SECTION 6
AIR CONDITIONING (HEATING AND HUMIDIFICATION)
UNIT 30: ELECTRIC HEAT
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
Ceiling of Structure

RADIANT HEATING PANELS

Insulation

Gypsum Board with Wire Heating Circuits

Thermostat

Line Voltage
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
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
Thermostat

Fan Relay
Fan Auto On
Cooling Anticipator
System Switch
Cool Heat Anticipator
Cool Heat System Switch
Cool Heat Contactor
Heat Contactor
24 Volts

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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

Movable Contacts

Armature

From Transformer

Bimetal Strip with 24-volt heater coil

To Thermostat

Stage 1 Contacts

Stage 2 Contacts

Stage 3 Contacts
THREE-STAGE SEQUENCER

Stage 1 Contacts

Stage 2 Contacts

Stage 3 Contacts

As current flows through the heater the bimetal strip heats up
THREE-STAGE SEQUENCER

Contacts Closed  Stage 1 Contacts

Contacts Open  Stage 2 Contacts

Contacts Open  Stage 3 Contacts

Bimetal begins to warp
THREE-STAGE SEQUENCER

Contacts Closed
Stage 1 Contacts

Contacts Closed
Stage 2 Contacts

Contacts Closed
Stage 3 Contacts

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