SECTION 6

AIR CONDITIONING (HEATING AND HUMIDIFICATION)

UNIT 30: ELECTRIC HEAT

DELMAR CENGAGE Learning

UNIT OBJECTIVES

After studying this unit, the reader should be able to

- Discuss the efficiency and relative operating costs of electric heat.
- List types of electric heaters and state their uses.
- Describe how sequencers operate in electric forced-air furnaces.
- Trace the circuitry in a diagram of an electric forced-air furnace.
- Perform basic tests in troubleshooting electrical problems in an electric forced-air furnace.
- Describe typical preventive maintenance procedures used in electric heating units and systems.

INTRODUCTION TO ELECTRIC HEAT

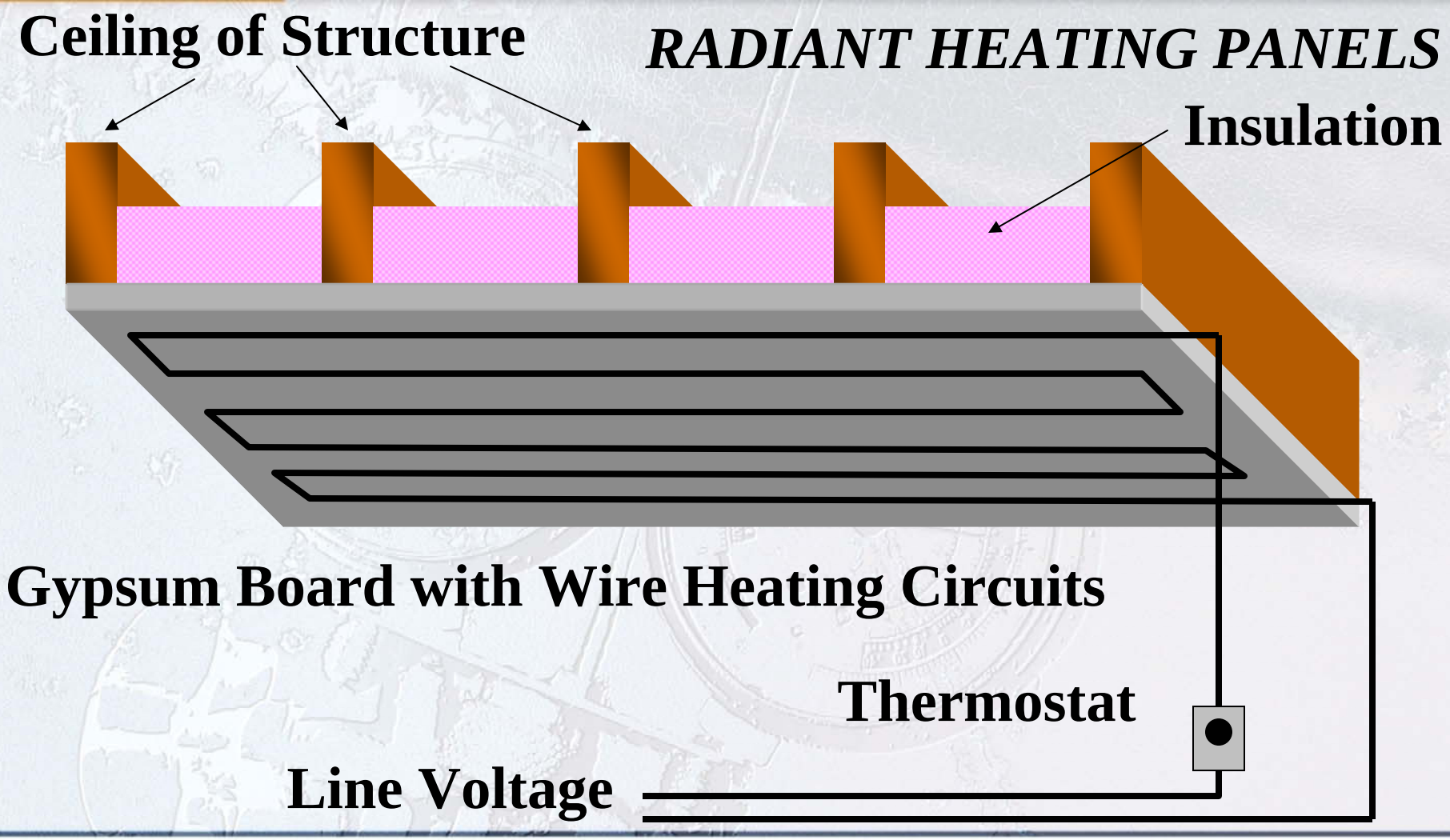
- Coils of Nickel Chromium (Nichrome) wire
  - Do not conduct electricity well
  - Resistance produces heat
- Efficient but expensive
- Very little loss of energy
- Building insulation reduces energy costs

