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# Automation of Electroplating Technique Using P.L.C.

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***Abstract*—Electroplating technique is widely utilized in various industries for the purpose of coating metal objects with a thin layer of a different metal's. The layer of metal deposited has some desired property, which the metal of the object lacks. For example, chromium plating is done on many objects such as car parts, bath taps, kitchen gas burners, wheel rims and many others for the fact that chromium is very corrosion resistant, and thus prolongs the life of the parts. It is also used in making inexpensive jewelry. Electroplating increases life of metal and prevents corrosion. This paper deals with the detailed process of electroplating technique using PLC**.

***Index Terms*—PLC, DC power supply, cation, electro-deposition.**

## I. INTRODUCTION

Electroplating:-It is a process in which a layer of a metal is deposited on metallic or non-metallic electrode by electrolysis in an electrolytic cell. Electroplating is primarily used to change the surface properties of an object, but may also be used to build up thickness on undersized parts or to form objects by electroforming.

An example of a chemical change is when nickel plating improves corrosion resistance. An example of a physical change is a change in the outward appearance. An example of a mechanical change is a change in tensile strength or surface hardness which is a required attribute in tooling industry.[10] Electroplating of acid gold on underlying copper/nickel-plated circuits reduces contact Resistance as well as surface hardness. Copper-plated areas of mild steel act as a mask if case hardening of such areas are not desired. Tin-plated steel is chromium-plated to prevent dulling of the surface due to oxidation of tin.

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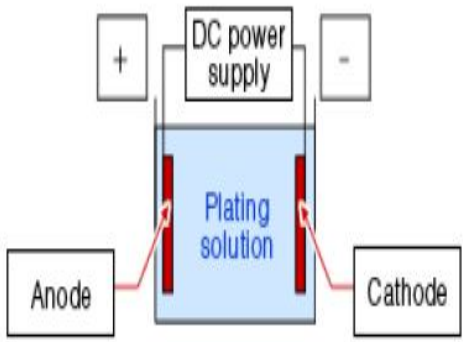



Fig.1: Electroplating of metal [5][11]

The process used in electroplating is called **electro-deposition**. It is analogous to a galvanic cell acting in reverse. The part to be plated is the cathode of the circuit. In one technique, the anode is made of the metal to be plated on the part.

Both components are immersed in a solution called an electrolyte containing one or more dissolved metal salts as well as other ions that permit the flow of electricity. A power supply supplies a direct current to the anode, oxidizing the metal [2] [11] atoms that it comprises and allowing them to dissolve in the solution. At the cathode, the dissolved metal ions in the electrolyte solution are reduced at the interface between the solution and the cathode, such that they "plate out" onto the cathode. The rate at which the anode is dissolved is equal to the rate at which the cathode is plated, is a current through the circuit. In this manner, the ions in the electrolyte bath are continuously replenished by the anode.

## II. PURPOSE OF ELECTROPLATING

Some of the purposes for which articles are electroplated are:

(1) Appearance

(2) Protection

(3) Special surface properties

(4) Engineering or mechanical properties.

The very thin layer of gold applied to some articles of inexpensive jewellery has little or no protective value; it is there principally to attract a potential buyer.

## III. COMPARISON OF DIFFERENT TYPES OF ELECTROPLATING [9][8]

| Chrome or chromium plating | Stainless steel | Carbon Steel | Aluminum | Steel | Non-stick |
|---|---|---|---|---|---|
| Not an alloy; only Chromium. | Alloy containing at least 10.5% Chromium. | An alloy of iron and carbon | Is an element but not an alloy | An alloy of iron and carbon | Coated metal |
| Less durable than Stainless steel. | More durable than chrome. | Can rust | Lighter and not very strong compared to steel | Can rust | Can be easily damaged |
| Shinier than stainless steel, but more difficult to Keep clean. | Not as shiny as chrome, but easier to keep Clean. | Hard and wear-resistant | Doesn't give out sparks | Used in making heavy equipment and in the construction industry | Easier to clean |
| Less expensive than stainless steel. | More expensive than chrome. | Brittle | Cheaper Less reactive Cheaper due to simple refining process | Strong and malleable | Concerns about health |

