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Needle Clamp For Irregular Bodies

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***Abstract*—Needle Clamp is a smart mechanical Clamp which facilitates the firm holding of irregular shaped bodies. In the current scenario the Clamps are limited with the shape restriction made by the irregular shaped objects. Here arises the need for a better Clamp design which facilitates the arrest of six degrees of freedom possible. Traditionally the Clamps are limited to consider mainly the basic shaped materials. Even though some mechanical inventions allows the arrest of six degrees of freedom, there is a limitation in acceptance of various shaped materials for clamping using the same clamp. Many special purpose Clamps will stay idle when the variation of shape is introduced to it due to the low elastic nature of usage. The "Needle Clamp" is a mechanical Clamp which can be considered as special purpose Clamp that could accept various shaped irregular bodies in a single Clamp. Multiple rows and columns of needles are arranged which resembles a bed that allows the proper clamping possible. This facilitates the maximal arrest of freedom of movement of a solid body as a Clamp.**

***Index Terms*—Needle Bed, Clamp, Irregular Shape, Arrest of Freedom**

I. INTRODUCTION

Clamps are special mechanical device which facilitates the firm holding of bodies that have to be machined. A Clamp aims in the arrest of degrees of freedom and avoids the formation of vibration or other disturbances during the machining process. They should ensure that no shifting of position is been made by the body, so that proper and accurate machining operation could be done. Various types of Clamps are available in the industry that allows the firm holding of bodies. Their main function is to ensure that all the six degrees of freedom are made arrested, and no movement of body is made when clamped.

Traditionally the Clamps are limited to consider mainly the basic shaped materials. The surface of the body that could be easily holded by a regular Clamp is mainly plain or cylindrical. The more variation in complexity of irregularity, lesser is the options of Clamps available. The arrest of degrees of freedom also becomes less effective in increase of irregularity in the surface of the body.

Even though there is some exceptional clamp, there still remains a limitation in acceptance of various shaped materials for machining purposes in the same Clamp. Many Clamps will stay idle when the variation of shape is introduced to it due to the low elastic nature of usage. In case of special purpose Clamps there exists a limitation of accepting only the identical shaped bodies for holding purpose.

The "Needle Clamp" is a mechanical Clamp which could accept various shaped irregular bodies in a single Clamp. They consist of multiple rows and columns of needles that are arranged in such a way which resembles a bed. When an irregular shaped body is been placed in the surface of the needle, they align accordingly, as if mimicking the surface of the body placed in between the two positions .This is achieved by the change of equal displacement of the needle in its position.

This new innovative concept allows the acceptance of complex irregular shaped body very easily. It makes the cavity of placement automatically at the instant of placing the body. A locking arrangement is made to arrest the to and fro movement of the needle through the bed. A simple push button is installed for this purpose.

Once the movements of needles are arrested there remains a cavity even after removal of the body from the surface. This could be thus introduced as the best way for production in the large scale since it facilitates the arrest of six degrees of freedom of a solid body as a Clamp.

Clamps are special type holding devices that holds the material that are to be machined by eliminating the chance of, vibration while machining, shifting of position of the body and also to wastage of body by miss-machined operation. The claps are so much important in every industry in one or the other way. But there lack clamps, that clamps irregular bodies and here arises the need of "Needle Clamp for Irregular Bodies" that could accept any complex shapes like cone, spherical or even gear. Thus the Needle Clamp is sure to become the ultimate need of the future industries for easy and smooth manufacturing process and promises to accept any shape solid surface to get clamped.

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STUDY OF SUBJECT

WORK HOLDING DEVICES

Mechanical Clamping is perhaps the basic form of work holding. The most common forms are vises and strap clamps. Vises are generally the first choice for Vertical Machining Centers. They can be single, double, or mounted in combinations. Many are equipped with an angle lock feature that holds the work down as well as clamping it in place. Soft jaws can also be used to facilitate clamping of irregular shapes.

In recent years, several vise manufacturers have developed and marketed Vise Towers. These devices are typically used on Horizontal Machining Centers and provide for machining on multiple parts as well as multiple sides.

Straps are bars with a center stud/nut combination and a back rest. Clamping is accomplished by tightening the nut and forcing the bar down on the work and the back rest. Clamping force capabilities range from 500 lbs. for a ¼-20 stud to 5500 lbs. for a ¾-10 stud (at 33% of stud yield).

Mechanical clamping can take many forms. Several adaptations of basic mechanical devices can provide for effective work holding. The main advantages to mechanical clamping are cost and versatility. The main disadvantages are inconsistent force application and actuation time.

Pneumatic Clamping is accomplished by using air cylinders as actuation devices. These devices can take the form of vises, pull cylinders, push cylinders, or swing and pull cylinders. While the majority of these devices are Double Acting (air pressure is required for clamp and unclamp) some are available as Single Acting (spring return).

The main advantages to Pneumatic Clamping are cost, availability of shop air pressure, and speed of action. The main disadvantage is clamping force. Typical shop air is 80 psi maximum. The clamping force for a typical push cylinder would be the effective area of the piston times the pressure. In the case of a 2 inch bore cylinder the exerted force would be 251 lbs. at 80 psi shop air.

Air boosters are available generally in 3 to 1 ratios and they can be used to increase the applied force. However, this adds to cost and slows the actuation time.

While Pneumatic Clamping has its applications, we have found that it is limited by available clamping force and therefore we have only applied it to jobs with very low cutting force requirements.

Hydraulic Clamping is perhaps the most widely used form of Work Holding in today's high paced manufacturing industry. Clamping force is applied by forcing a piston forward (or backward) using oil under pressure.

