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Design Development and Analysis of Indexable Tool Head and Auto-feed Table Mechanism forPortable Orbital Form Rivetter

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Abstract—Riveting process is conventionally carried out using either a press machine, or manually hammering. This process is not accurate, takes considerable time and effort and so also may result into damage of component. The angle of the riveting tool held in the riveting head plays a significant role in the reduction in forming force, whereas the table motion will determine the accurate positioning of the rivet in to tool profile, resulting into exact shape and size of rivet head formed.

This paper deals with determination of optimal tool angle in tool head, and tool geometry and mechanism of table feed for accurate positioning. The portable orbital form riveting machine with optimal angle tool head and auto-positioning feed table will be designed and modeled.

Index Terms— Portable Orbital Riveter, Optimal angle tool head, Auto-positioning feed table.

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1 Introduction

Rivets are a permanent mechanical fastener. Before being installed, a rivet consists of a smooth cylindrical shaft with a head on one end. The end opposite the head is called the buck-tail. On installation the rivet is placed in a punched or drilled hole, and the tail is upset, or bucked (i.e., deformed), so that it expands to about 1.5 times the original shaft diameter, holding the rivet in place. To distinguish between the two ends of the rivet, the original head is called the factory head and the deformed end is called the shop head or buck-tail.

Because there is effectively a head on each end of an installed rivet, it can support tension loads (loads parallel to the axis of the shaft); however, it is much more capable of supporting shear loads (loads perpendicular to the axis of the shaft). Bolts and screws are better suited for tension applications.

Fastenings used in traditional wooden boat building, such as copper nails and clinch bolts, work on the same principle as the rivet but were in use long before the term rivet was introduced and, where they are remembered, are usually classified among nails and bolts respectively.

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There are various types of rivets such as solid rivet, high strength structural steel rivet, semi tubular rivet, blind rivets, Oscar rivet, Drive rivet etc. Each rivet is used for different applications.

Rivet diameters are commonly measured in imperical and metric unit. In imperical rivets are measured in inch whereas in metric they are measured in millimeters.

Applications of rivets are steam locomotive, bridge over oscar river, ship hull.

For installation there are several methods such as manual with hammer handset or bucking bar, pneumatic hammers, hand-held squeezers.

1.1 Types of Rivetting

Orbital Riveting is a unique process characterized by a variety of rivet head shapes and by very low force requirements.
Other features of orbital riveting are:
- Precise forming of the rivet head material
- No impact force
- Fast and quiet
- Capable of manufacturing moving rotatable joints.

1.1.1 Orbital Forming

An eccentric attaching procedure cuts the cost of numerous material shaping and gathering applications.

Most architects have a tendency to depend on customary securing strategies to join parts, however a lesser-known proce-

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dure, orbital framing, regularly gives better outcomes at lower costs. Orbital shaping, as the name infers, is a chilly framing process that uses a "circling" instrument. Some of the time called turning, spiral riveting, or turn arresting, orbital shaping is frequently used to head, swage, crown, flare, or frame a section or projection of material in affixing and get together operations.

The procedure is to some degree like effect and pressure framing, where the instrument applies a compressive pivotal load to plastically twist the part. The distinction is that in orbital framing, the apparatus pivots at a settled point — regularly 3 to 6° — and applies both hub and spiral strengths to dynamically move pliant material into a coveted, foreordained shape. Not at all like effect or pressure framing, where the procedure is finished in a solitary pass, orbital shaping requires a few instrument insurgencies and ordinarily takes 1.5 to 3 sec to finish. A large portion of the work amid orbital shaping is engaged at the device's line of contact, not along the whole instrument surface. This lessens pivotal loads by as much as 80%, which has a few points of interest.

1.1.2 Radial Forming

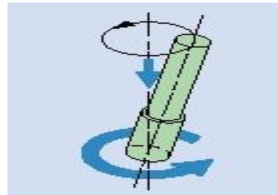
Outspread framing was created in Europe in the 1960s and is frequently mistaken for orbital shaping. The two procedures do share similitudes. Like orbital shaping, the spiral procedure produces heads on bolts, sticks and posts. The operation is tranquil and produces joints and heads of high caliber and marginally cleaned in appearance. The apparatuses can be adjusted to work in close quarter. Spiral shaping can be acclimated to create a tight or free clasp.

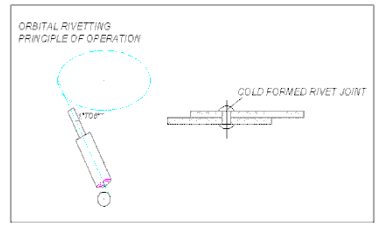
Be that as it may, there are contrasts between the two procedures. One contrast is that the control of a joint can be held inside limits that are marginally superior to anything orbital shaping.

