

Combo Fixture for Axial Profile Fan Lever

Karthikeyan.N.K¹, Aravind.R², Roobash Raj.S.V³, Vigneshwaran.R⁴

¹ Assistant professor, Department of Mechanical Engineering, Vel tech, Avadi

^{2,3,4} Bachelor of Engineering, Department of Mechanical Engineering, Vel tech, Avadi

Abstract- we can't deny the fact that manufacturing also depends on conformity as equal to productivity. The invention of fixtures not only reduced the possibilities of errors in products but also increased the productivity rapidly which had paved the way for industrialization. Here our project is about a set of fixtures used for finishing the Levers which are solely responsible for the rotation of Axial Profile fan through its helical angle. These Axial profile fans find its application in Thermal Power plants. The role of our fixtures is to rapidly reduce the possible errors by holding the levers more firmly and making the operation accurate.

Thus increasing the rate of production and also lowers the requirement of highly skilled labour in the production unit. This also increased the productivity and the chances of rework and scrap in manufacturing unit.

I. INTRODUCTION

A fixture is a mechanism used in manufacturing to hold a work piece, position it correctly with respect to a machine tool, and support it during machining. Fixture is a device for locating, holding and supporting a work piece during a manufacturing operation. 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. They are normally designed for a definite operation to process a specific work piece and are designed and manufactured individually. Widely used in manufacturing, fixtures have a direct impact upon product quality, productivity and cost. Generally, the costs associated with fixture design and manufacture can account for 10%–20% of the total cost of a manufacturing system. Approximately 40% of rejected parts are due to dimensioning errors that are attributed to poor fixture design. Fixture design work is also tedious and time-consuming. Traditionally, the design and manufacture of a fixture can take several days or

even longer to complete when human experience in fixture design is utilized. And a good fixture design is often based on the designer's experience, his understanding of the products, and a try-and-error process. Therefore, with the increasingly intense global competition which pushes every manufacturer in industry to make the best effort to sharpen its competitiveness by enhancing the product's quality, squeezing the production costs and reducing the lead time. There is a strong desire for the upgrading of fixture design with the hope of making sound fixture design more efficiently and at a lower cost. Many academic and applications papers have been published in this area. In this paper, we will focus on a fixture design research. The following sections will give a survey on the state of the art of these researches. Some conclusions on research trends are also discussed.

1.1 Elements of Fixtures

Generally, all fixtures consist of the following elements:

1.1.1 Locators

A locator is usually a fixed component of a fixture. It is used to establish and maintain the position of a part in the fixture by constraining the movement of the part. For work pieces of greater variability in shapes and surface conditions, a locator can also be adjustable.

1.1.2 Clamps

A clamp is a force-actuating mechanism of a fixture. The forces exerted by the clamps hold a part securely in the fixture against all other external forces acting on to the component.

1.1.3 Supports

A support is a fixed or adjustable element of a fixture. When severe part displacement/ deflection is

expected under the action of imposed clamping and processing forces, supports are added and placed below the work piece so as to prevent or constrain deformation. Supports in excess of what is required for the determination of the location of the part should be compatible with the locators and clamps

II. FIXTURES IN MANUFACTURING

A fixture is designed to position and hold one or more workpiece(s) within some specifications. It is widely used in manufacturing, e.g. machining (including turning, milling, grinding, drilling, etc.), welding, assembly, inspection and testing. Fixtures can be classified with different principles. However, compared with the publications of CAFD research in machining fixture field, only a few have been focused on other important manufacturing fields, for instance, assembly fixtures and welding fixtures.

2.1. Welding fixtures

Welding is essential to a high dollar volume of manufacturing processes, including national defense industries. According to Economic Impact and Productivity of Welding, Heavy Manufacturing Industries Report, by American Welding Society and Edison Welding Institute on June 2001, “the contribution of welding to the US economy in 1999 via these industries was no less than \$7.85 billion. This figure represented 7% of total expenditures by these firms in 1999”. So there are significant technical and commercial advantages in the development and deployment of welding fixture design systems. There are obvious differences between machining fixture design and welding fixture design. As in the following:

The workpiece in a welding process is usually an assembly of several parts, while workpieces undergoing a machining process contain only one part.