Typical pressures range from 2000 to 5000 psi. In some rare cases up to 10,000 psi may be applied. This is not the clamping force but rather the force (in pounds per square inch) that is applied to the piston. The total force applied is equal to the effective piston area times the pressure, with corrections for friction and geometric variables.

BASIC SYSTEM STUDY

Work Holding can be accomplished in many ways. In order to understand the fundamentals of Clamping it is important to define some of the basic knowledge about it. Few Major system components are discussed below.

- Push Cylinder – A device that applies force by extending
- Pull Cylinder – A device that applies force by retracting
- Swing Cylinder – A pull cylinder with a piston shaft that rotates (usually 90 degrees) while clamping. These cylinders have a rotate stroke and a clamping stroke.
- Positive Clamping Cylinder – A cylinder that clamps (with disc springs) when the hydraulic pressure is not applied
- Link Cylinder – A push cylinder with a linkage arm for directing the clamping force downward
- Edge Clamps – Devices that push against the side of the part being clamp with side and downward force
- Work Rest – Spring or fluid advance pistons that "freeze" under final pressure for support under parts without applying downward clamping force
- Single Acting – A hydraulic system that provides only forward clamping force and depends on spring force in the cylinders for return
- Double Acting – A hydraulic system that provides clamping and unclamping force to the cylinders

The above discussed are the basics that are important to study the traditional clamping process that are practiced in every industries all around the world.

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PROPOSED METHODOLOGY

PRINCIPLE USED

An equal displacement is made by the needle when an object is placed in the surface. The bed of needle heads comprises of tiny needles help in the surface graphing possible.

When considered single, one needle will make only a to and fro motion between the three layers. Two among the three layers a capable of motion in a horizontal direction to the needle which is used in arresting the needles from movement from its displaced position

PARTS OF A NEEDLE CLAMP

A needle clamp consists of several parts, but the needle is the major part when it comes to this case. There are mainly three arrangements for a Needle Clamp, namely:

01. Locating Arrangement
02. Locking Arrangement

LOCATING ARRANGEMENT

The locating arrangement is specialized with its ability to accept any complex irregular shaped objects. Complex irregular shaped bodies are also easily accommodated by this new and innovative arrangement that is made. This arrangement consists of mainly two parts namely:

01 The Needle
02 Needle Bed
03 Spring

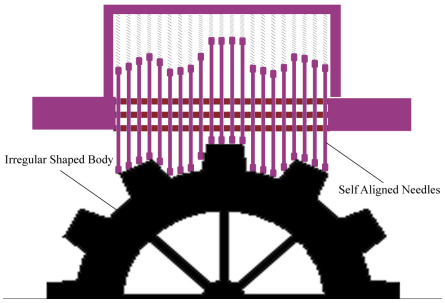

FIG-01

FIG-02

Needle : In locating of an object the needle places a major role. When an object is placed on the Needle Clamp each needle will make the corresponding displacement to the area of contact, creating a clamping of the object possible.

Needle Bed : Needles are arranged in rows and columns to resemble the shape of a bed, and thus the whole arrangement could be called as the Needle Bed.

Spring : A spring arrangement is made for automatic align of the needles and to catch and clamp the surface of the body by arresting all degrees of freedom.

LOCKING ARRANGEMENT

This is a smart arrangement that is made for arresting them to and fro movement of the Needle. This arrangement consists of two parts namely:

01 The Needle
02 Locking layers

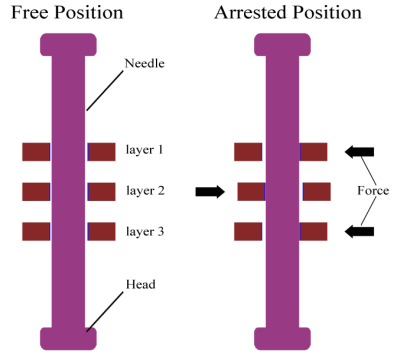

FIG-02

Needle : The needle passes equally through three of the layer and makes the displacement according to the object made. Now the movement of the needle should be made arrested by locking the position of needle

Locking Layers : The two of the layers have the freedom to move relatively considering the other layer. A push button makes a displacement of the layers, making the arrest of the needle possible.

WORKING PROCEDURE

In the initial arrangement of the Needle Clamp without any object, the spring seems to be relaxed and all needles are found arranged linear to the surface.

When we introduce a new material the needle arranges according to the surface of the object. Then we have to bolt the nut to the tightened position. Now the push button is made pushed so that the displacement made by the needle could be maintained.

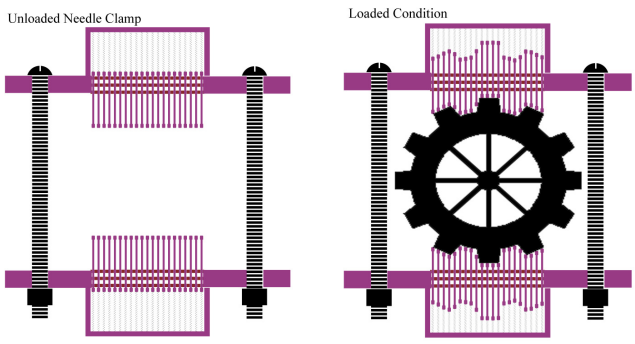

FIG-03

The Needle Clamp eliminates all six degrees of freedom so that the machining operation of the body could be done very easily.

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CONCLUSION

A Needle Clamp is a special type of clamp which allows the clamping of any shaped body, especially irregular shaped bodies. This clamping ensures the arrest of all six degrees of freedom. The time used for clamping a body is negligible, which makes the device a smart device.

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