Electro-Mechanical Lighting Control

An Online Continuing Education Course for Engineers

Course Number: E-3083

Credit: 3 Hours / 3 PDH / 3 CPD

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Introduction

Electro-Mechanical lighting control is still very relevant. Multiple companies manufacture individual components or assemblies. There are superior applications and reasons for them.

Who might be interested in lighting control? Persons of many different backgrounds and roles bare responsibility for aspects of lighting and its control. Reputation, outcomes, and tasks may improve if they have an idea about “how lighting controls look” and “how lighting controls work.”

Information is somewhat detailed and deep, so everyone should learn "something." However, no one will be expected to learn "everything." The quiz surveys some significant main points.

What is unique about this presentation? This author prepared text, elementary diagrams, and a Lighting Control Panel schedule for this presentation. Drawings linework features various widths, styles, and colors to help students trace wiring. Information is presented in a manner similar to facility construction documents, showing components, "description of function," and related drawings.

Requisite: This course is designed for display at 8.5 x 11 inches, for legibility. Your device must display 8.5 x 11 for you to "follow" the linework and closely observe the equipment images.

Learning Objectives

This course teaches the following specific knowledge and skills regarding Electro-Mechanical lighting control.

- The essence of "Electro-Mechanical," advantages, and limitations.
- Devices: contactor, dimmer, selector switch, pushbutton, indicator lamp, time clock, and photocell
- The essence of the description of function, drawing legend, plan drawing, and elementary diagram, and how they relate
- How to "read" an elementary diagram circuit
- Control power sources: line voltage or control power transformer
- Control panel schedule elements and usage
- Some management principles for a successful project
- Some principles of commissioning a lighting control system

Part 1: What is “Electro-Mechanical”?

Definition of “Electro-Mechanical”

“Electro-Mechanical” means that the device or equipment converts energy from electrical-magnetic energy to mechanical energy, or converts from mechanical energy to electrical and magnetic energy, or some of both. These are some examples.

Electricity opens or closes mechanical contacts in a relay, contactor, or switch.

The mechanical contacts in a relay, contactor, or switch can stop or allow electric current.

A motor converts electricity to mechanical rotation.

An alternator or generator converts mechanical rotation to electricity.

A mechanical transformer converts one form of electricity to another.

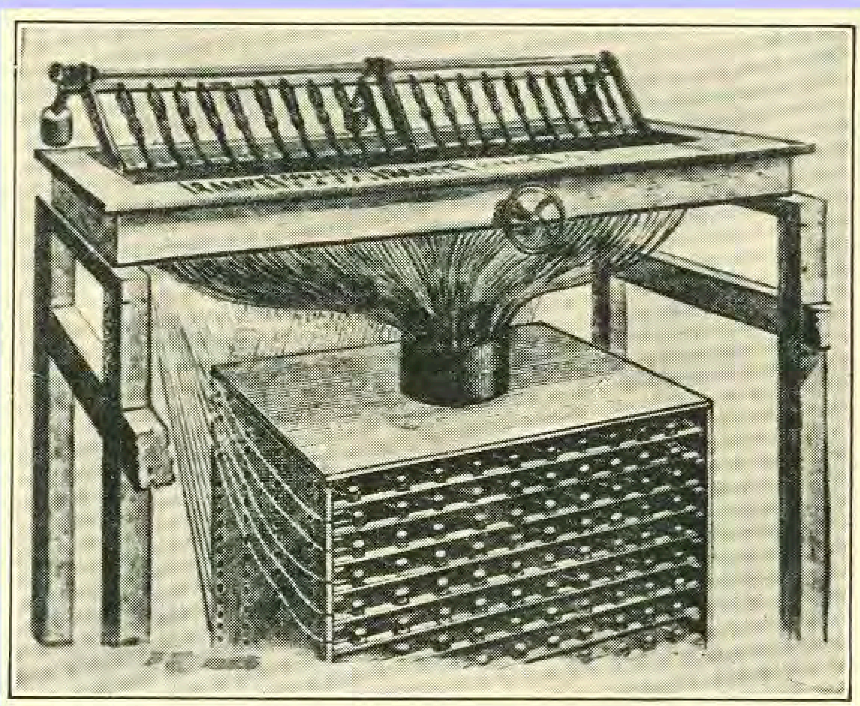
A mechanical teletype, typewriter, ticker tape, or calculator converts electricity into printed information.

