SECTION 3

BASIC AUTOMATIC CONTROLS

UNIT 13

INTRODUCTION TO AUTOMATIC CONTROLS

UNIT OBJECTIVES

After studying this unit, the reader should be able to

- Define bimetal.
- Make general comparisons between different bimetal applications.
- Describe the rod and tube.
- Describe fluid-filled controls.
- Describe partial liquid, partial vapor-filled controls.

UNIT OBJECTIVES

After studying this unit, the reader should be able to

- Distinguish between the bellows, diaphragm, and bourdon tube.
- Discuss the thermocouple.
- Explain the thermistor

TYPES OF AUTOMATIC CONTROLS

- Electrical – normally control electrical devices
- Mechanical – Typically operated by pressure or temperature and often used to control fluid flow
- Electromechanical – Controlled by pressure or temperature to provide electrical functions OR controlled by electricity to control fluid flow
- Electronic – use electronic circuitry to perform same functions as electrical and electromechanical controls

THERMAL CHANGE CONTROLS

- Thermostats – Intended to maintain the desired temperature in an occupied space or refrigeration system
- Safety devices – Protect equipment and people from damage and injury by disabling a system if unsafe temperature conditions exist

THE BIMETAL DEVICE

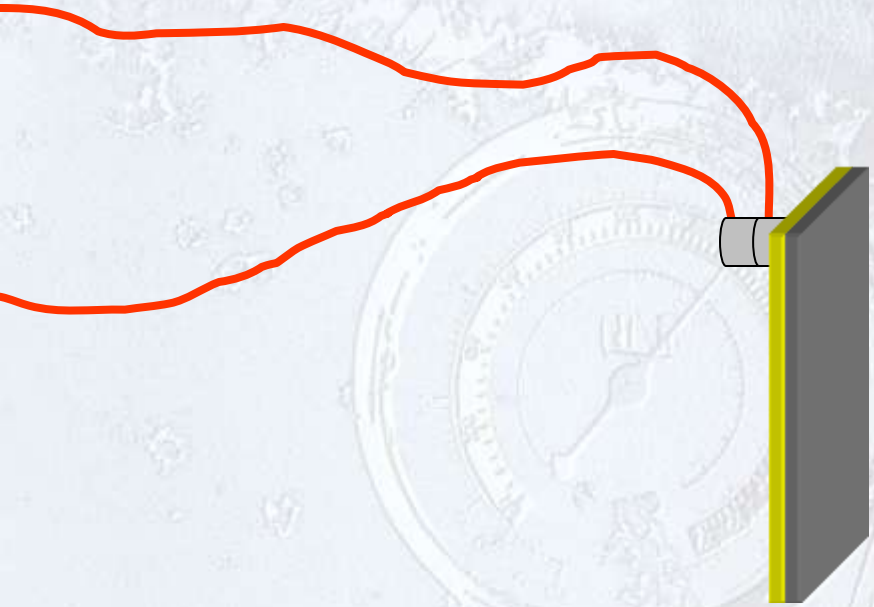
- Most common device used to detect thermal change
- Consists of two dissimilar metal strips (brass/steel)
- Strips have different rates of expansion/contraction
- When heated, the device warps out of shape to start, stop or modulate electric or fluid flow
- Rod and tube – type of bimetal control
- Snap disc – Quick open, quick close device

MOVEABLE END

BRASS STEEL

STATIONARY END

When heated, the bimetal warps to open or close electrical contacts

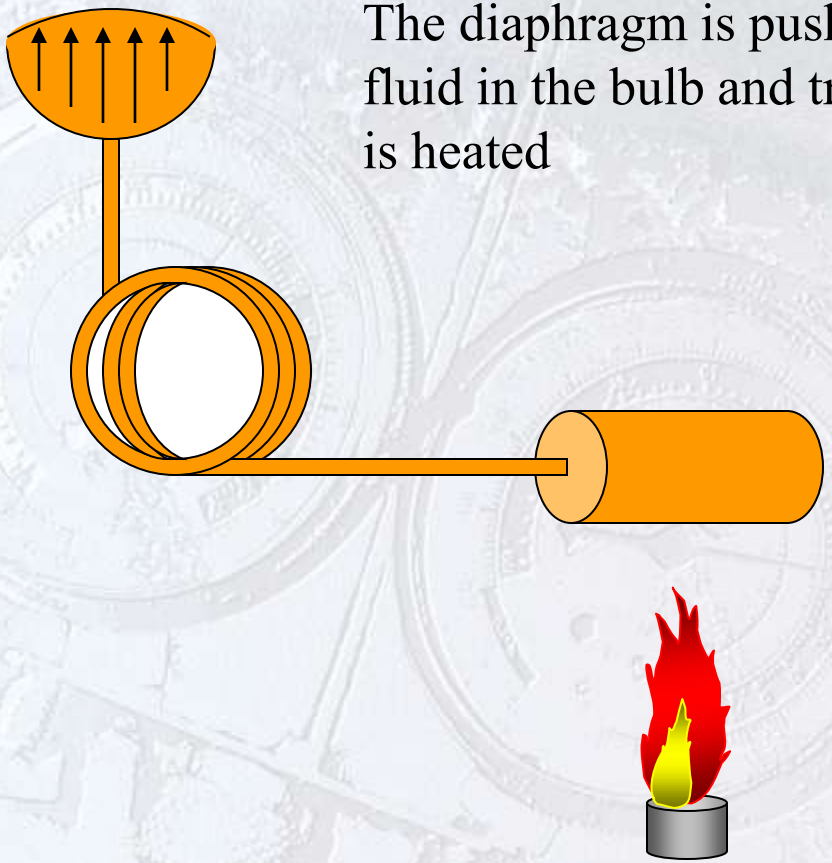


These contacts are in the closed position and electric current can pass through the contacts on the bimetal switch

