VIVA-TECH IJRI
ANNUAL RESEARCH JOURNAL
VIVA-TECH INTERNATIONAL JOURNAL FOR RESEARCH AND INNOVATION
ANNUAL RESEARCH JOURNAL
ISSN(ONLINE): 2581-7280

"DESIGN AND FABRICATION OF TINNING MACHINE"

Vinayak Sagar[1], Mayuresh Patil[2], Vinay Vadvalkar[3], Rohan Pagare[4]
[1](Department Of Mechanical Engineering ,Viva institute of technology/ Mumbai University, India)
[1](Department Of Mechanical Engineering ,Viva institute of technology/ Mumbai University, India)
[1](Department Of Mechanical Engineering ,Viva institute of technology/ Mumbai University, India)
[1](Department Of Mechanical Engineering ,Viva institute of technology/ Mumbai University, India)

Abstract: *Tinning is the procedure of daintily covering sheets of fashioned iron or steel with tin, and the subsequent item is known as tinplate. The term is likewise broadly utilized for the diverse procedure of covering a metal with weld before binding. Tinplate is a slight steel sheet covered by tin. It has an amazingly lovely metallic brilliance just as fantastic properties in consumption obstruction, solderability, and weldability. Tinplate is utilized for making a wide range of holders, for example, nourishment jars, drink jars, 18-liter jars, and masterful jars. Its applications are not restricted to holders; as of late, tinplate has likewise been utilized for making electrical apparatus parts and numerous different items. Tin Free Steel (TFS) is created by applying electrolytic chromic corrosive treatment over steel sheets. This steel item was created to meet financial prerequisites, and exceeds expectations tinplate in paintability, paint bond, and economy. It is broadly utilized for making drink jars and 18-liter jars. It is likewise utilized for making photographic film cases and as a defensive material for optical fiber links. The principle reason for this paper is to give a diagram about the way toward assembling of tinplate in the wake of visiting a plant. Induction heating was first noted when it was found that heat was produced in transformer and motor windings, as mentioned in the Chapter "Heat Treating of Metal" in this book. Accordingly, the theory of induction heating was studied so that motors and transformers could be built for maximum efficiency by minimizing heating losses. The development of high-frequency induction power supplies provided a means of using induction heating for surface hardening. The early use of induction involved trial and error with built-up personal knowledge of specific applications, but a lack of understanding of the basic principles. Throughout the years the understanding of the basic principles has been expanded, extending currently into computer modeling of heating applications and processes. Knowledge of these basic theories of induction heating helps to understand the application of induction heating as applied to induction heat treating. Induction heating occurs due to electromagnetic force fields producing an electrical current in a part. The parts heat due to the resistance to the flow of this electric current*

Keywords *–PCB(PRINTED CIRCUIT BOARD),Tinning machine,Induction heating method, Inductor circuit.*

I. INTRODUCTION

The project work presented in this report is based on PCB (PRINTED CIRCUIT BOARD) manufacturing process. The project topic we selected is tinning process which is used during the manufacturing process of PCB. This project work presented in this report is to increase profit of the manufacturing companies and to make tinning process affordable with high production rate for small manufacturing companies.

PCB (PRINTED CIRCUIT BOARD) manufacturing companies use the tinning machine for tinning process for tinning process during manufacturing of PCB. Tinning is the process of thinly coating sheets of rough iron, copper or steel with tin and the resulting product is known as tin plate. The term is also widely used for the different process of coating a metal with solder before soldering. Tinning is accomplished by passing Printed circuit boards between a larger steel roller which rotates through a molten bath of solder and an upper silicon coated steel roller. The PCB Roller Tinner machine is designed for bench mounting. Great attention has being

taken to ensure that all components are protected from the corrosive flux and minimal heat transfer from the hot tin solder to other parts of the PCB Roller Tinner machine: there being no direct heat path. The PCB Roller Tinning solder tin tank is constructed from high-grade stainless steel, suspended from a linkage mechanism, which allows the solder bath to be lowered from the solder tinning roller for ease of maintenance and heater replacement. The solder tank has externally mounted heaters; these give fast heat-up, with excellent temperature control.

II. PROBLEM DEFINATION

2.1 Problem Statement:-

After visiting PCB manufacturing company several times, it is found that the machine (FORTEX ROLLER INNING MACHINE) they were using is too expensive which is not affordable for small industries. Also this Vortex Roller tinning machine consumes more power as the result manufacturing companies get electricity bills with high amount. This vortex machine is too heavy for transportation, to loading and unloading. The heating method used in this machine takes more pre-heating time. With further digging into this matter, following causes were identified

I. takes more space

II .Need skilled worker

III. Heavy for transportation

IV. High Maintenance

VI. Complex mechanism

VII. 20 min. to 30 min. of heating time

VIII. Heavy in weight around 30kg to 40kg.

All the above mentioned problems are affecting the production rate and profit on production shop floor and thereby affecting Productivity of the company. Hence in order to eliminate the above mentioned causes, the two step methodology of modification can be used as a continuous improvement program.[3]

III. PROPOSED METHODOLOGY

In order to overcome problems mentioned in previous chapter a brief study was carried out and implementation of modification of tinning machine was finalized with low price in order to increase profit of manufacturing industries.