A person operates a mechanical toggle or pushbutton to operate an electrical contact.

A photo-electric cell operates a contact to control electricity.

A time clock mechanically operates a contact to control electricity.

In a dimmer, a physical object must be moved to change the voltage or current.



Dimmer control equipment used at the Munich Electrotechnical Exposition.

Signal Transmission

Before the 1960s, before modern computers and data cabling, the control system technology was hardwired electro-mechanical. "Everyone" knew that technology. Now, most of us are familiar with electronics and data cables more than "hardwiring." Comparing three methods of signal transmission will help one comprehend hardwiring.

"Hardwiring" indicates the wiring connecting Electro-Mechanical devices. Each signal of intelligence requires one or two electrical wires. Each wire performs only one logic function. Hardwiring works fine for Electro-Mechanical systems of modest size. When hardwired Electro-Mechanical systems were the only control systems available, large systems could contain a multitude of wires.

"Data cables" or "cabled data": Most of us are now familiar with terms such as Category 5, Category 6, Local Area Network, and "cable," meaning coaxial cable for TV and internet. Each data cable serves as a " bus" for a large number of intelligence signals in digital format. Many devices, such as controllers and sensors, may connect to each data cable. Each device sends and receives digitally coded messages. Large systems can contain relatively few cables compared to the wires of a hardwired system. Data may include a digital address for each device, and control panels distinguish among devices by their addresses.

A "Radio Frequency" "RF" system is a type of wireless communication. Terms we might hear are "microwave," "dish," or "WiFi." RF is sometimes convenient, where access is a physical problem for cables. RF systems transmit digital signals of the same description shown for "data cables."

An Electro-Mechanical system works well in these situations.

Fit: An Electro-Mechanical lighting control system can be a good idea if the lighting control system fits these parameters.

Space: Physical size of equipment or panels fits the available space.

Intuitive and Legible: Simple knobs and buttons, large indicator lamps, and large explanatory labels are legible. Compare to modern black buttons on black background, or the complication of logic levels by pushing buttons.

Accessible: Security can consist of a locked room or a locked cover instead of digital security with unknown passwords taught to one person who is no longer available.

Long lifespan: In some facilities, systems don't get much attention until they break. Electro-Mechanical components can last for many more years than the three to ten-year expected lifespan of "electronics."

Few logic changes: In some facilities, the panel logic will seldom be changed because the facility is seldom changed. So rewiring the logic is less of an issue.

Local Labor and Parts: Electro-Mechanical replacement parts and wiring can be modestly priced, locally available, and easily changed by the maintenance people. If the exact replacement part is not available, a similar non-proprietary part can perform the function. This avoids expensive "specialists" from another city. Their boards and modules would be expensive, proprietary, and quickly obsolete.

Low carbon footprint: A side benefit from less change-out is less "technical trash," which means less carbon footprint (That's the buzzword now.)

