ISSN (Online): 2583 648X

I J I R I D

International Journal of Ingenious Research, Invention and Development

Volume 1 | Issue 4 | June 2023

Scientific Journal Impact Factor (SJIF 2023): 3.647

DOI: 10.5281/zenodo.8108631

www.ijirid.in

Portable Induction Based Metal Hardening Machine

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Abstract: *This abstract provides an overview of a project focused on the development of a portable induction-based metal hardening machine. The project aims to enhance the surface properties of metals through localized heating and controlled quenching processes. The objective of the project is to design and construct a compact and efficient machine capable of delivering precise and consistent metal hardening results. The machine utilizes induction heating technology, which enables rapid and localized heating of metal surfaces without direct contact. This method offers advantages such as improved energy efficiency and precise control over the heating process. The research encompasses the conceptual design, detailed engineering, fabrication, and testing of the portable induction-based metal hardening machine. Considerations such as power requirements, heating uniformity, and temperature control are considered during the design phase. The fabrication process involves the selection of suitable materials and components to ensure the machine's durability and performance. The developed portable induction-based metal hardening machine offers several advantages, including its compact size, ease of use, and versatility. It has the potential to find applications in industries such as automotive, aerospace, and manufacturing, where localized surface hardening is required to enhance the strength and wear resistance of metal components. The machine's compact design and efficient performance make it a valuable tool for improving the surface properties of metals in various industrial applications.*

Keywords: Portable Induction, Metal Hardening, Surface Properties, Induction Heating, Quenching, etc.

I. INTRODUCTION

Induction hardening is a type of surface hardening in which a metal part is induction-heated and then quenched. The quenched metal undergoes a martensitic transformation, increasing the hardness and brittleness of the part. Induction hardening is used to selectively harden areas of a part or assembly without affecting the properties of the part. In the field of metallurgy, metal hardening is a critical process that aims to improve the mechanical properties and durability of metallic components. It involves altering the microstructure of metals to increase their hardness, strength, and resistance to wear and fatigue. Various techniques have been developed over the years to achieve metal hardening, each with its own advantages and limitations. One such technique that has gained significant attention is induction-based metal hardening.

Induction-based metal hardening is a process that utilizes the principles of electromagnetic induction to generate heat directly within the metal being treated. This method offers several advantages over traditional heating methods, including precise and controlled heating, rapid heat generation, localized heating, and reduced energy consumption. It has found applications in various industries, such as automotive, aerospace, tool manufacturing, and many others.

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II. LITERATURE REVIEW

Knorovsky et al: The report on the Hardenability/Quench Severity Analysis is covered in great length in the study by Knorovsky et al. The report primarily examines two topics: (1) assessing the influence of non-isothermal temperature profiles, particularly surface heating, on cooling rates during quenching; and (2) creating an analysis procedure to calculate case depth variation brought on by changes in ideal diameter (DI) and quench factor (H). Peng yuan Qi, Qi Sun, Jingyi Zhong, Gang Wang, Xinghua Liu, and Weijie Liu: The researchers compared cooling rates at various depths in 1-inch diameter bars using finite element modelling to assess the impact of non-isothermal temperature profiles. They contrasted bars with temperature profiles resembling induction heated shafts with those with uniform heating throughout. Surprisingly, the findings revealed that the initial temperature profile for the given bar had no discernible influence on the cooling rates.

III. PROBLEM DEFINATION

Conventional methods (Flame Hardening) have faced several issues, including cracking, and flaking, as well as increased fire dangers, and overheating or distortion of the surrounding material. Bringing an expensive centralized hardening equipment to various location is impossible. The risk of human error and produces repeatable outcomes.

IV. OBJECTIVES

Objective of this research works are as follows:

1. The machine should be designed to be portable, allowing for easy transportation and flexibility in its usage, which enables the machine to be used in different locations and accommodate various workpiece.
2. The goal is to secure the desirable qualities of the remaining section while improving the wear resistance and strength of selective regions.
3. The machine should prioritize safety features to protect the operator and ensure proper functioning.

V. METHODOLOGY

Fabricating the machine according to following steps:

1. Development of the new concept.
2. Literature review and research.
3. Comparison between working model and other active machines in present.
4. Fabricate the actual machine by using the machine components.
5. Cost analysis

VI. WORKING

portable induction-based metal hardening machine that incorporates a switch mode power supply (SMPS), microcontroller, switcher, display, and a 120-watt induction coil typically operate as follows:

Power Supply: The SMPS serves as the power supply for the machine. It converts the electricity to the required voltage and current levels for the machine's operation.

Microcontroller: The microcontroller serves as the central control unit of the machine. It manages and coordinates the operation of various components, including the power supply, switcher, display, and induction coil.

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Display: The display module provides visual feedback to the user, presenting information such as time, heating mode, and system status. The microcontroller communicates with the display module to update and present relevant information in a user-friendly manner.

Induction Coil: The 120-watt induction coil is a crucial component responsible for generating the alternating magnetic field required for induction heating. When the heating board activates the coil with the high-frequency current, it creates a magnetic field that interacts with the metal workpiece, inducing eddy currents and causing resistive heating.

Control Interface: The portable machine may include user-friendly controls, such as buttons, to allow the operator to input heating parameters, adjust settings, and initiate the hardening process. The microcontroller processes these inputs and executes the corresponding actions.

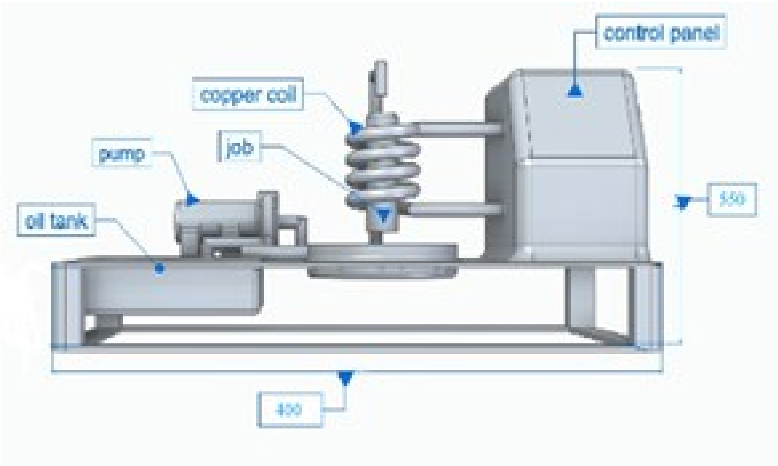

Figure 01: 3D Drawing

Figure 02: Machine Set-up

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VII. CONCLUSION

By delving into the topic, individuals can gain a comprehensive understanding of the principles, advantages, and applications of portable electromagnetic induction metal hardening machines.

The development of a portable induction-based metal hardening machine offers a compact, efficient, and precise solution for enhancing the hardness and durability of metal components. It utilizes electromagnetic induction to heat the metal parts uniformly, providing consistent results while minimizing the risk of overheating or distortion. The machine's portability allows for its use in various industries and settings, such as manufacturing facilities, workshops, or on-site repairs. The project focuses on addressing challenges such as power efficiency, portability, and safety features.

REFERENCES

[1] Knorovsky et al: The report on the Hardenability/Quench Severity Analysis is covered in great length in the study by Knorovsky et al.

[2] Cai Tang, Bo Chen and Huiji Fan: the paper titled "Induction Hardening Process of G18NiMoCr3-6 Steel"

[3] Handbook of Induction Heating, Valery Rudnev, Don Loveless, Raymond L. Cook,