3.1 Modification of design

Tinning machine consist two rollers, which rotate in maintenance free bearings, are driven from a variable speed motor. The bottom roller is constructed of steel and is supplied pre-tinned. The top pressure roller is coated with silicone rubber to equalize the pressure over the total board area. The top pressure roller can be raised and lowered by nut and bolt mechanism with two separate adjusting nut. The top roller is also spring loaded to allow a thicker board than intended to feed through the two rollers without causing damage. The solder tank is constructed from stainless steel. Solder tank is surrounded by the induction coil. We are going to use induction heating system to melt the soldering material and to prevent heat loss. The operating temperature is electronically controlled via a thermocouple probe mounted at the center of the tank.[1]

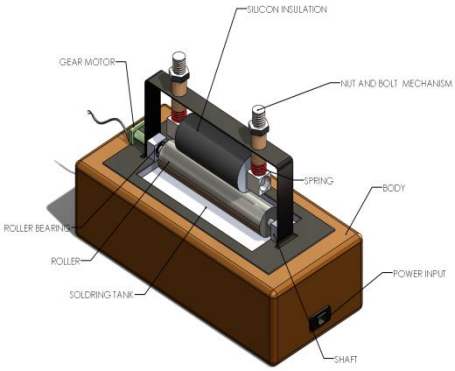

Fig No. 3.1.1 Internal View of Model

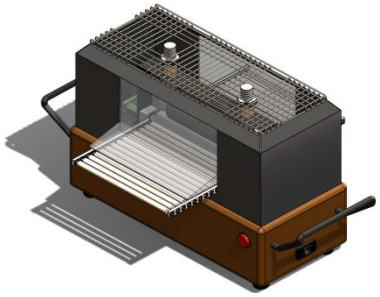

Fig No. 3.1.2 External view of the Model safety cover

TABLE No.01 Parts Details

Parts To be Purches	Parts To Be Manufacture	Price
-	Metal container(3'*3' Metal Sheet)	-/Rs. 720
Inductor coil (6 feet copper pipe)	-	-/Rs. 600
-	Inductor Circuit(with 12V supply)	-/Rs. 300
-	Timer(To maintain the temperature of melted material)	-/Rs. 175
Rollers+Silicon rubber insulation	-	-/Rs. 4000
Ceramic fiber insulation(sq.meter)	-	-/Rs. 1000
Gear motor(12V)	-	-/Rs. 200
Motor(To pump water)	-	-/Rs. 200
-	Bearing and shafts ,Nutbolt mechanism	-/Rs. 1000
-	Solder drum(stainless steel sheet)	-/Rs. 720

3.2 Induction heating method

The physics of the induction heating is based on coupling of the electromagnetism and heat transfer. The main heat source during induction heating is resistive heating caused by eddy currents in the heated specimen.[7] The geometrical position of the inductors influences the final surface temperature distribution. There are many technological processes which require uniform surface temperature like process of induction hardening. The scope of the article is to show the numerical approach to optimize geometrical dimensions of the induction heating process in order to reach uniform surface temperature on heated specimen. Induction heating is used in the industry over the past three decades. Due to the rapid heating and good reproducibility are used in applications the heat treatment. In recent years, there has been significant interest in expanding the use of induction heating process in different manufacturing process.[6]

