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Design and Fabrication of Automatic Clamping Fixture for Seamless Tube Swaging Machine

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***Abstract*—The main purpose of swaging machine is to reduce the diameter up to particular level, while performing swaging operation clamping fixture play most important role for mounting pipe on swaging machine. Pipe swaging apparatus includes a swaging fluid motor for moving a swage die toward a pipe clamping assembly including a stationary bottom clamping plate and a movable top clamping plate. Clamp operating hydraulic cylinder mounted at above the clamping plate and having a piston rod coupled with the top clamping plate to permit automatic operation of the pipe clamping assembly and simultaneously with operation of the swaging fluid motor. An automatic swaging machine including a conveyor system for moving tubes during swaging operation.**

Now a days the clamping of component is done manually. For that more cycle time is required for clamping and unclamping the material so there is a need to develop a system which can help in improving productivity and time. Therefore automatic clamping fixture will reduce operation time and increase productivity.

***Index Terms*—swaging machine, hydraulic cylinder, clamping fixture, power pack unit, supports and tooling parameters**

I. Introduction

In swaging, we press the work piece from all the directions, and this die punch type of arrangement is rotating. So, along the periphery of the circle, there are punches or there are die sets which press the material from all directions simultaneously.

The basic principle of swaging is that in this process, the diameter of the rod or a tube is reduced by forcing it into a confining die. So, confining die will have the dimension, according to the final dimension of the rod or the tube that we want. If we want to make use of a tube, we will make use of a mandrel in that process. So, basically swaging is a process in which the diameter of the rod or a tube will be reduced by a forcing it through a die. This operation is performing in cold condition.

Fixture is special tool or work holding device used for locating and firmly holding the work piece in the proper position during manufacturing operation. Fixture design work is time consuming and tedious. Fixtures have direct impact upon product quality, productivity and cost. Fixture devices include various standard clamps, chucks, and vises. Metal plates containing dowel and/or tapped locating holes or key slots and dedicated fixtures with specific design and build requirements.

II. Problem Statement

Swaging operations are accomplished manually, one piece at a time, by having a worker grip the tube and insert the end of it into a swaging tool, activate the swaging tool to accomplish the swaging and then upon release of the swaging tool from the end of the tube, the tube is manually extracted.

Fig. 1. Manually operated swaging machine

During the performance of the swaging operation while the tool is in engagement with the end of the tube, the tube must be allowed to move longitudinally so that the swaging tool can function properly. Such often becomes very difficult. In such apparatus the tubes are firmly clamped in position during the entire performance of the swaging operations. Such continuous and firm clamping precludes longitudinal movement of the tube during the swaging operation, thus often resulting in a defective product.

III. Objectives

The main objectives of this design are listed below:

1. To reduce machine idle time.
2. To increase the manufacturing rate & productivity.
3. To reduce efforts of the operator.
4. To increase accuracy and precision in fitting.
5. To implement automation in conventional manually operated swaging machine.

IV. Clamping Fixture

A. Fixture

Fixture design plays most important role at the setup

planning phase. Proper fixture design is crucial for developing product quality in different terms of accuracy, surface finish and precision of the machined parts. Hydraulic fixture provides the manufacturer for flexibility in holding forces and to optimize design for machine operation as well as process function ability.

B. Types of Fixtures

- According to Arrangement
  1. Vise Fixture
  2. Plate Fixture
  3. Angle Plate Fixture

- According to Operation
  1. Milling fixture
  2. Drilling fixture
  3. Lathe fixture

C. Steps for Fixture Design

Fixture design starts with a logical and systematic plan. The following is a detailed analysis of each step.

Step 1- Define Requirements
Step 2- Collect Required Information
Step 3- Develop several options
Step 4- Choose the best option
Step 5- Implement the Design

As per Availability of Space on Swaging Machine We Select Dimension –

1. Length of Fixture = 450 mm
2. Height of Fixture = 160 mm
3. Breadth of Fixture = 180 mm
4. Groove on Fixture = Ø 80 mm depth
5. Drill on Fixture for Ram = Ø 60 mm
6. Drills for Bolt = Ø 16 mm

D. Fixture with Hydraulic Cylinder 3D Model on Software

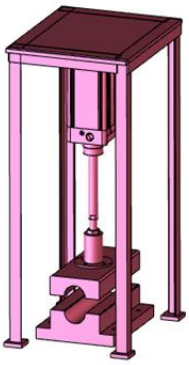

Fig. 2. Clamping fixture with hydraulic cylinder

V. Hydraulic Cylinder

Cylinders are used to convert fluid power into mechanical motion. A cylinder consists of a cylindrical body, closures at each end, movable piston, and a rod attached to the piston. When fluid pressure acts on the piston, the pressure is transmitted to the piston rod, resulting in linear motion. The piston rod thrust force developed by the fluid pressure acting on the piston is easily determined by multiplying the line pressure by the piston area.

A. Types of Cylinder

1. Single Acting Cylinder
2. Double Acting Cylinder
3. Spring Return Cylinder
4. Tandem Cylinder
5. Double Rod End Cylinder
6. Duplex Cylinder

B. Double Acting Cylinder

The most familiar double acting cylinder is the single rod end. This type of cylinder provides power in both directions, with a pressure port at either end. Single rod end cylinders exert greater forces when extending than when retracting, since the piston area on the blind end is larger than the piston area on the rod end.

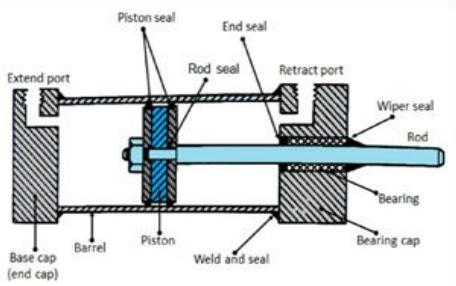

Fig. 3. Double acting cylinder

C. Design of Hydraulic Cylinder

To determine the correct size of cylinder, it is necessary to use the formula:

Thrust = Pressure x Area x Efficiency

Where,

F = Weight of Upper plate = 15 kg
= 150 N

P = Power Pack Pressure = 30 bar

1 bar = 1 x 10^5 N/m²

η = Efficiency = 95 %

$F = P \times A \times \eta$

$150 = 30 \times 10^5 \times A \times 0.95$

$A = 7853.7$ mm²

D = 94.5 mm

From Design data Book,

Select 100 mm Outer diameter for Cylinder and 60 mm. Piston rod diameter

Therefore Do = 100 mm

Di = 60 mm

VI. Fixture Assembly

For successful implementation of this fixture, it will have wide scope in production. After implementing of this fixture it could be made automatic. This is low cost fixture using

hydraulic system for making sliding movement of the fixture. Later other method could be developed for Sliding movements. There is also a wide scope for computer aided fixture design (CAFixD). Many researcher has been reported in this field. This is reciprocating type of fixture further rotary fixture can also be developed.

Fig. 4. Actual assembly of automatic clamping fixture

VII. Conclusion

This automation reduced the human effort and hence don't need a person to adjust the plate of fixture. This design also enabled vibration free operation which increases the quality of clamping fixture. It increases the productivity and reduces the cycle time of 10 minutes to 5 minutes.

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