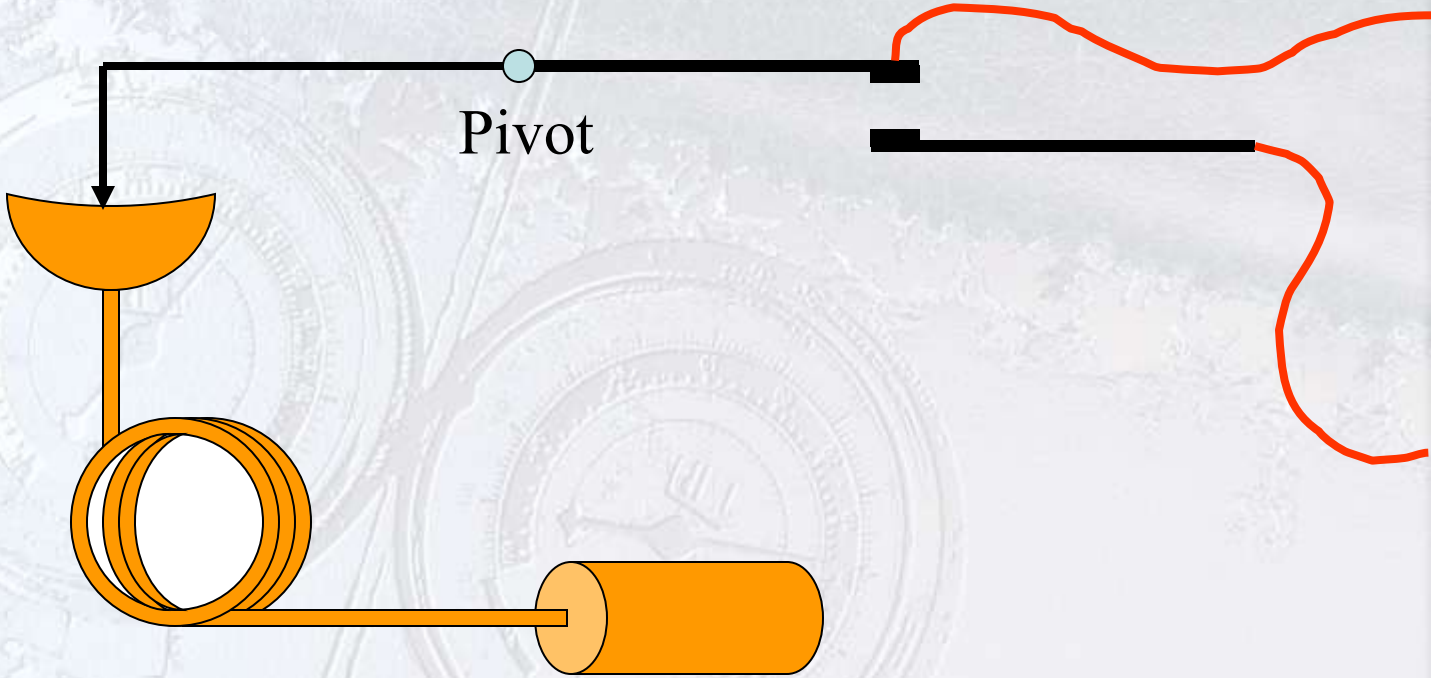
When the contacts open, the flow of electric current through the bimetal device is stopped