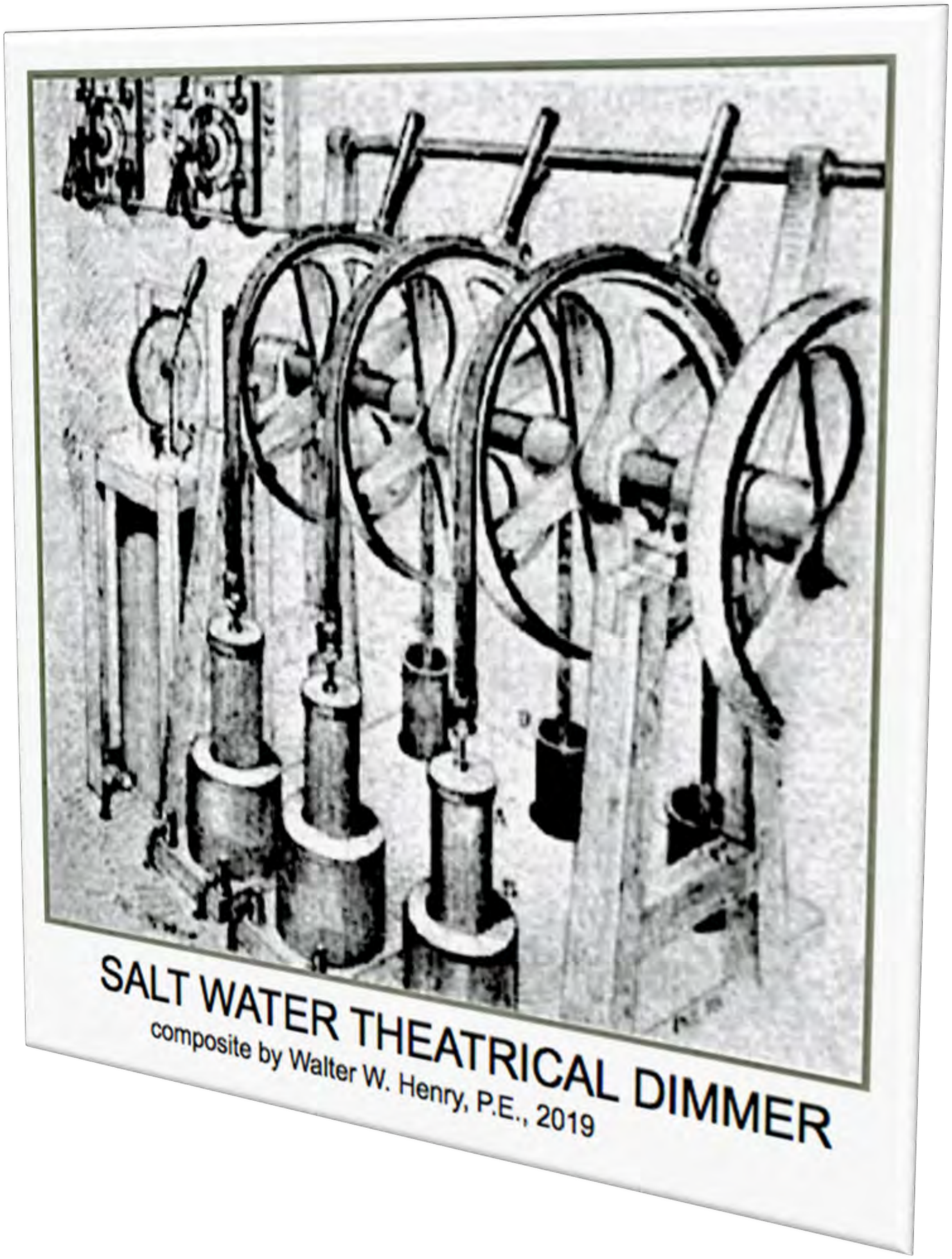
Durability against EMI: Electro-Magnetic Interference affects Electro-Mechanical devices less than EMI affects electronics. Some EMI causes are lightning, power company switching surges, motor starting, or static electricity.

Part 2: Electro-Mechanical Dimming

Salt Water Dimmer

Until compact solid state technology was commercialized in the 1960s, dimming equipment was so large that it was used mainly in theatres.

In 1890 Granville Woods developed one of the earliest recorded dimmers. Two conductors and saltwater were inside a glass beaker. One conductor was raised out of the water to adjust the dimming. Input electric power divided between the connected electric lamps and heating the water. The heat helped evaporate the water. These dimmers were messy and hard to maintain and operate.



Rheostat Dimmer

Rheostats were one of the earliest devices to dim lights. Rheostats are adjustable resistors. A coiled resistive wire is arranged in a circle. Or segments have resistors connected between them. A knob turns a "wiper" to select a resistance. Input electric energy divides between the electric lamps and the resistors. Some energy wastes as heat. The advantage was that there was no water to evaporate.