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IMPLEMENTATION OF A RADIATOR AND EVAPORATOR LEAK TESTING MACHINE

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ABSTRACT:

A radiator is a device that helps in cooling the engine by transferring heat from the engine to the coolant and then from the coolant to the surrounding atmosphere. Radiators are mainly used for cooling large-capacity engines. A water jacket is provided around the engine through which the coolant circulates. Due to the heat released by the engine, the coolant becomes heated and is subsequently cooled by the radiator. Leakage problems may occur during the manufacturing or assembly process. To address this issue, this project focuses on the design of a pneumatic circuit for a leak testing machine. The pneumatic circuit includes components such as a pneumatic compressor unit, a toggle-operated 5/2 directional control valve, hoses, fittings, and a double-acting cylinder. The cylinder design has been finalized for this system. The piston is used to produce the upward and downward motion of the platform, which supports different radiators selected for leakage testing. The movement of the piston is controlled using the pneumatic circuit. The designs of the tank and platform have also been finalized. The theoretical aspects have been completed, and the design is confirmed as the final stage of this project. The main objective of the project is to design and manufacture a special-purpose radiator leak testing machine.

KEYWORDS*:* Text detection, Inpainting, Morphological operations, Connected component labelling.

INTRODUCTION

The raw materials used for radiator manufacturing, mainly copper and brass strips, are received by the industry and stored in the warehouse. These materials are kept in a safe location, away from other machinery and sharp objects that could cause damage. Copper and brass are preferred for radiator manufacturing because they can be easily repaired. Various machines and manufacturing processes are used to produce copper and brass radiators. Initially, the radiator core, which is the main component of the radiator, is manufactured. Brass strips are taken from the warehouse and sent to the tinning machine, where they are coated with a thin layer of tin ranging from 0.2 to 0.3 microns. This tin coating is applied because, after the brass strips are bent into tubes, small gaps remain between the metal surfaces. These gaps are later filled when the tin melts in the furnace during the heating process. The lead tube roll is then transferred to a single tinning tube mill radiator machine. This machine is programmed to bend the corrugated brass strips into tubes of required dimensions according to customer specifications. Sensors are used to cut the tubes into equal lengths based on the radiator core size. Accurate tube dimensions are essential to ensure proper fitting through the fins during radiator assembly. Simultaneously, radiator fins are manufactured using a standard flat fin machine. This machine includes a cylindrical die that rotates with the help of a motor. The fin pattern is determined based on the design and type of tubes used in the radiator. The die is manufactured according to the required fin pattern. A copper strip roll is mounted at one end of the machine, and the strip passes through multiple rolling dies to form the desired pattern. Sensors then cut the patterned strip into the required lengths.

Header plates are produced using a hydraulic press. These header plates have patterns matching those of the fins to allow the tubes to pass through them. The press consists of a punch mounted on the ram and a die placed below it. When the ram moves downward, the metal plate between the punch and die takes the shape of the punch pattern. Thick metal is used for header plates as they hold the radiator core firmly in position. Once the tubes, fins, and header plates are manufactured, they are assembled on a jig to form the radiator core. The fins are carefully placed on the jig, and proper alignment of all tube holes is verified. Misalignment of even a single fin can result in rejection of the entire core. After inserting all the tubes through the fins, the assembled core is sent to the baking department. The baking department consists of a shouldering tub and a low-capacity furnace. First, the radiator core is dipped into the shouldering tub containing shouldering iron, which helps fill minute holes and cavities. After shouldering, the core is placed in a furnace maintained at approximately 350°C. At this temperature, the shouldering metal melts and fills the tiny cavities in the core. Once removed from the furnace, the core is sent to the testing department. In the testing department, the core is filled with pressurized air and submerged in water for a few minutes. If air bubbles are observed, the leakage points are repaired, and the core is tested again. After passing the leakage test, the header plates, top tank, and bottom tank are assembled onto the core. The completed radiator is then ready for use in cooling large-capacity engines, and manufacturers typically provide a one-year warranty. Testing machines vary significantly in procedure, purpose, design, and terminology across different fields of machine building. Tests are conducted both in factories and during machine operation. Depending on the objective, tests may be acceptance tests, check tests, or research tests. Machine-building industries test prototypes, full-scale machines, and random samples from assembly lines to support ongoing research and development. Automobile radiators are becoming increasingly compact and powerful due to higher power-to-weight and power-to-volume ratios. There is a growing demand for radiators capable of dissipating maximum heat within limited space. Although radiator design and manufacturing have undergone only minor changes over the past 70 years, more advanced, efficient, and cost-effective radiator designs are now available in the industry. The paper is organized as follows: Section II explains automatic text detection using morphological operations, connected component analysis, and selection or rejection criteria, along with the algorithm flow diagram. Section III describes the in painting technique used to fill detected text regions. Section IV presents experimental results obtained from tested images, and Section V provides the conclusion.