PORTABLE ELECTRIC HEATING DEVICES

- Transfer heat by radiation
- Radiant heat dissipates quickly
- Heat concentration decreases by the square of the distance
- Forced convection heaters use fans or blowers

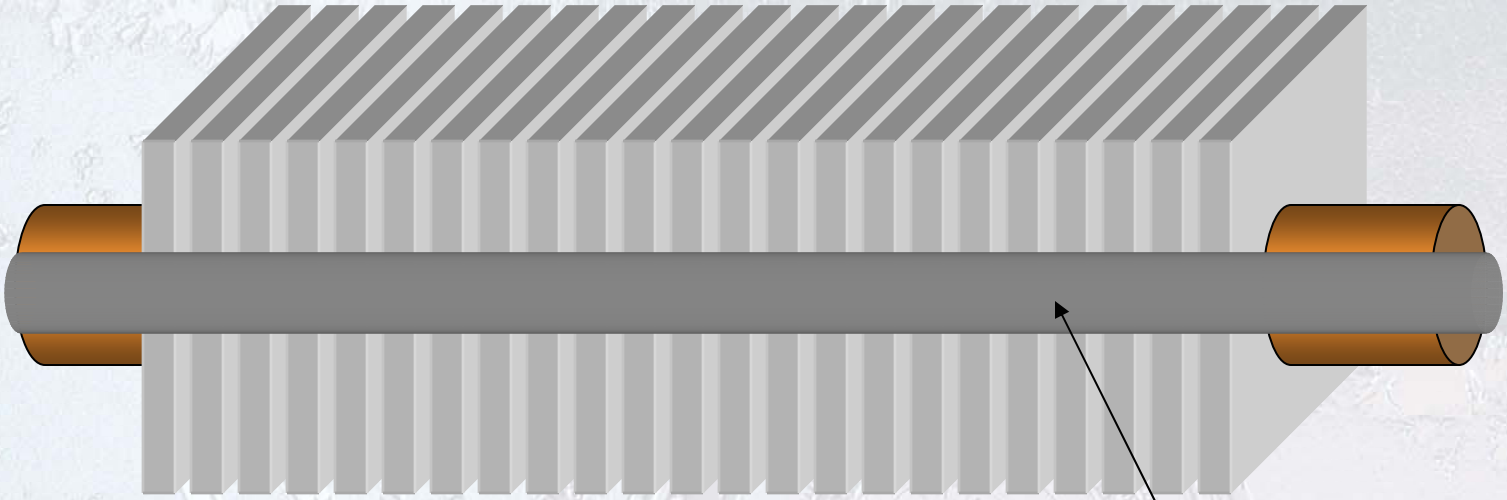
RADIANT HEATING PANELS

- Used in residential and light commercial applications
- Often made of gypsum board with heating circuits located throughout the board
- Controlled with line voltage thermostats
- Insulation must be installed behind the boards
- Produces a very even heat



ELECTRIC BASEBOARD

- Used for individual areas
- Uses a finned element to increase the heat transfer surface
- Thermostatically controlled
- Thermostats are line-voltage devices
- Located on exterior walls
- Natural draft devices



