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Research Article

Development of Tube Expansion Station in radiator assembly line

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Abstract

In radiator there are chances of the tubes in header plate to move laterally which will cause leakages, low heat transfer rates and decreased efficiency. In order to overcome this possibility, the tubes of radiator are flared to restrict the lateral motion of the tubes. The process of flaring plays an important role to constrain the system of header plate. We had developed a station which is used for flaring operation of radiator tubes which increases the contact area of the tube to increase the heat exchange rate and avoid leakages which highly affect the efficiency of the radiator and decreases the cycle time of production. The flaring operation of each tube by a single flaring tube is time consuming on industrial level. The customer of our station TATA TOYO wanted a semi-automated station for tube expansion of radiator. The tube expansion station offers flexibility with respect to parameters of number of holes, diameter of tube, pitch; according to the design of individual radiator. The flaring tool which is used for operation of tube expansion is mounted on a LM rail for sliding the whole tool mounting set up. The tool is powered by a standard hydraulic cylinder. Indexing is done manually to move the tool set up to the next series of tubes. The flaring is simultaneously done on two or more tubes which reduce the cycle time of the station. As the production rate is low it is semi-automated. For the whole set up one electric power pack is used. Mild steel is used as material for entire station considering its high welding, anticorrosive, ductile and malleable properties. The station is designed vertical to reduce floor area and ease of installation of radiator on the radiator plates of the station. This station will be used in Diesel Generator system so an attempt is made to increase the efficiency of the radiator with minimum Build-In time of the radiator assembly.

Keywords: *Tube expansion, flaring, semi-automated.*

1. Introduction

As in case of any engine a lot of energy is wasted in the form of heat in the exhaust so there must be an efficient cooling system to avoid this loss of energy. A radiator is responsible for preventing the engine from overheating. When the engine is in use, it produces a lot of friction and heat, and the radiator uses coolants for heat exchange to keep the engine running at a sustainable temperature. Hence while using these radiators for any engine, it must be compact and offer a good convective heat transfer for better efficiency. Also the radiator must be safe for the user and operators.

A radiator is a type of heat exchanger. It is designed to transfer heat from the hot coolant that flows through tubes to the air blown over it by the fan. Since air has a lower heat capacity and density than liquid coolants, a fairly large volume flow rate must be blown through the radiator core to capture the heat from the coolant.
The tubes of radiator are not constrained so it moves laterally in header plate causing leakages, reduced heat transfer rates and decreased efficiency. In order to overcome this possibility, the tubes of radiator are flared to restrict the lateral motion of the tubes by flaring. The process of flaring plays an important role to constrain the system of header plate either manually, semi-automated or automated. The manual flaring on a radiator is certainly not possible due to large number of tubes so semi-automated/ automated operations are used according of the production rate. According to our customer requirement and required production rate, we had developed a semi-automated station for tube expansion of the radiator.

2. Designs

As according to customer requirement, the station is developed following the size of their standard radiator. All designs with specifications and proper dimensions are ready by customer TATA TOYO.

Designs are analyzed in primary stage on rough sheet works then standard dimensions are chosen with proper references like design data book.

2D designs are drawn in software AUTOCAD and force analysis is roughly carried out on ANSYS software. The scale chosen for designing of all components is 1:1.

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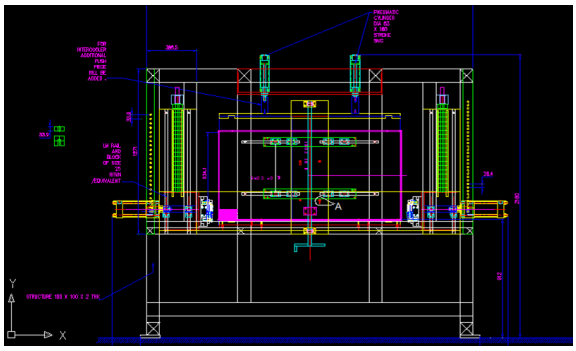