RELATED WORK

Prof. Prashant Vavhal has carried out work on the Design and Assembly of a Special Purpose Leak Testing Machine. As indicated by the title, the machine is a Special Purpose Machine (SPM) developed to meet specific customer requirements and testing applications. The component under consideration was a casting-type tubular structure that required precise leak testing. To fulfill this specialized requirement, the industry provided training related to the design and manufacturing of the complete machine. The selection of the testing method was a critical factor and was decided based on the application of the component. During initial discussions with the customer, it was specified that the component was an aluminum casting that needed leak testing. Since casting components cannot be welded or machined to repair cracks, any detected crack renders the component unusable. Therefore, a dry leak testing method was selected, as the customer only needed confirmation of the presence of a crack and not its exact location. Thus, the dry testing method was found to be suitable. The primary objective of this project was the design and fabrication of a special-purpose leak testing machine [1].

Prof. Jalpesh Solanki, Prof. Hardik Acharya, and Prof. Ajay Bhimani conducted research on the Optimization of Defects Encountered in the Manufacturing of Radiators. Their work highlights that automobile radiators are becoming increasingly compact and powerful due to higher power-to-weight and power-to-volume ratios. This has resulted in a growing demand for radiators capable of dissipating maximum heat within limited space. Their study analyzed all major processes involved in radiator manufacturing, identified defects occurring during production, and proposed improvements in parameters such as furnace temperature, assembly jigs, internal deposits, and cracks in plastic tanks. By optimizing these parameters, both manufacturing efficiency and cost-effectiveness can be improved [2].

M. Aliff Ashraf carried out work on the Design and Development of a Radiator Test Rig. According to the study, the developed test rig can be used for further performance analysis depending on the required application. The project successfully achieved all its defined objectives. By simulating an actual automobile radiator system, the test rig allows performance evaluation under various operating conditions. The study also concludes that changes in fan speed significantly affect the cooling efficiency of the radiator system [3].

A. N. Gowardipe, Ajay Deshmukh, Prashant Dimble, Akash Deshmukh, and Nandkishor Garje presented work on a Leakage Testing Machine. Their study describes different methods used to detect leaks and identify their locations within components. The project contributes to improved automation in leak testing processes and helps enhance product quality in manufacturing industries [4].

Darshan Dabholkar, Dipak Shenvi, Nitinkumar Anekar, and Onkar Joshi conducted a study titled Design of a Wet Leak Test Machine for Radiators. Their research focuses on the design of a wet leak testing machine used for detecting leaks in radiators. In this system, a piston mechanism is used to generate upward and downward movement of a platform that supports radiators of varying sizes during testing. The piston motion is controlled using a pneumatic timer circuit designed with SMC software. The designs of the tank and platform were finalized as part of the study [5].

METHODOLOGY

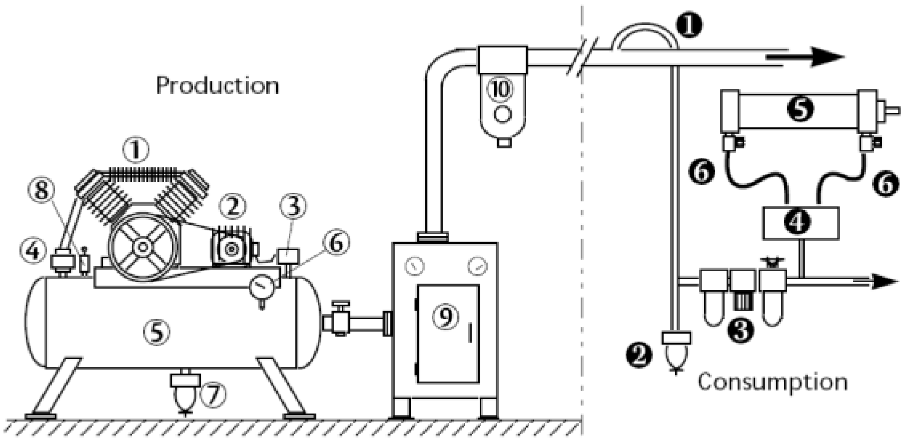

Fig: Basic Pneumatic Design

The component parts and their main functions are:

a) Compressor: Air taken in at atmospheric pressure is compressed and delivered at a higher pressure to the pneumatic system. It thus transforms mechanical energy into pneumatic energy.

b) Electric Motor: Supplies the mechanical power to the compressor. It transforms electrical energy into mechanical energy.

c) Pressure Switch: Controls the electric motor by sensing the pressure in the tank. It is set to a maximum pressure at which it stops the motor, and a minimum pressure at which it restarts it.

d) Check Valve: Lets the compressed air from the compressor into the tank and prevents it leaking back when the compressor is stopped.

e) Tank: Stores the compressed air. Its size is defined by the capacity of the compressor. The larger the volume, the longer the intervals between compressor runs.

f) Pressure Gauge: Indicates the Tank Pressure.

g) Auto Drain: Drains all the water condensing in the tank without supervision.

h) Safety Valve: Blows compressed air off if the pressure in the tank should rise above the allowed pressure.

i) Refrigerated Air Dryer: Cools the compressed air to a few degrees above freezing point and condenses most of the air humidity. This avoids having water in the downstream system.

j) Line Filter: Being in the main pipe, this filter must have a minimal pressure drop and the capability of oil mist removal. It helps to keep the line free from dust, water and oil.