FINS TO INCREASE HEAT TRANSFER SURFACE

ELECTRIC HEATING ELEMENT

ELECTRIC HYDRONIC BOILERS

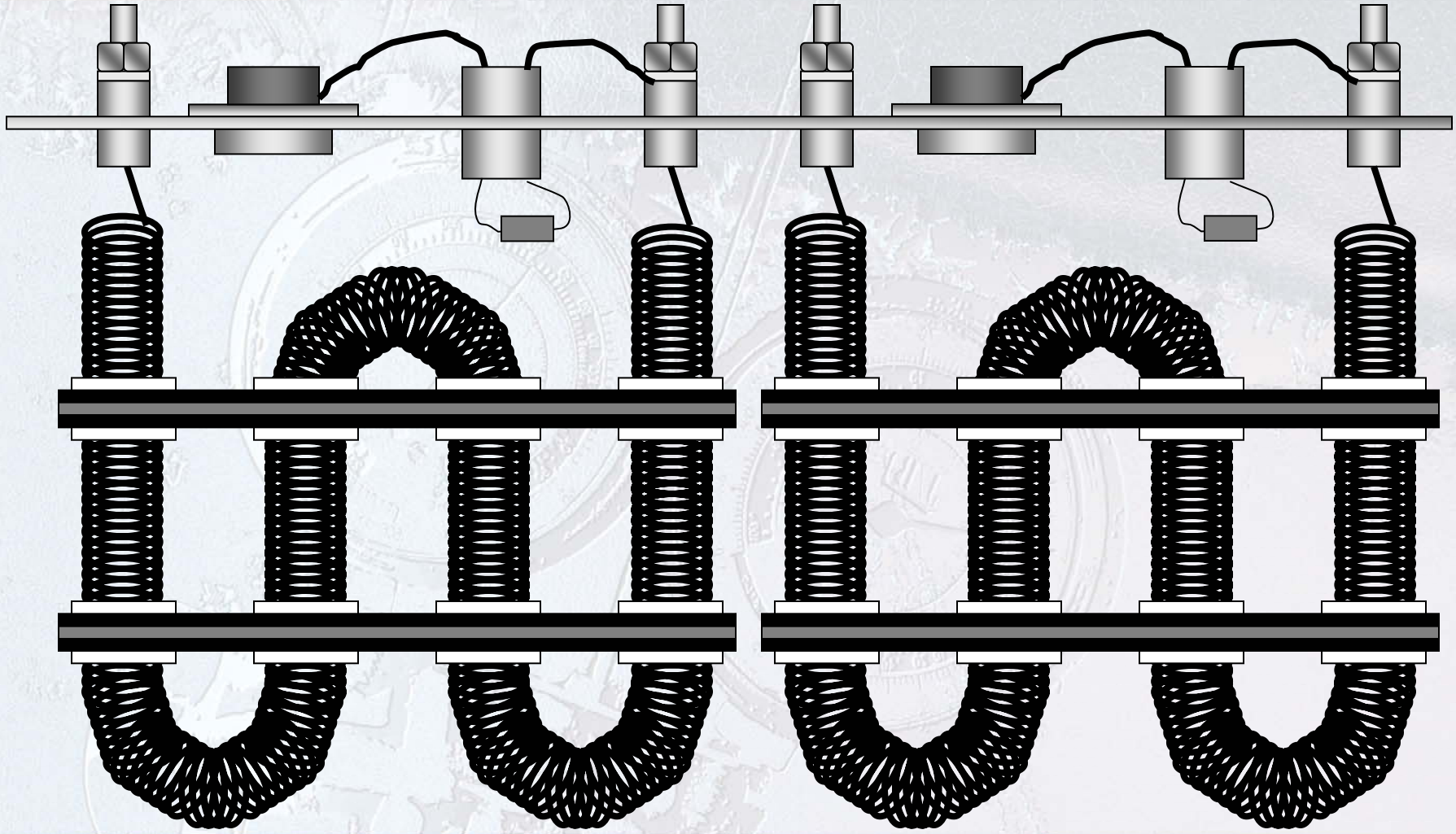
- Similar in operation to a domestic water heater, although use different controls and safety devices
- Uses a pump to circulate water
- Very efficient
- Easy to troubleshoot and repair

CENTRAL FORCED-AIR ELECTRIC FURNACES

- Duct system distributes heated air
- Thermostat controlled
- Individual duct heaters can be used
- Blower must operate in order for heaters to be energized
- Nichrome heating elements insulated with ceramic material