Table 1 Comparison of different types of electroplating

## IV.ELECTROPLATING TECHNIQUE WITH PLC[12]

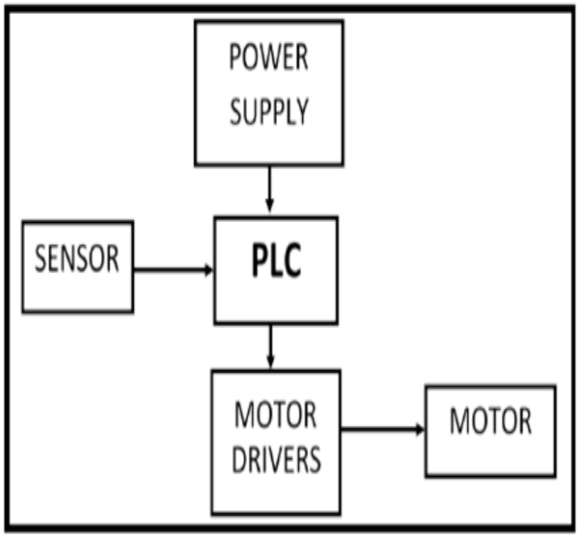



Fig.2: Block diagram of electroplating [5]

## V. PROPOSED BLOCK DIAGRAM [1],[2],[3]

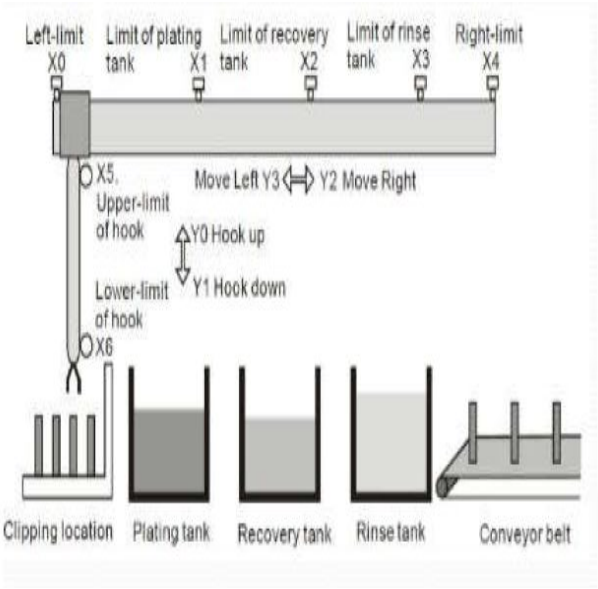
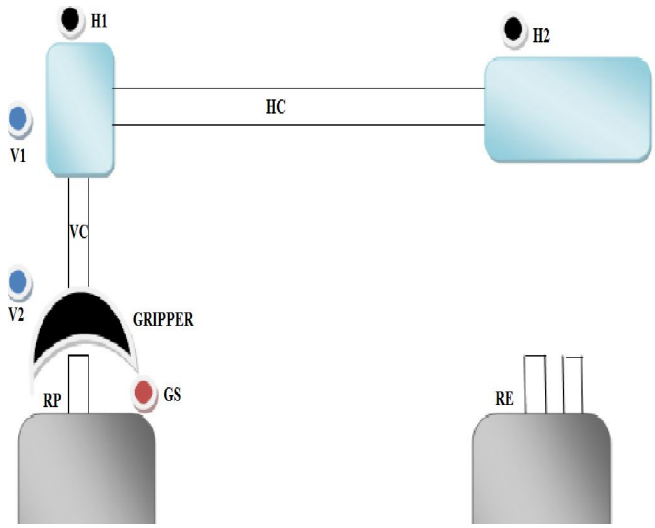



Fig.3: Proposed Block diagram of electroplating

## VI.IMPLEMENTED BLOCK DIAGRAM IN PLC [12][9]




**INPUT:** H1, H2, V1, V2, RP, RE
**OUTPUT:** HC, VC, GS

Fig.4: Implemented Block diagram of electroplating in PLC

## VII. HORIZONTAL CONVEYER [9]

Ton:- $H1*V1*\overline{GS}*RP$
Toff:-$GS*V1*H2$
$HC = (Ton+HC) * \overline{Toff}$
$HC = (H1*V1*\overline{GS}*RP+HC)*(\overline{H2*V1*GS})$