Be that as it may, the real distinction lies with the procedure, itself. With spiral framing, the peen pivot is not held at a settled point with the shaft hub. The working end of the peen disregards the finish of the bolt shank on a way that is a 11-circle rosette. The edge between the peen pivot and axle hub fluctuates ceaselessly between 0 to 6 degrees. The point between the two is 0 degrees when the tomahawks are adjusted.

The peen pivots as the device is circling the bolt. Framing weight is connected after the rosette design, so the weight line on the peen moves over and again through the normal focuses of the peen and the bolt shank. The procedure of the peen squeezing against the bolt shank spreads the bolt material radially outward, radially internal and digressively covering.

2. Orbital Rivetting





Rivet is set at the joint such that the rivet set angle is from 10 to 80 depending upon the joint to be obtained. It turns around the vertical axis at about 2000 to 3000 rpm and describes a cone whose apex corresponds to the center of gravity of the joint formed. It is the tool which gives the shape.

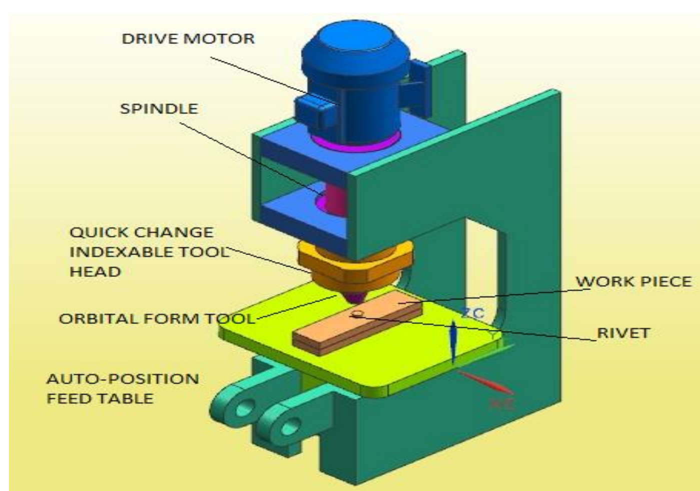
2.1 Features of Orbital Rivetting

1. This riveting process allows fixed or hinged assemblies to be made.
2. It allows special shapes to be riveted without difficulty. (eg. Square section tubes as ladder rungs)
3. Due to orbital riveting principle and specific position of tool (rivet set) on the part to be riveted, the upsetting load required is six times lower than for direct thrust(press).

2.2 Possibilities due to Orbital Rivetting Machine

1. Fixed or hinged assembled parts can be done.
2. Many types of materials can be riveted eg. Steel, SS, Plastics, aluminium, etc.
3. All working positions possible.
4. All possibilities of automation.

3 . Working



Engine is begun which turns the fundamental shaft at fast. The device or bolt set mounted in the apparatus holder pivots at rapid. The employment to be bolted alongside the bolt is set in the work holder .The encourage engine is worked to move in upward heading to lift the table slide and table in the table guide by means of roller plan.

The instrument turns about the bolt anticipating out of the joint in this manner frosty shaping the head on the bolt side. The measure of weight connected relies on the kind of joint i.e., settled or pivoted to be finished.

In the wake of riveting is done, the bolster handle is discharged which brings the table slide around self-weight. Occupation is supplanted in holder to shape the following riveting joint.

3.1 Advantages

1. The rivet head is gradually formed into desired shape, hence excellent mechanical holding or security of joint.
2. Resultant joint by orbital riveting machine is more resistant to vibrations.
3. Orbital riveting machine gives quieter riveting.
4. Orbital riveting machine causes limited deformation and pressure on parts to be assembled.
5. Orbital riveting reduces cost of riveting.
6. Fast riveting process.
7. Many types of materials can be riveted.
8. Can make both fixed as well as hinged joints.
9. Excellent mechanical holding(security)
10. Limited deformation and pressure of the parts to be assembled.
11. Fast and rational implementation
12. Noiseless operation
13. Reduced cost.

3.2 Apllications

1. Work, tools, toys, kitchen utensils, general hardware.
2. Scissors, pliers, hinges, etc.
3. Fabrication hinges
4. Agricultural trimming and cutting equipment.

Parts subjected to thermal cycling,e.g., Boiler shells.

4. Design

Configuration comprises of utilization of logical standards, specialized data and creative ability for improvement of new or ad libbed machine or component to play out a particular capacity with most extreme economy and proficiency.