Refrigeration & Air Conditioning Technology

SIXTH EDITION



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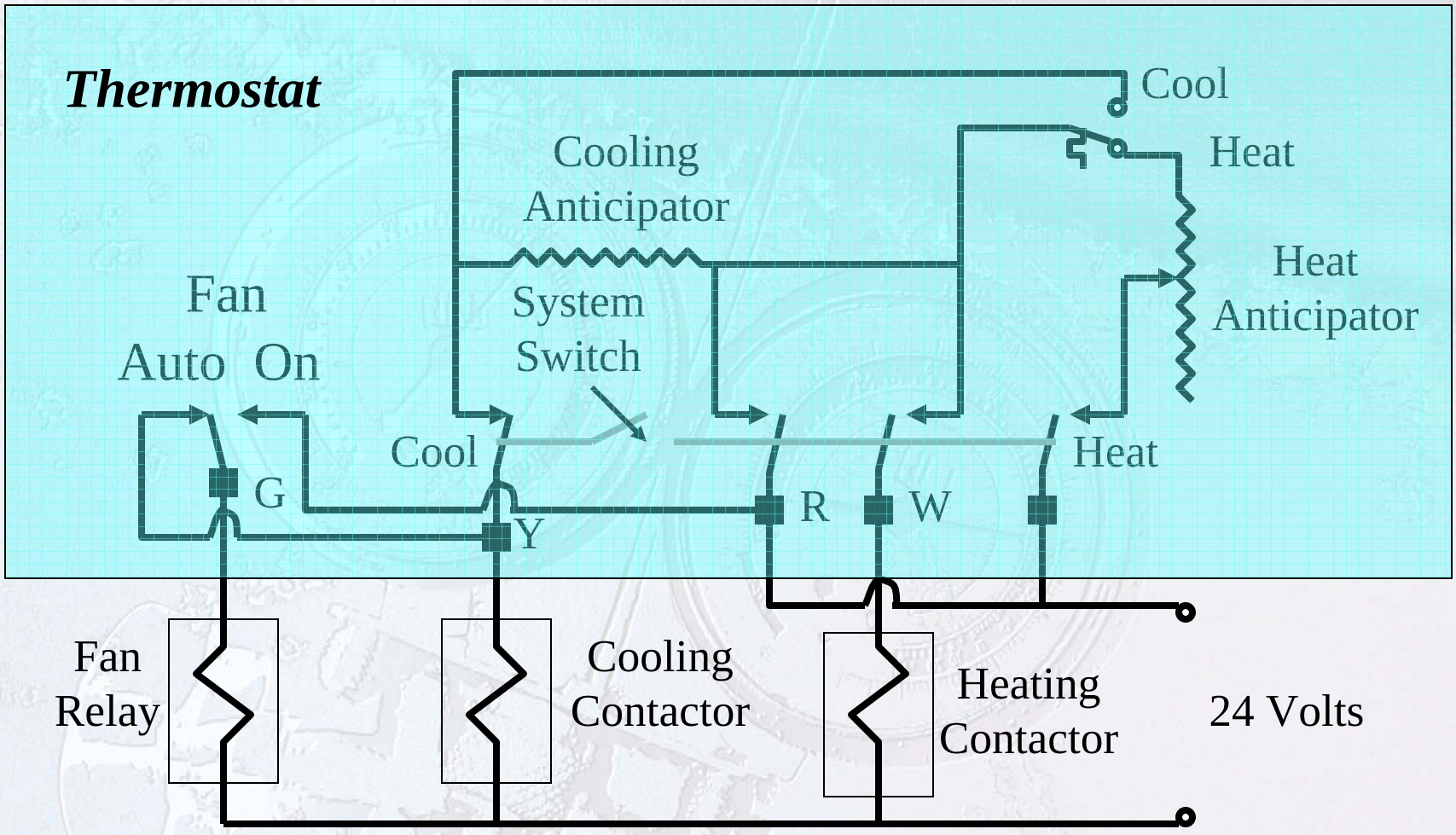
AUTOMATIC FORCED-AIR FURNACE CONTROLS

- Protect equipment and structure
- Maintain desired space temperature
- Thermostats, relays, sequencers, contactors, limit switches, fusible links