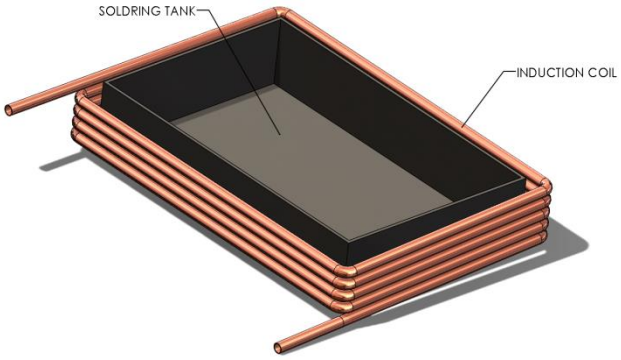

Fig No. 3.2.1 Induction heating coil with Soldering tank

High frequency alternating current is generated in the heating coil by resonant power inverter employing two semiconductor switches. The input AC supply voltage is rectified by the full wave rectifier at the AC input side.[4] The capacitor is used to bypass high frequency current components generated by the power inverter and reduces their magnitude on the main side. The capacitor is not too large as to smooth DC input signal; therefore, a DC signal which is composed of rectified AC half cycles is fed to the power stages. The main task of the power stage is to transfer amount of power to the inductance (and hence the container) at the resonant frequency of LC circuit. This frequency is about 24k Hz.
There is no DC output level to be regulated in induction cooking system. Therefore, the voltage feedback input is related to the output power of the cooker or inductor current level. The protection circuit in the gate operating circuit controls the output voltage by varying the oscillator output frequencies.[5]
The required frequency pulse signal is carried from the comparator to pulse transformer throughout the driver section. The output of the comparator is 180. Out of phase pulse signals which is fed to the IGBT gate in the half-bridge series resonant converter. The power has not been drawn any current when the IGBT is turned off. The initial spikes when the transistor is turned on are due to the short circuit that charges the resonant capacitor and flows through the IGBT. Once the capacitor is charged, and the current begins to flow through the heating coil. The container of the cooker is put inside magnetic field, and then induced the voltage andeddy current are created on the skin depth of the container as a result of the skin effect. This generates heat energy on the surface of the container and rice is cooked by this heat energy.[2]

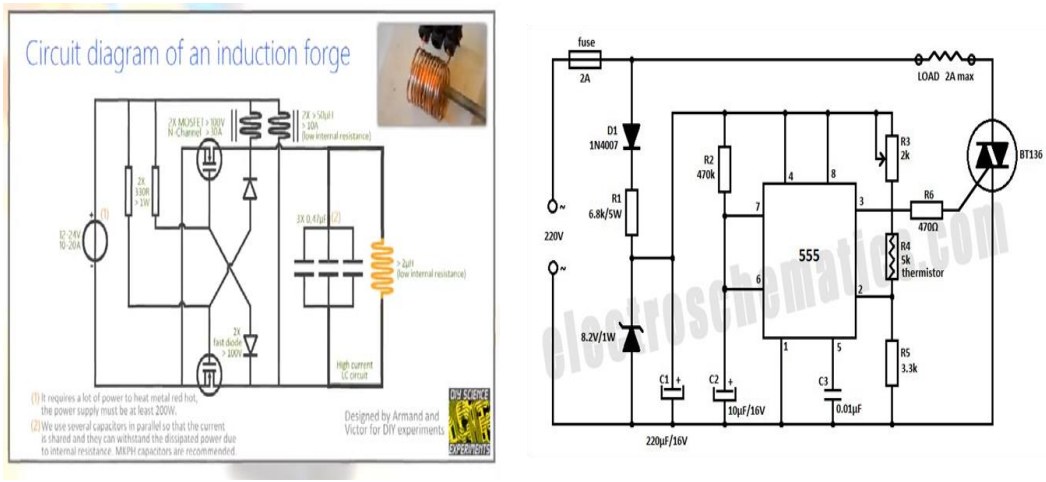

Fig No. 3.2.2 Circuit Diagram Of Temperature Time Control

IV. CONCLUSION

The literature represented in this study describes the importance compact low cost tinning machine, it also described the advantage of changing heating method from heater to induction coil to decrease space as well as cost of Machine, Changing heating method from heater to induction coil increases safety of machine. In this article were applied equations of the electromagnetic and thermal field to solve problem of induction heating. The numerical simulation of induction heating process is shown as a coupling of electromagnetic and thermal problem leading to a system of thermal transient analysis by the explicit Euler method used in the time integration solutions. In country like India there are so many new small industries are starting they cannot afford such high price tinning machine so we are creating new low cost tinning machine that can help them grow.

REFERENCES

Journal Papers:

[1]Y. Pleshivtseva, P. DI Barba, E. Rapoport, B. Nacke, A Nikanorov., S Lupi., E. Sieni, M. Forzan. International journal of microstructure and materials properties, 6, 532-551 (2014).

[2] L.F. Quevedo, C.G. Mancheno, J.A. Morales, F.A.Quizhpi, IEEE International Autumn Meeting on Power, Electronics and Computing (ROPEC), 1-6 (2016).

[3] Cao, R.; Chang, J.H.; Huang, Q.; Zhang, X.B.; Yan, Y.J.; Chen, J.H. Behaviors and effects of Zn coating on welding-brazing process of Al-steel and Mg-steel dissimilar metals. J. Manuf. Process. 2018, 31, 674–688.

[4] Wang, W.; Sun, K.; Liu, H.T. Effects of different aluminum sources on morphologies and properties of ceramic floor tiles from red mud. Constr. Build. Mater. 2020, 241, 118119.

[5] Xiang, N.; Yin, T.; Tian, B.H.; Tang, S.W.; Chen, E. Evaluation on the manufacturability of solderable Sn coatings obtained by employing hot-dipped tinning process. JOM 2019.

[6]https://en.wikipedia.org/w/index.php?title=Induction_heating&oldid=973400361 Induction heating 17 August 2020

[7] LX Cao, T Yin, MX Jin, ZZ He - Applied Thermal Engineering, 2019.

Books:

[1] Utilization of Electric Energy- E, Openshaw Taylor.

[2] A Text Book of Electrical Technology by B.L.Theraja

[3] Material Mechanics at Lule˚a University of Technology from May 2006 to December 2008.