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Microprocessor Based Eddycurrent Thickness Meter

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Abstract

A statistical eddy current thickness meter has been developed based on Intel 8085 microprocessor system. Two separate measuring probes have been designed to measure the thickness of coatings on non-magnetic and magnetic substrates. The performance of the instrument has been evaluated by using it to measure the thickness of different coatings on different substrates.

1. Introduction

Thickness is a vital parameter in metal finishing/ corrosion research and industry. The amount of coating applied is critical to the final product's utility and cost. The useful life of a coating and its quality are often related to its thickness. Hence thickness measurement has received greater attention in metal finishing industry. Coulometric method, beta back scatter, X-ray fluorescence, eddy current, magnetic methods are some of the very important techniques used to monitor the thickness. The principles and applications of these methods are extensively dealtwith in literature[1-3]. Each technique has its own advantages and limitations and there is no single technique which will satisfy the measurement of all types of coatings. X-ray fluorescence and beta backscattering which fall under radiation methods are extensively used to monitor the thickness of precious metal coatings[4-6]. Present paper deals with a thickness meter based on eddy current technique.

2. Principle

Figure 1 shows the basic principle of a eddy current thickness meter. If a measuring coil carrying alternating Current is applied to the coating to be tested, then the eddy current is generated in the adjacent base metal. The eddy current field thus generated has a reactive effect on the primary current in the coil from the effect of induction; and so changes the impedance of the measuring coil[7]. The change in impedance is dependent on the coating thickness which separates the coil from the base metal. The depth of penetration of the currents is limited by the skin effect. This method has the advantages of being rapid, nondestructive, requires little skill and cost effective. The technique has the greatest accuracy when testing non-conducting coatings on conducting base. It can also be used when the coating and substrate differ in their conductivity to a considerable extent. The instrument has wide applications to test anodic coatings on aluminium and paint films on steel.

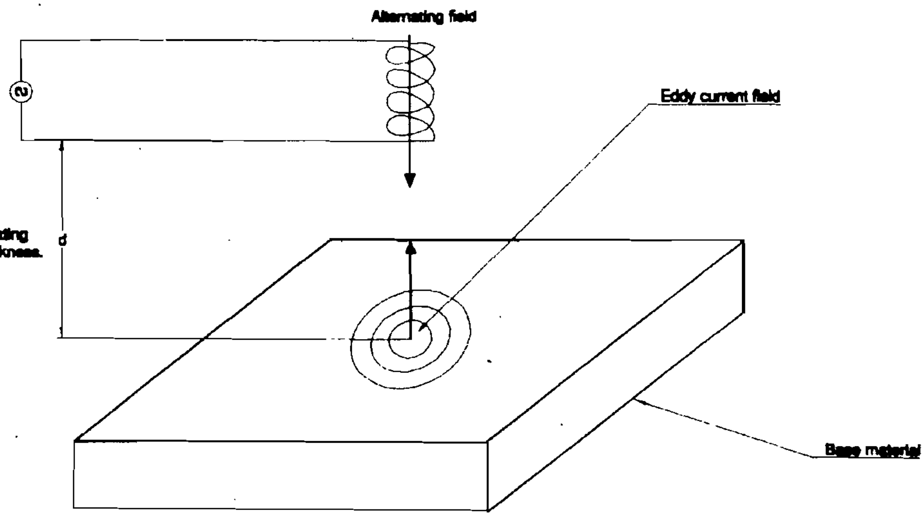

Fig. 1 Principal Diagram

3. The Instrument

The instrument mainly consists of three parts namely sensing probes, electronic hardware circuits and the microprocessor.

3.1 Probes

Two separate probes have been specially designed and fabricated to use in the measurement of coating thickness on non-magnetic and magnetic metal surfaces. They are fabricated by winding coils with fixed number of turns on ferrite rods. The probe used to measure coatings on non-magnetic metals responds to high frequency signal and the probe used with the magnetic base responds to fairly low frequency signal.