THE LOW VOLTAGE THERMOSTAT

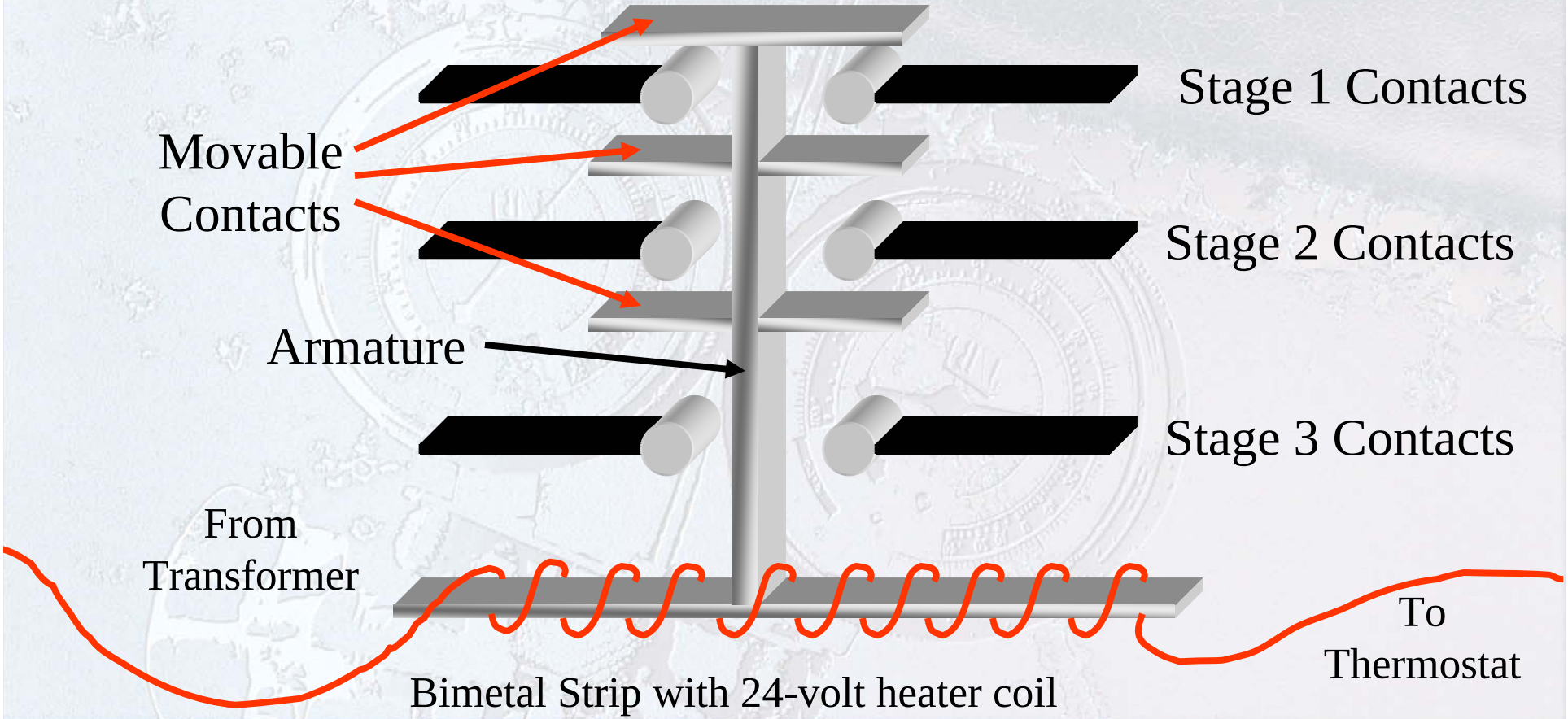
- Safe, compact, easy to install
- Can be used to control heating and cooling equipment
- Can be used with one or two power supplies
  - Standard or isolation subbase
  - Isolated subbases have Rc and Rh terminals
- Heat anticipator set upon installation



SEQUENCERS

- Used for controlling multiple heating stages
- Heaters are energized at different times
- Reduces load on power supply
- Utilize bimetal strips
- Can control heaters, blower and other sequencers

