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DEVELOPMENT OF RADITOR TUBE CLEANING MACHINE

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ABSTRACT

Radiator is equipment which helps engine to cool down by heat transfer of engine heat to coolant and from coolant to the atmosphere. Radiators are used to cool large size engines. A water jacket is provided around which the coolant is provided so due to heat released from the engine the coolant gets heated up and is cooled down by the radiator. Also, during the manufacturing of radiator tubes, the chips, burrs or debris may get clogged into the tubes which may considerably affect the engine performance. So the objective of our project is to develop and construct a special purpose semi-automated radiator tube cleaning machine as required by the company Tata Toyo Radiator Limited. It may also help in increasing the efficiency of manufacturing process and the manual fatigue during the manufacture of the tubes. The project work is being conducted at Rishi Engineering Pvt. Ltd which has been contracted with this project.

Keywords – Radiator, Clogged, Semi-automated.

I. INTRODUCTION

Designing and construction of a semi-automated machine to carry out the cleaning of radiator tubes to remove the burr and fine metal particles generated during the machining stage also to reduce manual fatigue and to obtain the efficient cleaning of the tubes at the higher rate and to maximize the work output.

Generally radiator tube cleaning is done by hand. In which we use small diameter wire to remove dirt inside the tube then washing by water we clean the radiator tube. It is time consuming and which can be done totally manually. Hence in order to increase work efficiency we have done this operation automatic.

Automobile radiators consist of a pair of header tanks, linked by a Core with many narrow passageways, giving a high surface area relative to volume. This core is usually made of stacked layers of metal sheet, pressed to form channels and soldered or brazed together.

Fig.1. radiator

The core consists of rows of finned tubes that allow the coolant to pass through them. Air rushing through the fins and the tubes transfers the heat to the air thus lowering the temperature of the coolant. It essentially is an automotive heat exchanger. Generally, the more rows of the tubes, the heavier duty the radiator is. A common occurrence was seeing a car at the side of the road boiling over on a hot summer day. Radiators were made of copper and brass in the old days but Aluminium has been overshadowing copper due to their light weight and design characteristics.

II. PROBLEM

Designing and construction of a semi-automated machine to carry out the cleaning of radiator tubes to remove the burr and fine metal particles generated during the machining stage also to reduce manual fatigue, to obtain the efficient cleaning of the tubes at the higher rate, to maximize the work output.

III. OBJECTIVES

1. To design and development of radiator tube cleaning machine for reducing manual working process.
2. To reduce number of worker and cycle/setup time using radiator tube cleaning machine.
3. To increase productivity using radiator tube cleaning machine.

IV. DESIGN CONCEPT

The radiator tubes after undergoing the manufacturing stage contain some amount of burr and other fine debris. Due to the small dimensions of the tubes these unwanted particulates get trapped in the tube and do not readily fall out. These particles if not removed will eventually clog the cooling system and also promote rust formation. Thus it is necessary to remove the debris prior to the assembly of the radiator. The cleaning is carried out in two stages which involve first application of vibrations to loosen up the particles and second use of pressurized air to carry away the particles out of the tubes.