3.2 Electronic Circuit

The complete electronic circuit used in the instrument is shown in Fig. 2. It consists of an oscillator, a buffer, a precision rectifier, a summing amplifier and a scaling amplifier. The oscillator, configured using IC 8038 has two fixed frequencies, selectable using the switch 'S'. The output of the oscillator is fed to the probe through a buffer built using IC CA 3140. The output from the probe, which carries information about the coating thickness is rectified by the precision rectifier. The output of the rectifier is fed to the summing amplifier which is used to null the effect due to the substrate. The output of the summing amplifier which is related to the coating thickness is fed to the scaling amplifier. Scaling amplifier is used to calibrate the instrument with thickness standards. The output of the scaling amplifier is directly fed to a 12 bit analog to digital converter (ADC 7109), the output of which is fed to the Intel 8085 microprocessor through the PPI (8255).

3.3 The Software

A software has been developed to make the instrument statistical. The flowchart of the software is given in Fig. 3. Software permits to adjust the instrument output to zero and then to calibrate the

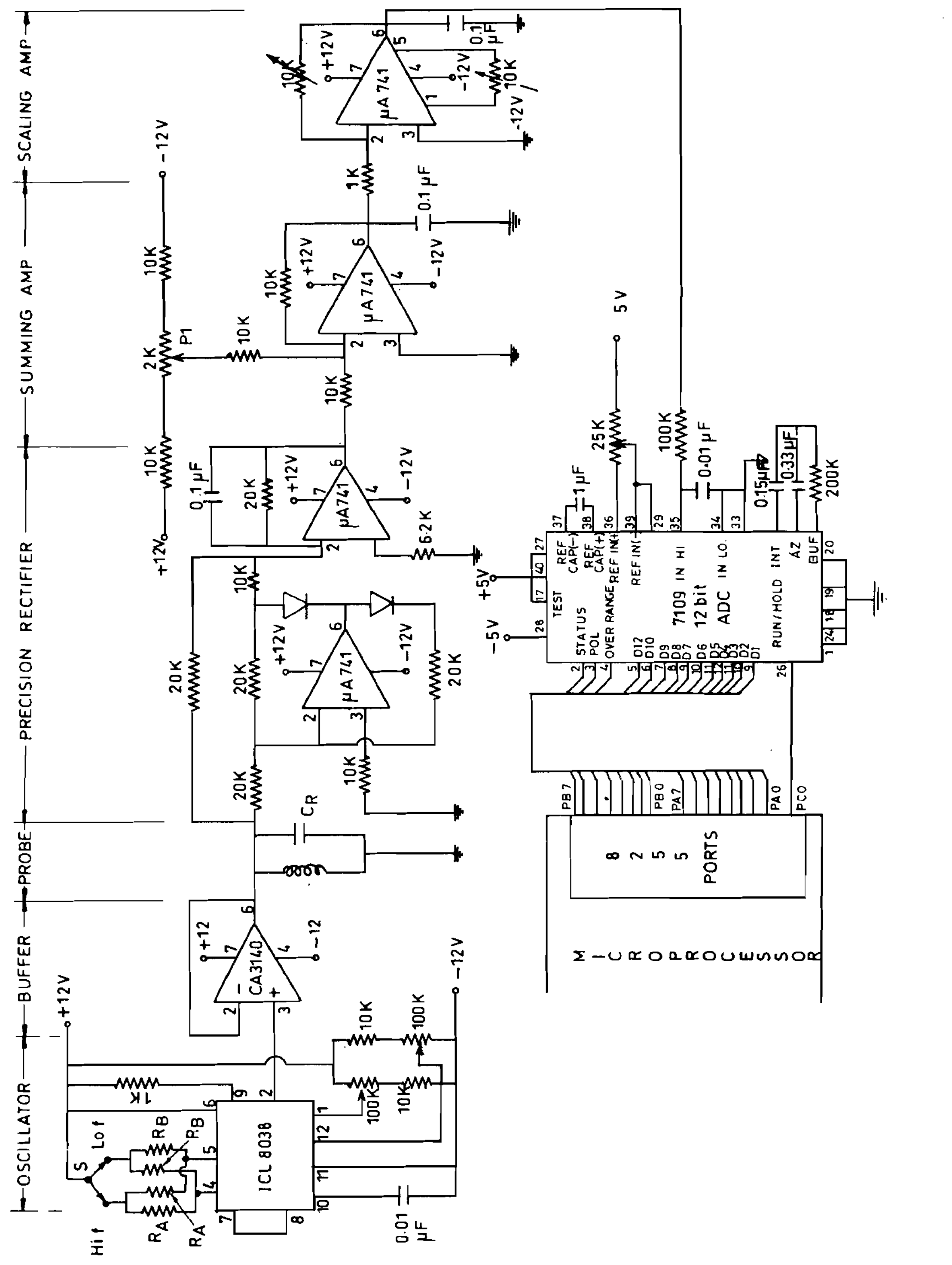

Fig. 2 Electronic Circuit Diagram

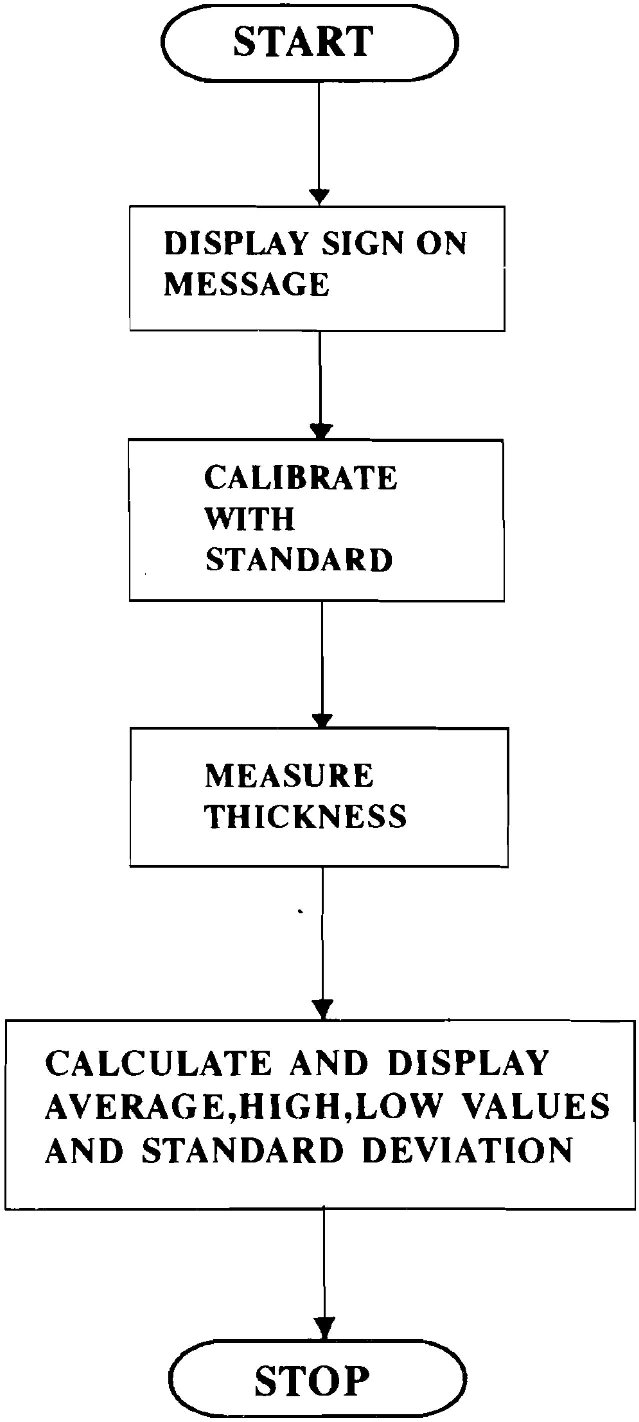

Fig. 3 Flow Chart