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Development of PLC-Based Controller for Pneumatic Pressing Machine in Engine-Bearing Manufacturing Plant

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Abstract

The paper reports design and development of a PLC-based controller for pneumatic pressing machine, which performs the most critical operation in an engine bearing manufacturing plant. The paper firstly overviews the manufacturing process of engine bearing and then discusses the need of automating the pneumatic press. The proposed automation system involves (a) speed control by replacing the conventional method with a variable frequency drive (VFD), (b) feeder and pusher control using PLC, (c) fault detection and safety measures, (d) and PLC-based sequential control of all the processes carried out on pneumatic press. The control system is based on MicroLogix-1000 PLC from Allen Bradley and the ladder logic program for it has been written on RSlogix-500. For the evaluation of the proposed control system, the PLC program was emulated on RSLogix Emulate-500 and the operations of the pneumatic press were simulated on FluidSIM-P. The results of simulation validate the design of PLC-based controller in general and digital input-output connections of the PLC and PLC program in particular.

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Keywords: Automation; Engine bearing; Pneumatic press; Programmable logic controller; FluidSIM-P

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1. Introduction

Engine bearings are primarily used in engines of automobiles and in some other machines also. These bearings hold the crankshaft in place and prevent it from dislodging. Most engine bearings have layered structure, which provides an optimalal combination of the bearing material properties, like fatigue strength, seizure resistance, wear resistance, conformability, embedability, corrosion resistance and cavitations resistance [1]. Most engine bearings are either bi-metal or tri-metal type. Bi-metal bearings used are either copper based or aluminium based, and the manufacturing of the former one is considered in this paper. The manufacturing process of bi-metal engine bearings is a complex one, involving a sequence of several operations. The most important of these operations are stamping, blanking and forming carried out on a pneumatic press.

The modern trend in manufacturing industry is to automate machine operations [2, 3]. As is well appreciated now, automation leads to increase in productivity, improved quality or increased predictability of quality, improved robustness of the process and increased consistency of the output. This applies equally well to a press machine. The paper proposes a MicroLogix-1000 PLC-based controller to automate the pneumatic press used in engine bearing manufacturing.

The paper is organized as follows: An overview of the complete bi-metallic bearing manufacturing process is presented in section 2. Section 3 describes the operation of the pneumatic press machine used in bearing manufacturing and brings out the necessity of automating it. A PLC based control system for the pneumatic press is proposed in section 4 to carry out feeder and pusher controls along with fault detection and safety operations. A flowchart is given for the automation software, which is written on RSlogix-500. Section 5 presents simulation of the press operations on FluidSIM-P, emulation of the program on RSLogix Emulate-500 and evaluation of the overall PLC based control system. Conclusion and scope of future research work are given in the last section.

2. Overview of manufacturing process

The manufacturing process of bearings involves a sequence of operations illustrated in fig. 1 and below.

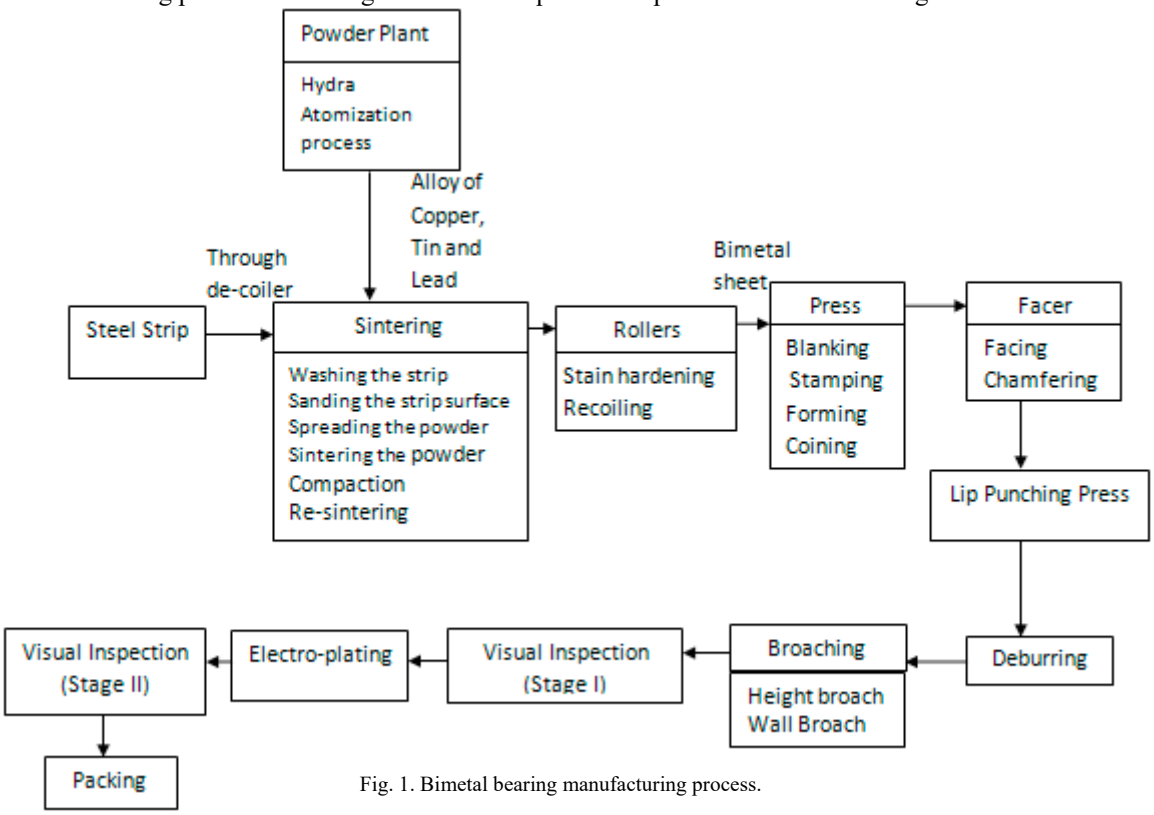

Fig. 1. Bimetal bearing manufacturing process.