V. REQUIRED COMPONENTS

1. Linear Table
2. Pallets
3. Tapping(vibration) mechanism
4. Electric motor

5. Air blowing mechanism

VI. PROPOSED MODEL

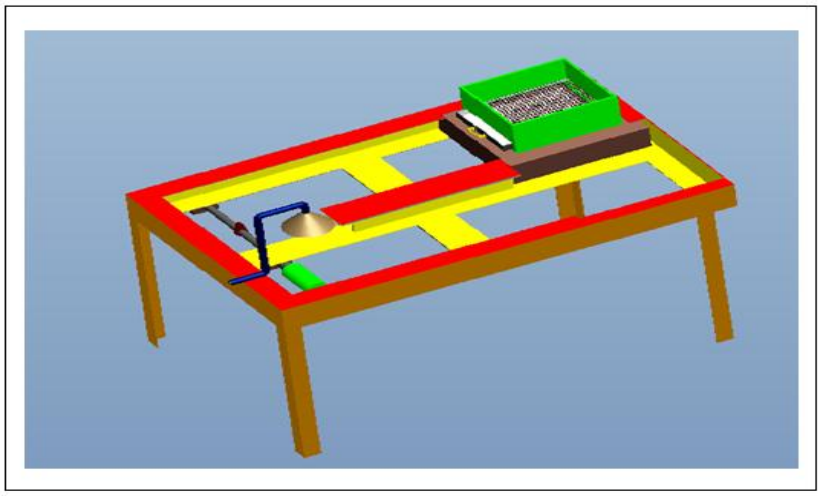

Fig.2. proposed model

VII. DESIGN FORMULAE

1. Linear Table - C-Guide
   - A) Volume of c-guide = L * W * H

     Where,

     L = Length

     W = Width

     H = Height
   - B) Mass of C-Guide = V * Density of material
   - C) Weight of C-Guide = M * G

     Where,

     M = Mass

     G = Acceleration due to gravity
2. Pallet
   - A) Area of the pallet = L * B

     Where,

     L = Length of pallet

     B = Width of pallet
   - B) Volume of the pallet = A * T

     Where,

     T = Thickness of pallet

C) Mass of the pallet = Volume * Density

3. Taping mechanism

A) Bearing design

a) Life of bearing =L = $(60 * n * L_h / 10^6)$

Where,

L_h = Life of bearing in Hrs

b) Dynamic load capacity= C = $(L * P)^{1/p}$

B) Shaft design

a) $\tau_{max} = 0.18\ S_{ut}$

b) $\tau_{max} = 0.3\ S_{yt}$

c) $\tau_{act} = \dfrac{16 \times Td}{\Pi \times d^3}$

Where,

τ_{max} = Maximum stress in shaft

S_{ut} = Ultimate tensile Stress

S_{yt} = Yield Stress

τ_{act} = Actual Stress

VIII. FABRICATION OF SYSTEM

This product consist of main four parts pallet, cam and follower tapping mechanism, air blowing mechanism, guiding mechanism and supporting frame. In this operation radiator is placed on pallet guided over c-channel guided mechanism up to tapping mechanism by using cam follower mechanism we provide a vibration in order to remove dirt or loose the dirt particles inside the tube then pallet is again guided to air blowing mechanism where all dirt particles will be flushed out by air at high pressure. Then pallet moves to exist point where radiator will be removed.

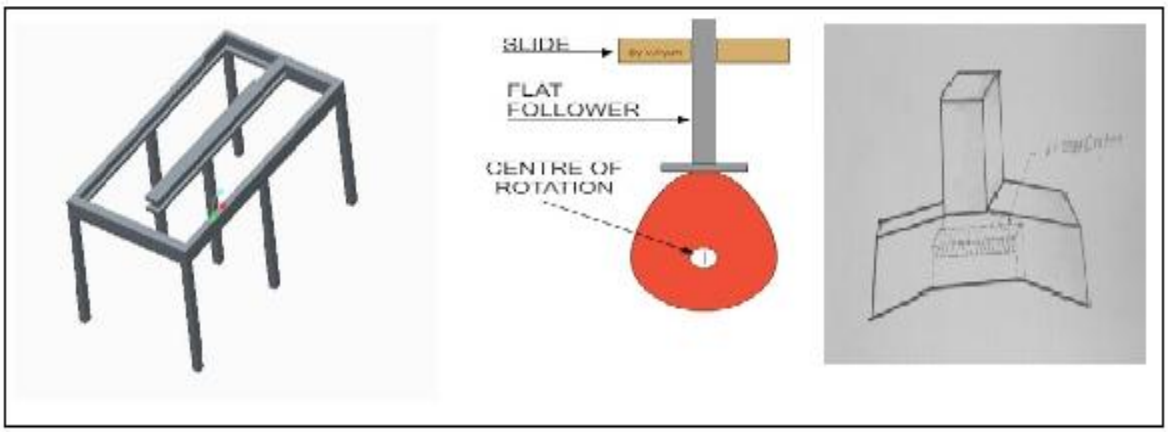

Fig.3. linear table, tapping mechanism, air blowing mechanism

IX. EXISTING WORK

Fig.4. radiator tube cleaning machine

X. WORKING OF THE SYSTEM

Firstly the radiator tubes which need to be cleaned are taken approximately (300 tubes) and are fixed to the pallet randomly. The pallet is moved to second station where the vibrating operation is done by using cam and follower mechanism. Now the pallet is moved to the next station there is a air blowing mechanism which blows high pressure air in the radiator tubes which cleans all the burrs, debris and small chips, after completion of cleaning the pallet is moved to last station where the tubes are removed from pallet.