THREE-STAGE SEQUENCER



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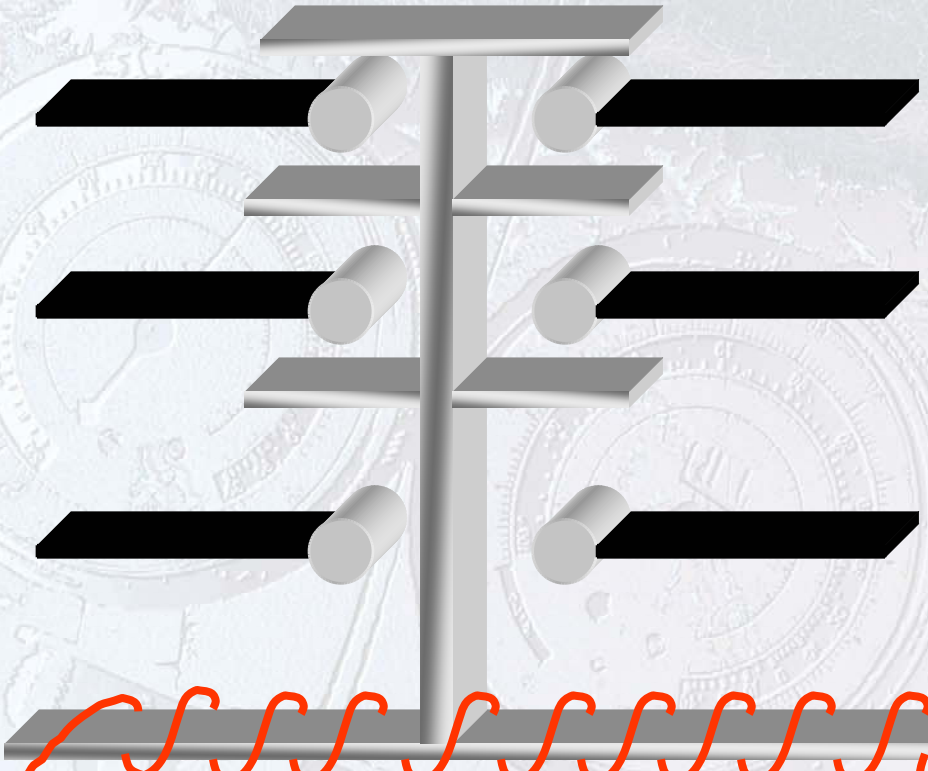
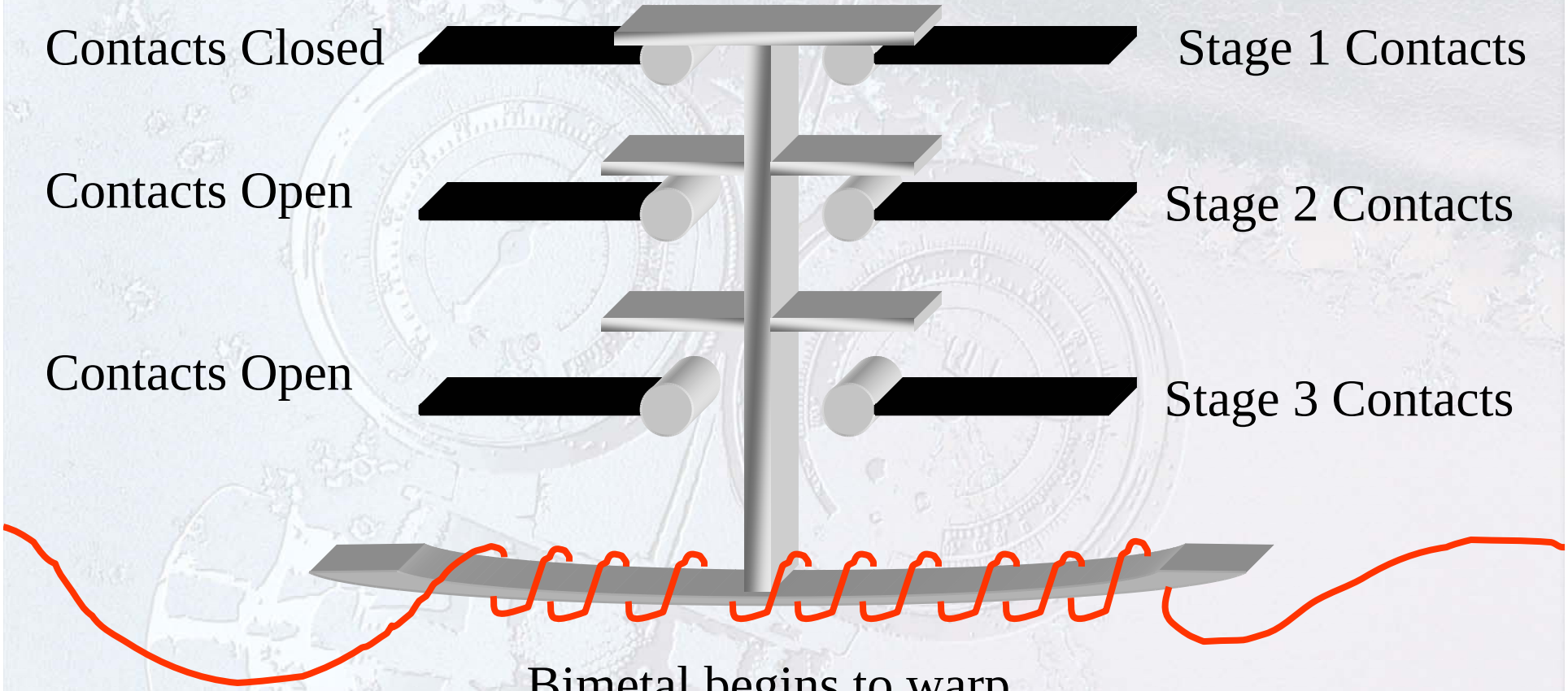