Usually, the accuracy requirement in a welding process is less than in machining.

Fixing forces and machining forces in a welding process commonly are smaller than in machining.

Thermal reactions in welding should be seriously considered. Furthermore, these factors also should be paid some attention in welding fixture design cases:

Electrical conductivity is critical for arc welding stability.

In addition to thermal conductivity, when selecting fixture material thermal expansion properties also should be considered.

Refined welding waveforms require an optimized welding circuit to maintain short arc lengths while reducing spatter, stubbing, arc flare, and arc outages to maximize travel speeds.

More complex applications may require a dedicated fixture. The design and installation of a dedicated fixture frequently involves installing and routing wiring and pneumatic or hydraulic lines.

2.2. Applications of modular fixtures and dedicated fixtures:

According to the fixture’s flexibility, fixtures also can be classified as dedicated fixtures and general purpose fixtures (e.g. reconfigurable and conformable fixtures, modular fixtures). Reconfigurable and conformable fixtures can be configured to accept parts of varying shapes and sizes. Particularly, conformable pin-array fixture technology is widely used in many fixture designs because some components contain internal variables that can be adjusted to meet the different features of workpieces. And phase-change materials-related fixtures also are used in some precision manufacturing. For instance, in the aerospace industry, low melting-point metals are used to enclose turbine blades and produce well-defined surfaces for part location and clamping for grinding operations. The most important and widest used within the general purpose fixture classifications are modular fixtures. As the flexible manufacturing system has been adopted by more and more manufacturers who are trying to remain competitive in this rapidly changing market by running production with short lead times and well controlled cost, modular fixtures have gained in popularity because of its performance on easy usage, versatility, and its adaptability to product changes.

III. RESTRICTIONS ON THE DEGREES OF FREEDOM OF A

WORK PIECE

A work piece, just like any free solid body, has six degrees of freedom

Three rectilinear displacements along them usually orthogonal co-ordinate axes.

Three angular displacements with respect to the same axes.

During a set-up, it is necessary to restrict certain degrees of freedom so as to locate and orient the active surfaces with respect to the cutting tools. Since supporting or restricting surfaces may vary from the true geometrical shape, especially on rough machined surfaces or cast blanks, it is desirable that the work piece be located with respect to the point supports. Locating using point supports in the form of hemispherical rest buttons would considerably reduce the influence of geometrical variations of locating surfaces on the locating accuracy.

For prismatic parts, the general principle of 3-2-1 location is most commonly employed. For achieving greatest stability, the first three points of location on the primary surface should be as far apart as possible, or the area enclosed by the three points as large as possible.

For cylindrical work pieces, three-point location cannot be obtained because of the non-existence of plane surfaces, V-locators and close-fitting bushes are often used instead.

For circular laminae, location can be achieved with the aid of a slot support. When a work piece is required to be located with respect to an inside hole or bore, a plug is used for locating the work piece. Locating from two holes typically uses a full and a diamond plug combination, with the latter inserted in the larger of the two holes.

IV. FIXTURE DESIGN PROCEDURE

In the design of a fixture, a definite sequence of design stages is involved. They can be grouped into three broad stages of design development.

Stage one deals with information gathering and analysis, which includes study of the component which includes the shape of the component, size of the component, geometrical shape required, locating faces and clamping faces. Determination of setup work piece orientation and position.

Stage two involves product analysis such as the study of design specifications, process planning, examining the processing equipment's and considering operators safety and ease of use. Determination of clamping and locating position. In this stage all critical dimensions and feasible datum areas are examined in detail and layout of fixture is done.

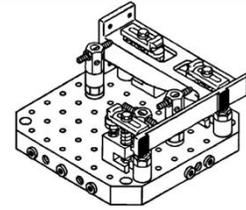


Fig. 1. Fixture used for Hub Boring, Spot Facing, Pin Side Facing, Turning, Recess, Circlip Groove, Transition at Shoulder.