We used pneumatic system, as it has some advantages over the hydraulic system. There is no need for fluid replenishment. Light tubing/piping is sufficient. There is no fire hazard. But in our pneumatic system, we have used air as a working fluid. Because air has the some advantages over the other gases.

EXPERIMENTAL RESULTS

In every radiator and evaporator manufacturing industry the main problem is leakage found in the casting, forged & welded component. Due to this various leakages problem are occurs after the components are assembled in actual working condition. Due to this faulty component break down in machine or equipment is occurred. In our machine we detect the various leakages formed in the casting component, forged component, welded component etc. In this machine we use the wet testing for the detection of leakages in the component or equipment. The air is blown in casting component for the checking the leakage of component with the help of compressed air. This compressed air is supplied by the pneumatic compressor. For this we use the pneumatic circuit by using various pneumatic valves and hoses. Then we dip the radiator and evaporator component in clean water tank for the detecting the location of leakage then we mark the location with help of marker. For these we used the pneumatic circuit. For checking the loss of air in the component we use visual testing, which observe passing air through the part of leak component. After that we can tell component is ok or faulty.

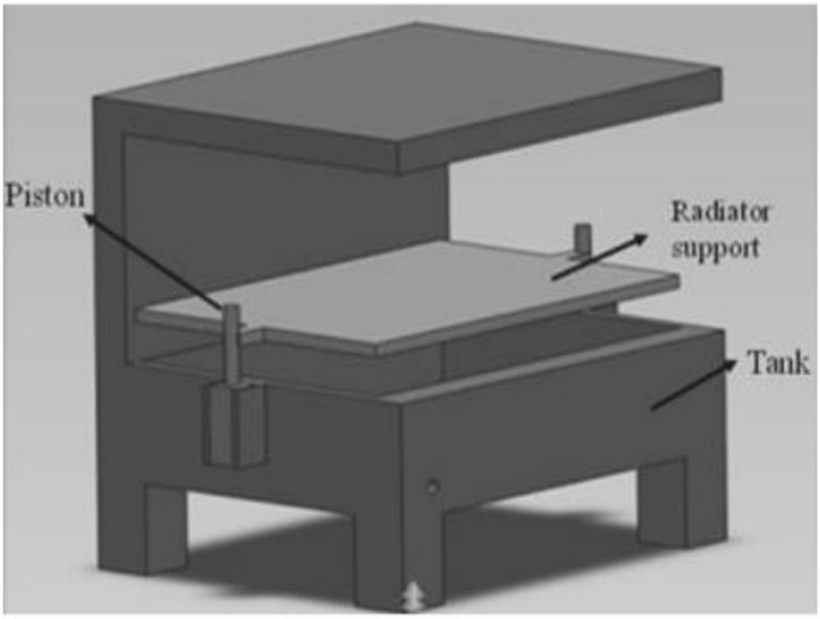

Fig: .Concept of Radiator & Evaporator leak testing machine

Design of Pneumatic Cylinder: Clavarino's equation for closed end cylinder at both ends.
For ductile material use to determine the thickness of cylinder.
Let, Material of the cylinder is Aluminum.

CONCLUSION

In this project, we have finalized the design for cylinder. The piston is used for generating the up and down movement of the platform which will bear the loads of the various radiators, which are selected for leakage testing. The piston movement is controlled with the help of the pneumatic circuit. The designs for the tank and platform have been finalized. The theory regarding it has been finalized and the design will be confirmed as the final part of this procedure. The main objective of the project was to design and manufacture special purpose leak testing machine. Manufacturing of this machine is done after the studies of all process for manufacturing of a radiator. The problems in their manufacturing process are shown and improving some parameters of radiator. In the first part component is studied in details for the forces and the calculations. The conceptual model of the fixture is drawn for simplification and understanding of the rough picture of fixture. The cylinders of the fixtures are selected according to the forces on the radiator fixture. The mounting of the cylinders is also important in the machine. The mounting is selected as front mounting for all cylinders. Manufacturing is done of radiator fixture first and then it is attached to the main part of the machine. Which is a stable part base frame. While concluding this report, we feel quite fulfill in having completed the project assignment well on time, we had enormous practical experience on fulfillment of the manufacturing schedules of the working project model. We are therefore, happy to state that the in calculation of mechanical aptitude proved to be a very useful purpose. Although the design criterions imposed challenging problems which, however were overcome by us due to availability of good reference books. The selection of choice raw materials helped us in machining of the various components to very close tolerance and thereby minimizing the level of problem. Needless to emphasis here that we had lift no stone unturned in our potential efforts during machining, fabrication and assembly work of the fixture project model to our entire satisfaction.

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