Subsequently a cautious plan approach must be embraced. The aggregate outline work , has been part up into two sections

- System plan
- Mechanical Design.

Framework configuration for the most part concerns the different physical imperatives and ergonomics, space necessities, course of action of different segments on fundamental edge at framework, man + machine cooperations, No. of controls, position of controls, workplace of machine, odds of disappointment, security measures to be given, overhauling helps, simplicity of upkeep, extent of change, weight of machine from ground level, add up to weight of machine and significantly more.

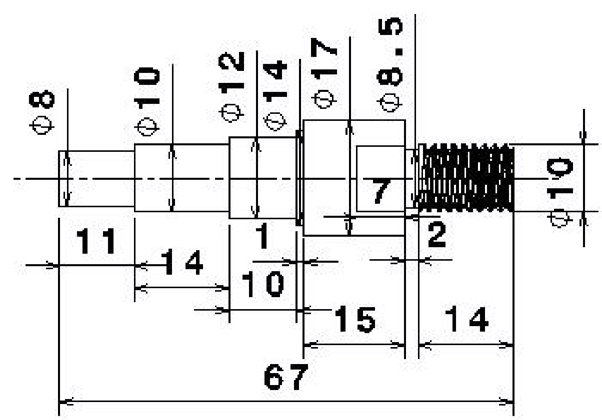
In mechanical outline the segments are recorded down and put away on the premise of their acquisition, plan in two classes specifically,

- Designed Parts
- Parts to be bought

For planned parts isolates configuration is done and qualifications along these lines acquired are contrasted with next most noteworthy measurements which are promptly accessible in market. This intensifies the gathering and additionally postproduction overhauling work. The different resistances on the works are determined. The procedure graphs are arranged and passed on to the assembling stage

The parts which are to be acquired specifically are chosen from different inventories and indicated so anyone can buy the same from the retail shop with given particulars.

4.1.1. Design of Spindle



MATERIAL SELECTION : - Ref :- PSG (1.10 & 1.12) + (1.17)

ASME CODE FOR DESIGN OF SHAFT.

Since the loads on most shafts in connected machinery are not constant, it is necessary to make proper allowance for the harmful effects of load fluctuations

According to ASME code permissible values of shear stress may be calculated form various relations.

fs max = 0.18 fult
= 0.18 x 800
= 144N/mm2
OR
fs max = 0.3 fyt
=0.3 x 680= 204 N/mm2
Considering minimum of the above values ;

 fs max = 144 N/mm2

Shaft is provided with notch for locking ; this will reduce its strength. Hence reducing above value of allowable stress by 25

 fs max = 108 N/mm2

This is the allowable value of shear stress that can be induced in the shaft material for safe operation.

T= 2.84 x103 N-mm
Assuming 25% overload.

CHECK FOR TORSIONAL SHEAR FAILURE OF SHAFT.

minimum diameter of the spindle is 8,.5 mm at the M10 x 1.5 pitch threaded section

 d = 16 mm
Td = /16 x fs act x d3

 fs act = 16 x Td
 x d 3

= 16 x 2.84 x 10 3
 x (8.5) 3

 fs act =23.54 /mm2

As fs act < fs all
 I/P shaft is safe under torsional load.

4.1.2 Design of Tool Holder

MATERIAL SELECTION : - Ref :- PSG (1.10 and 1.12) + (1.18)

fs max = uts/fos = 520/2 = 260 N/mm2

This is the passable valve of shear stress that can be prompted in the pole material for safe operation.

Expecting 100 % proficiency of transmission

T plan = 2.84 Nm

Td = P/16 x fs act x(D4-d4)/D

Þ fs act = 16 x Td

P x (D4-d4)/D

Outside distance across of drum manager = 18mm

Inside distance across of drum manager = 10mm

= 16 x 2.84 x 10 3 x 18

P x (184-104)

Þ fs act = 2.74N/mm2

As fs act < fs all

5. Result & Discussion

So, during design and analysis of critical components of orbital riveting machine following theoretical results is getting,

TABLE. 1
RESULTS

Part Name	Maximum Therotical Stress N/mm²	Von-misses Stress N/mm²	Maximum Deformation mm	Results
Spindle	23.54	40.123	0.0037	safe
Tool Holder	2.74	7.99	0.00036	safe

Here, spindle show negligible deformation under the action of a system force And Tool holder is safe because von mises stress is within the allowable limit.maximum stress by a theoretical method and von-mises stress are well below the allowable limit hence the design is safe.

6. Conclusion

The orbital Rivetting machine enables to perform rivtting operation easily and accurately. It reduces the cycle time.It reduceds the chances of damaging during the operation.

7. Acknowledgment

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