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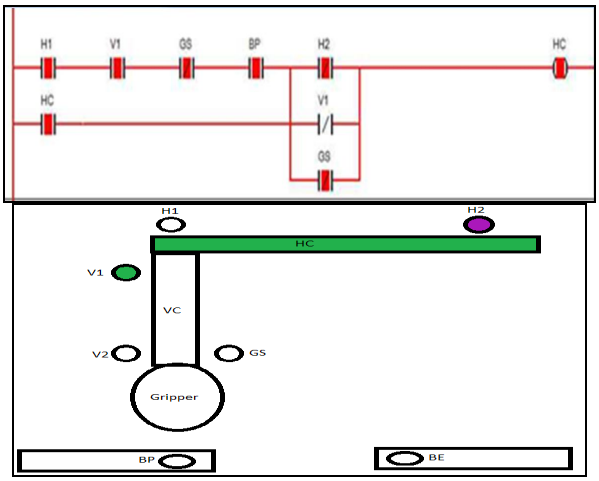


Fig.5: Program of Horizontal Conveyer Circuit

## VIII.VERTICAL CONVEYER CIRCUIT [5]

Ton:- H2*V1*$\overline{GS}$*RP+ H1*$\overline{V1}$*GS*RE

Toff:-GS*V2*H2+$\overline{H1}$*V2*$\overline{GS}$

VC = (Ton+VC) * Toff

VC = (H2*V1*GS*RP
+ H1*V1 *GS*RE+VC)*(GS*V2*H2+H1*V2*$\overline{GS}$)

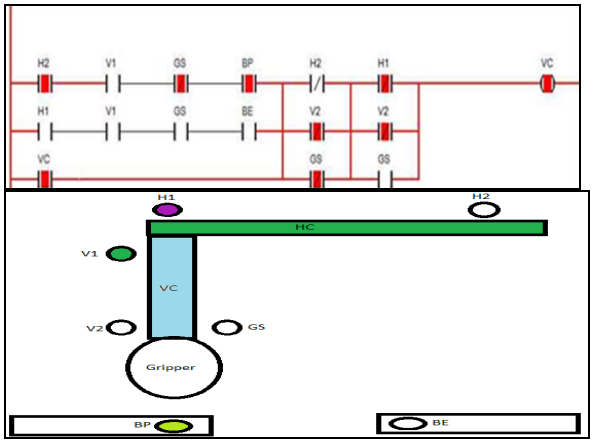


Fig .6: Program Of Vertical Conveyer Circuit

## IX .PROGRAM OF GRIPPER CIRCUIT

Ton:- H2*V2*RP

Toff:-V2*$\overline{H1}$

GRIPPER = (Ton+GRIPPER)*$\overline{Toff}$

GRIPPER = (H2*V2*RP+GRIPPER)*(H1*V2)

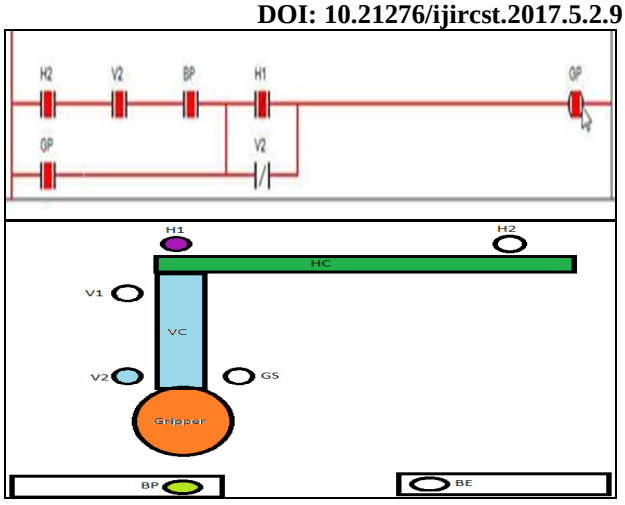


Fig.7 Program Of Gripper circuit

## V. CONCLUSION

This paper introduces the use of programmable controller to control a driving the working process of the electroplating method, simplified the connection of the control system. Implementation of electroplating production line system based on PLC control, the system has a strong ability to adapt, can be easily automated, manual control and switch between each other[12].

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