operation out of one which would otherwise require a lot of skill and time. Both jigs and fixtures position components accurately; and hold components rigid and prevent movement during working in order to impart greater productivity and part accuracy. Jigs and fixtures hold or grip a work-piece in the predetermined manner of firmness and location, to perform on the work-piece a manufacturing operation.

A jig or fixture is designed and built to hold, support and locate every component (part) to ensure that each is drilled or machined within the specified limits. The correct relationship and alignment between the tool and the work piece is maintained. Jigs and fixtures may be large (air plane fuselages are built on picture frame fixtures) or very small (as in watch making). Their use is limited only by job requirements and the imagination of the designer. The jigs and fixtures may be accurately made and the material used must be able to withstand wear and the operational (cutting) forces experienced during metal cutting.

Jigs and fixtures must be clean, undamaged and free from chips and grit. Components must not to be forced into a jig or fixture. Jigs and fixtures are precision tools. They are expensive to produce because they are made to fine limits from materials with good resistance to wear. They must be properly stored or isolated to prevent accidental damage and they must be numbered for identification or future use.

Jigs and fixtures are devices used to facilitate production work, making interchangeable pieces of work possible at a savings in cost of production. A jig is a guiding device and a fixture a holding device. Jigs and fixtures are used to locate and hold the holding device. Jigs and fixtures are used to locate and hold the work that is to be machined. These devices are provided with attachments for guiding, setting and supporting the tools in such a way that all the work pieces produced in a given jig or fixture will be exactly alike in every day. The employment of unskilled labour is possible when jigs and fixtures can be used in production work. The repetitive layout and setup(which are time-consuming activities and require considerable skill) are eliminated. Also, the use of these devices can result in such a minimum amount of fitting. A jig or fixture can be designed for a particular job. The form to be used depends on the shape and requirement of the work piece to be machined.

II. PROBLEM IDENTIFICATION

The Y type nuclear control valve was difficult to hold during machining as it had a Y type configuration, so to machine on all three sides of the valve body we had an idea to fabricate a fixture that ensures easy machining on all three sides of the valve body. The fabrication of fixture has enabled to reduce the complexity in machining and it has led to increase in productivity simultaneously.

III. FIXTURES

A fixture is a device for location, holding and supporting a work piece during a manufacturing operation. It is a production tool that locates, holds and support the work securely so that the required machining operation can be performed.

Fixtures have a much-wider scope of application than

jigs. These work holders are designed for application where the cutting tools cannot be guided as easily as a drill. With fixtures, an edge finder, centre finder, or gage blocks position the cutter. Examples of the more-common fixtures include milling fixtures, lathe fixtures, sawing fixture, and grinding fixtures. Moreover, a fixture can be used in almost any operation that requires a precise relationship in the position of tool to a work piece.

Fixtures are essential elements of production processes as they are required in most of the automated manufacturing, inspection, and assembly operations. Fixtures must correctly locate a work piece in a given orientation with respect to a cutting tool or measuring device, or with respect to another component, as for instance in assembly or welding. Such location must be invariant in the sense that the devices must clamp and secure the work piece in that location for the particular processing operation.

There are many standard work holding devices such as jaw chucks, machine vices, drill chucks, collects, etc. which are widely used in workshops and are usually kept in stock for general applications.

Fixtures are normally designed for a definite operation to process a specific work piece and designed and manufactured individually. Jigs are similar to fixtures, but they not only locate and hold the part but also guide the cutting tools in drilling and boring operations. These work holding devices are collectively known as jigs and fixture. Set blocks and feeler or thickness gauges are used with fixtures to reference the cutter to the work piece.

A fixture should be securely fastened to the table of the machine upon which the work is done. Though largely used on milling machines, fixtures are also designed to hold work for various operations on most of the standard machine tools. Fixtures vary in design from re4latively simple tools to expensive, complicated devices. Fixtures also help to simplify metal working operations performed on special equipment.

Fixtures are most often identified by the machine tool where they are used. Examples include mill fixtures or lathe fixtures, but the functions of the fixture can also identify a fixture type.so can the basic constructions of the tool. Thus, although a tool can be called simply a mill fixture, it could also be further defined as a straddle-milling, plate-type mill fixture. Moreover a lathe fixture could also be defined as a radius turning, angle-plate lathe fixture. The tool designer usually decides the specific identification of these tools. It, use set blocks and thickness, or feeler, gages to locate the tool relative to the work piece.

Fixtures are normally classified by the type of machine on which they are used. Fixtures can also be identified by a sub-classification. For example, if the fixture is designed to be used on a milling machine, it is called a milling fixture, if the task intended to perform is straddle milling, it is called a straddle milling fixture .The same principle applies to a lathe fixture that is designed to machine radii. It is called a lathe radius fixture.

IV. TYPES OF FIXTURES

The names used to describe the various types of fixtures are determined mainly by how the tool is built. Jigs and fixtures are made basically the same way as far as locators and positioners are connected. The main constructions difference is mass, because of the increased tool forces, fixtures are built stronger and heavier than a jig would be for the same part.

- Plate fixture
- Angle plate fixture
- Modified angle plate fixture
- Vice-jaw fixture
- Indexing fixture
- Multi-station fixture
- Duplex fixture
- Profiling fixture

V. INDEXING FIXTURE

Indexing fixtures are used when a number of surfaces are to be machined on a periphery of a work-piece such as gear teeth, slots, splines, in shafts, etc. The work-piece must be located and clamped to a movable member that can be indexed to the required position relative to the cutter and then locked in that position while each surface is machined.

In most of cases, a universal dividing head is used as an indexing device for milling machines. Another type of indexing fixture is working on the principle which is similar to the indexing jig. But for fixture, drill bush can be replaced by a setting block.