Stage three involves design of fixture elements such as structure of the fixture body frame, locators, baseplate, clamping and tool guiding arrangement.

Stage four deals with final design and verification, assembly of the fixture elements, evaluation of the design, incorporating the design changes if any required and completion of design.

Fixture planning is conceptualized by a basic fixture configuration through analyzing all the available information regarding the specifications of the workpiece such as its shape, dimensions and tolerances, material and geometry of the work-piece, operations required, processing equipment for the operations, and the operator. Other factors also influence the machining outcome including machining operations sequence, cost considerations, direction and strength of machining forces, capabilities and orientation of the machine tools.

The following inputs are included in the fixture plan:

- Fixture type and complexity.
- Number of work-pieces per fixture.
- Orientation of work-piece within fixture.
- Locating datum faces.
- Clamping surfaces.
- Support surfaces.

Generation of fixture layout is to represent the fixture concepts in a physical form. The following outputs are included in the fixture layout:

- Types and Position of locators.
- Types and Position of clamps.
- Types and Positions of supports.
- Clamping forces and sequence.

Fixture element design is either to detail the design drawings committed on paper or to create the solid models in a CAD system of the practical embodiment of the conceptual locators, clamps and supports. It is possible to use standard designs or proprietary

components. Fixture body design is to produce a rigid structure carrying all the individual fixture elements in their proper places.

stresses, damage preventing of the workpiece, and improving loading/unloading speed.

A clamp is a force-actuating mechanism of a fixture. The forces exerted by the clamps hold a part securely in the fixture against all other external forces. In every machining operation, clamping of work-pieces is an essential requirement. A clamp can be defined as a device for providing an invariant location with respect to an external loading system. In other words, the process of clamping induces a locking effect which, through frictional or some other forms of mechanism, provides a stability of location which cannot be changed until and unless external loading is able to overcome the locking effect.

Hence, when a cutting force is producing a load or moment on the work-piece, it is necessary that a sufficient clamping force must be exerted to withstand such actions. It is also essential that the idle time involving loading, locking, unlocking and unloading of workpieces should be minimized as much as possible to reduce the overall set-up and non-machining time. Clamping elements may be either manually operated or actuated by pneumatic, hydraulic or a combination of other power facilities.

They are also classified according to the mechanism by which a mechanical advantage is attained.

VI.COMPONENT DETAILS

The design of fixtures is dependent on numerous factors which are analyzed to achieve an optimum output. Jigs should be made of rigid light materials to facilitate easy handling, as it has to be rotated severally to enable holes to be drilled from different angles. It is recommended that four feet should be provided for jigs that are not bolted on the machine tool, to enable the jig to wobble if not well positioned on the table and thereby alert the operator. Drill jigs provide procedures for proper location of the work-piece with respect to the cutting tool, tightly clamp and rigidly support the work-piece during machining, and also guide the tool position and/or fasten the jig on the machine tool.

To achieve their expected objectives, jigs and fixtures consist of many elements:

Frame or body and base which has features for clamping; The accuracy and availability of indexing systems or plates;

The extent of automation, capacity and type of the machine tool where jigs and fixtures will be employed;

Bushes and tool guiding frames for jigs;

The availability of locating devices in the machine for blank orientation, and suitable positioning;

Auxiliary elements;

The strength of the machine tool under consideration; The precision level of the expected product;

Fastening parts;

The available safety mechanisms in the machine tool;

4The study of the fluctuation level of the machine tool.

VII.CONCLUSION

The machining fixture is a key contributor to the manufacturability of a component, and should be designed to optimize the performance of the overall machining process. However, at the present time, due to increase in competition in many industries, they are using automated fixture for their early product launch and to increase productivity and accuracy.

The present fixture model development described in this project includes the unique aspect of designing a hydraulic fixture that it enables the user to take account of machining strategy and all key interactions between fixture, component and other system elements at an early stage. By designing above fixture for the lever for axial fans, cylinder liners are exactly located, supported and clamped which reduces the machine settings time, hence productivity increased and which also increase the accuracy, improved quality of machining and process control.

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