XI. CONCLUSION

The rate of cleaning should be around 30000 tubes per hour. By using Special Purpose Radiator Tube Cleaning machine we can clean radiator tubes by removing burr and other impurities with the help of tapping and blowing.

After use of this machine for cleaning of radiator tubes, chances of clogging of tubes will get reduce and chances of choking of inlet and outlet of hoses will also get reduce. The machine process lead to increase an overall radiator efficiency.

XII. FUTURE SCOPE

A) Layout of circular radiator tube cleaning machine

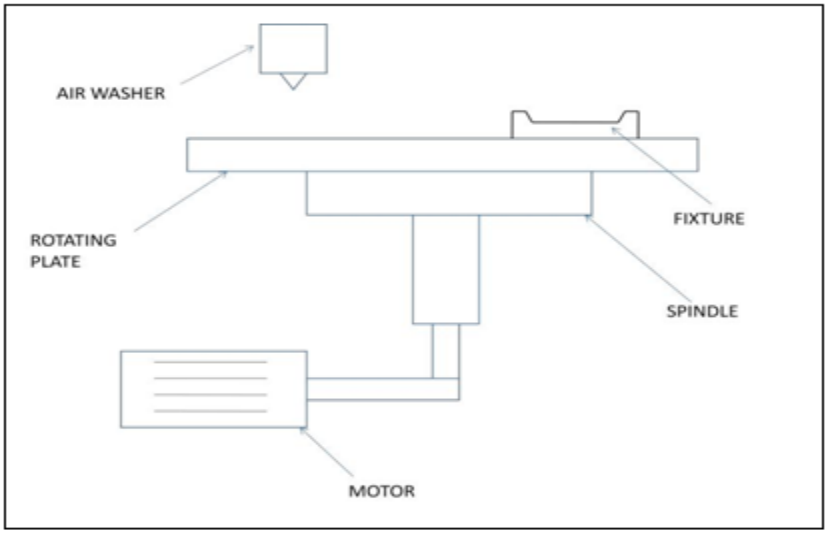

Fig. 5 front view of circular radiator tube cleaning machine

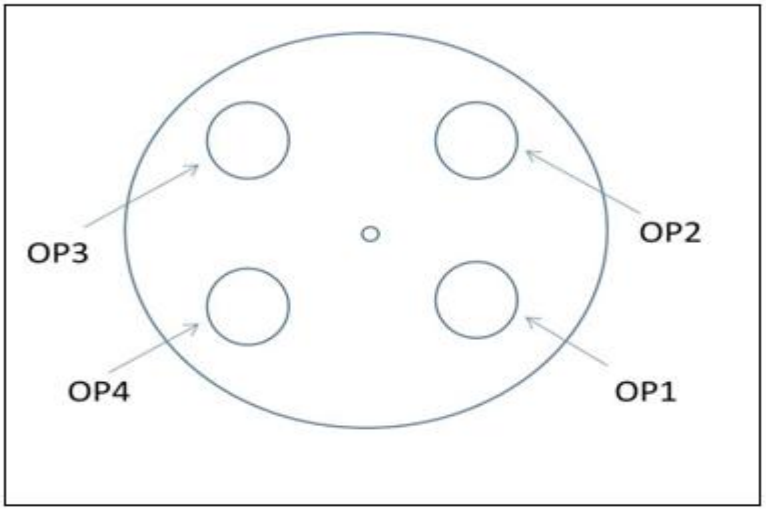

Fig.6 top view of circular radiator tube cleaning machine

The advantage of having the loading and unloading stations near to each other a circular rotating plate arrangement has been selected against a linear arrangement for carrying out the required task.

This process would ensure consistent and reliable cleaning of the tubes over a period of time reducing the workers involvement and the manual errors caused by fatigue. It will also increase the productivity of the task as the time required will be reduced.

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