As current flows through the heater the bimetal strip heats up

THREE-STAGE SEQUENCER



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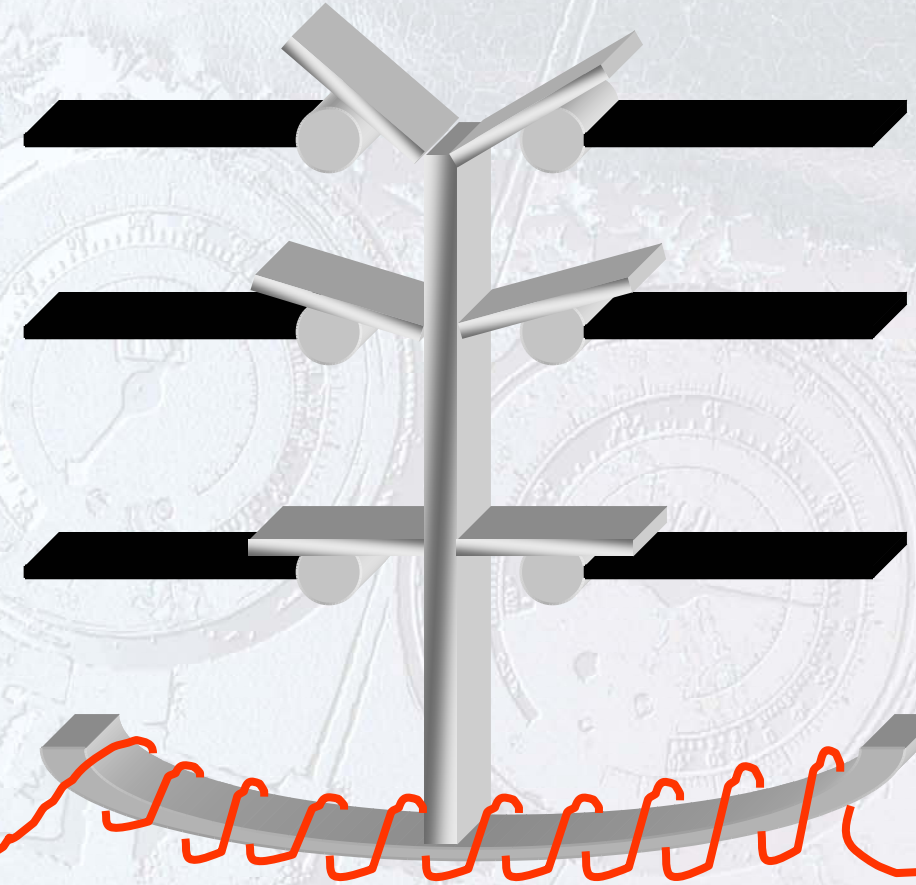

All contacts are closed when the strip has reached its maximum warp

CONTROL CIRCUITS FOR ELECTRIC FURNACES

- Low voltage circuit controls heating elements
- Safety devices include limit switches and fusible links
- Thermostat maintains desired space temperature
- Switches are power passing devices
- Loads are power-consuming devices
- Low voltage circuit energizes and de-energizes other circuits

CONTACTORS ON ELECTRIC FURNACES

- Usually energizes all heaters at once
- Snap action devices
- Time delay relays can be used
- Common contactor coil voltages are 24v, 115v and 230v

AIRFLOW IN ELECTRIC FURNACES

$Q_s = 1.08 \times \text{cfm} \times \text{TD}$

Q_s = Sensible heat in Btu/h

1.08 = A constant

cfm = Cubic feet per minute

TD = Temperature difference across furnace

The formula is restated and solved for cfm:

$$\text{cfm} = \frac{Q_s}{1.08 \times \text{TD}}$$

UNIT SUMMARY

- Electric heaters use Nichrome wire
- Electric heat is very efficient but often expensive
- Can be portable heating units, radiant heating panels, baseboard or part of an electric furnace
- Electric hydronic boilers operate in a manner similar to electric water heaters
- Electric furnace controls include thermostats, relays, contactors, sequencers, limit switches and fusible links