In the fixture of Y type nuclear valve body, an indexing plate having 3 V blocks assembled on it is indexed over the base plate which is then welded into the holding plate. The valve body is rotated at 180^0 for the machining of inlet and outlet sides and at 45^0 for the machining of the bonnet side.

The fixture makes use of manual type of indexing which uses locator pins that enables the y type valve body to be held in 3 configurations. As machining has to be done on all three sides, the introduction of such kind of fixtures reduces the machine lead time and the work in process time with higher accuracy and precision. The use of indexing fixture has enabled machining as well as drilling activities to be performed with ease on all sides of the valve body.

VI. NUCLEAR CONTROL VALVE

A nuclear control valve is a flow control element that is mainly used for nuclear applications. It's an electrically controlled valve with a piston actuator providing linear actuation to lift a seal off its seat. The seat can be an angle to provide maximum possible flow when unseated as in case of a Y type nuclear control valve. They are subjected to high temperature and large flow rates and

hence unlike other control valves these valves are manufactured by forging process. The most commonly used material according to American Society for Testing and Materials (ASTM) for their fabrication are Austenitic Chromium Nickel Molybdenum low Carbon with Nitrogen (A182 f316 LN or A240 Gr316 LN).

Fig 1: Nuclear Control Valve

Nuclear control valves are popularly used for nuclear applications in nuclear reactors and nuclear power stations for controlling the flow of pressurised steam or water through pipe lines which are used for the generation of electricity and heat.

The Y type nuclear control valve ensures a lesser pressure drop by eliminating the water hammer produced in the pipelines. Since the valves serve such an important purpose in nuclear power plants, the fabrication, design and as well as the material selection has to be perfect.

VII. FABRICATION OF FIXTURE

- Initially the machining of holding plate is carried out according to the design
- In the second step, the base plate is machined.
- The base plate is checked for 90^0 by keeping it on marking table and using a set square.
- The plates are then welded together by using arc welding.
- Next the machining of Indexing plate is carried out.
- Machining of 3 V blocks are carried out.
- Finally they are assembled and tightened into the base plate

VIII. FABRICATION OF Y TYPE NUCLEAR VALVE BODY

- Bonnet side rough turning is carried out in lathe.
- Inlet and outlet side drilling is done using in drilling machine.
- Sterlite Hard facing is done on valve seat of bonnet side.
- Liquid penetrant test (LPT) in performed on valve seat.
- Bonnet side finish turning is carried out in lathe.
- End preparation is done on both inlet and outlet sides in lathe.
- Drilling and tapping on bonnet side flange using drilling machine.

IX. COST ESTIMATION

Sl. No	Cost Associated	Cost (in Rs)
1	Material Cost	
	a) 80 kg – Mild steel	3200
	b) Welding Electrodes	862.5
2	Machining Cost	
	Lathe	
	a) Holding plate (4 hours)	1680
	b) Base plate (3 hours)	1260
	c) Indexing plate (3 hours)	1260
	d) V block base (2 hours)	840
	Milling Machine	
	a) Base plate (3 hours)	1200
	b) Holding plate (4 hours)	400
	c) V block base (3 hours)	1200
	d) V blocks (16 hours)	6400
	e) Supporting Blocks (2 hours)	800
3	Miscellaneous cost	
	a) Hexagonal 8mm bolt	19.5
	b) Hexagonal 8mm nut	6.3
	c) Hexagonal 12mm bolt	44.72
	d) Hexagonal 12mm nut	26
4	Total cost	19,199.02

Table 1 : Cost Estimation

*Cost of 1 kg Mild Steel = Rs 40
**Cost for 1 hour machining in Lathe = Rs 420
***Cost for 1 hour machining in Milling Machine = Rs 400
****Cost for Welding Electrode of 3.15 mm = Rs 17.25

X. 3D MODELING OF FIXTURE

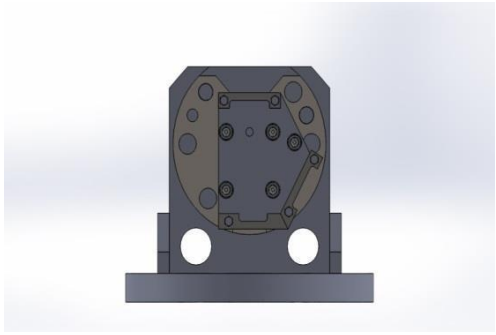

Fig 2 : Front View

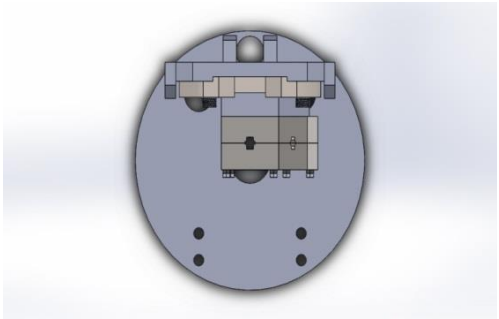

Fig 3 : Top View

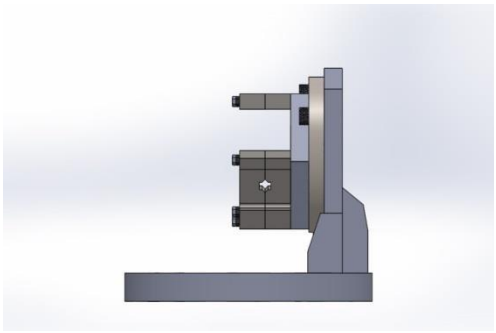

Fig 4 : Side View

XI. RESULT

As per the requirement the fixture is fabricated and it enhanced the machining of Y type nuclear control valve body.

The project is made with pre-planning, that it provides flexibility in operation. This innovation has made machining more precise and economical.

XII. REFERENCE

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