Fig.2.1 Tube Expansion station Assembly

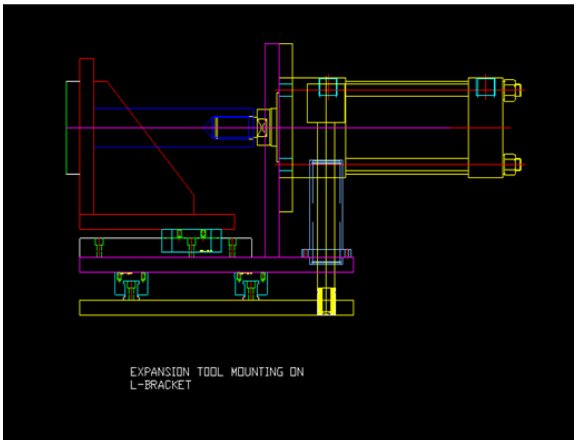

Fig.2.2 Tool set up on L-Bracket

3. Development and Manufacturing

The whole framework over which our station is developed is made up of Mild steel. Manufacturing process casting is used for foundation of station. The clamping plates are mounted over foundation by bolting. For holding purpose we had provided two hydraulic cylinders with smaller size than prime mover. The tool mounting setup is mounted on a base plate which is placed on LM rails. We are going to keep radiator clamping plate as a stationary and Tool set up sliding.

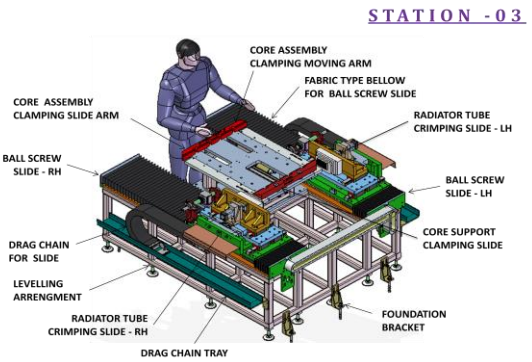

Fig.3.1 Schematic Figure of Station

Tool setup plate consist of prime mover hydraulic cylinder, and LM bracket is used for mounting of expansion tool. We are providing screw and nut arrangement at backside to carry out the movement of tool setup and perform indexing. To provide motion to the tool set up we are providing handle at bottom which converts rotating motion into linear motion. By single handle we can move tool setup of both sides at a time with proper parallel movement. Tool insertion and indexing is performed manually by screw nut arrangement and according to it setup is moved on rails provided. We are using hydraulic actuators as punching force provider because requirement of high amount of specific impact force for every hole.

Fig 3.2 Complete Manufacture of station

4. Working

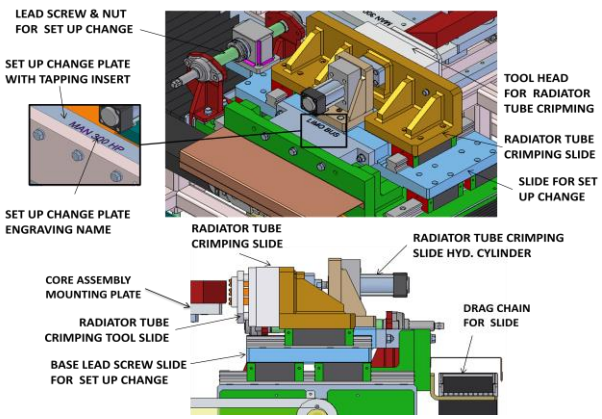

Fig.4.1 Working of Tube Expansion Station

Here our station provides flexibility to accommodate different sizes of radiators having different number of lines of tube according to customer requirement. We are going to clamp the radiator over the clamping plates made up of mild steel. A change over plate is inserted in between two clamping plates to facilitate the insertion of various sizes of radiator. We are using prime mover as a standard hydraulic cylinder with

standard specifications to provide precise impact force. We had replaced the conventional power systems by hydraulic system because of its precise impact force. We are using double acting piston cylinder arrangement. As we are performing flaring at the both end of tubes at a time, we require two hydraulic cylinders for both the sides as a prime mover with single power pack provided at base. For actuation of hydraulic actuator DC electric supply is used.

After mounting radiator over clamping plate we are going to insert our expansion tool in first set of tubes (two or three tubes simultaneously) and then lock our tool set by lock pin. Then providing proper force hydraulic cylinders we can insert tool to specify depth and then reverse motion of tool is carry out. Lock pin is taken out, handle is again rotated to get the next position of tubes i.e., indexing is carried out and again lock pin is inserted for keeping position fix on both the sides, similar process is carried out at a same time. This process is repeated until all the holes are expanded. This process reduces cycle time and increases accuracy of pitch required. According to the applications different pitches can be used. Using this station overall expansion cycle time of all tubes of a single radiator is reduced and the entire process of tube expansion for radiator is completed in 10-12 minutes with precise expansion operation.

Conclusions

- Here we are concluding that our station is providing ease in manufacturing of radiator with more efficiency in function.
- The Cycle time of tube expansion is decreased using semi-automated station.
- Large industries with mass production of radiators can use this Station for quick Production processes.
- The production rate of the industry increases considerably.

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