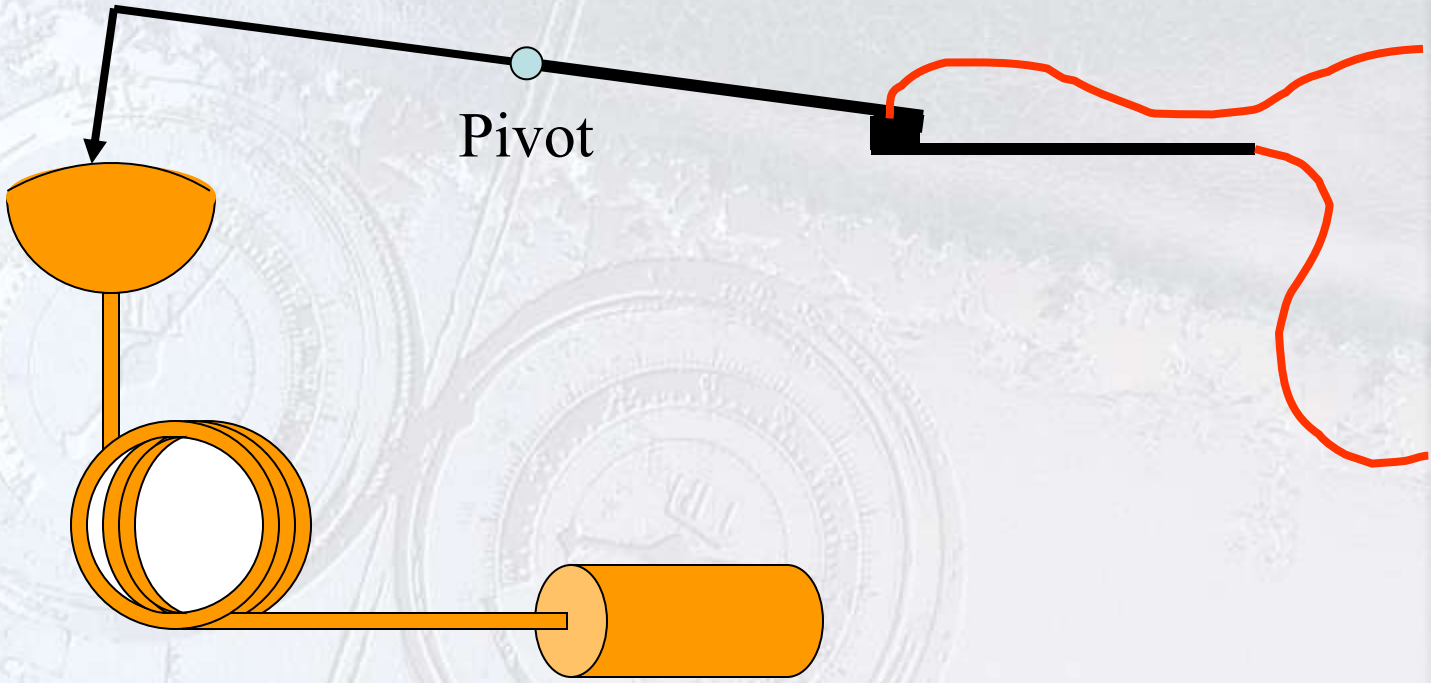
CONTROL BY FLUID EXPANSION

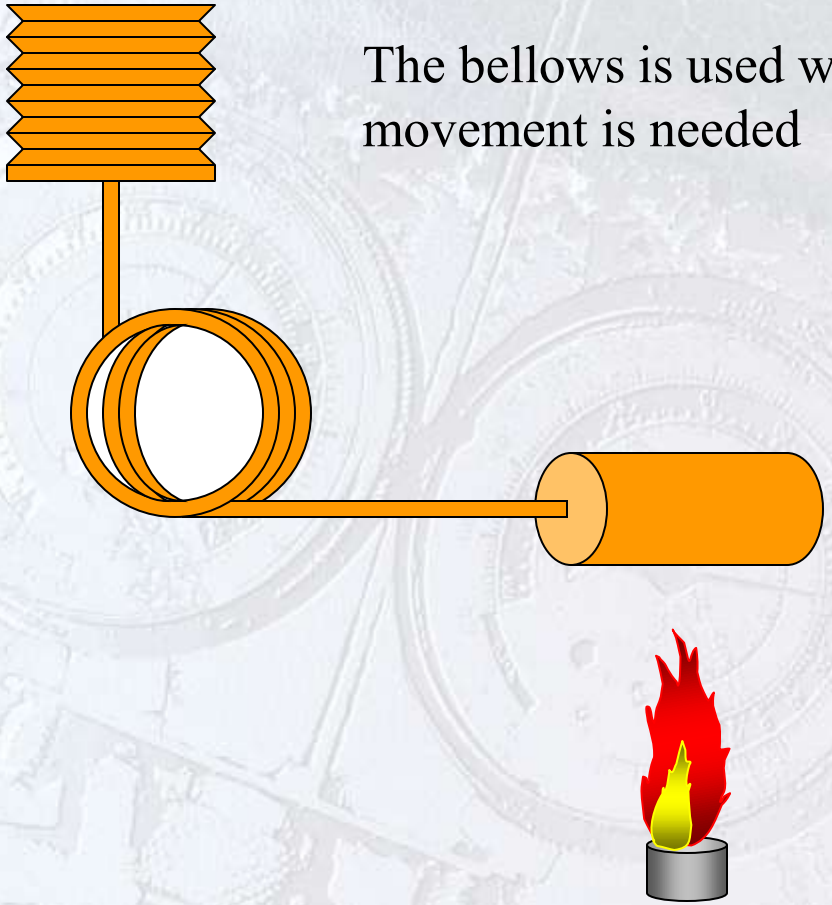
- Fluid inside a closed container expands and contracts in response to temperature changes
- Expansion/contraction converted to usable motion
- A thin, flexible diaphragm facilitates movement
- Bulb filled with volatile fluid is connected to the diaphragm by means of a transmission tube
- Partially filled bulbs provide accurate control
- Bellows are used when more movement is needed



The diaphragm is pushed up as the fluid in the bulb and transmission line is heated



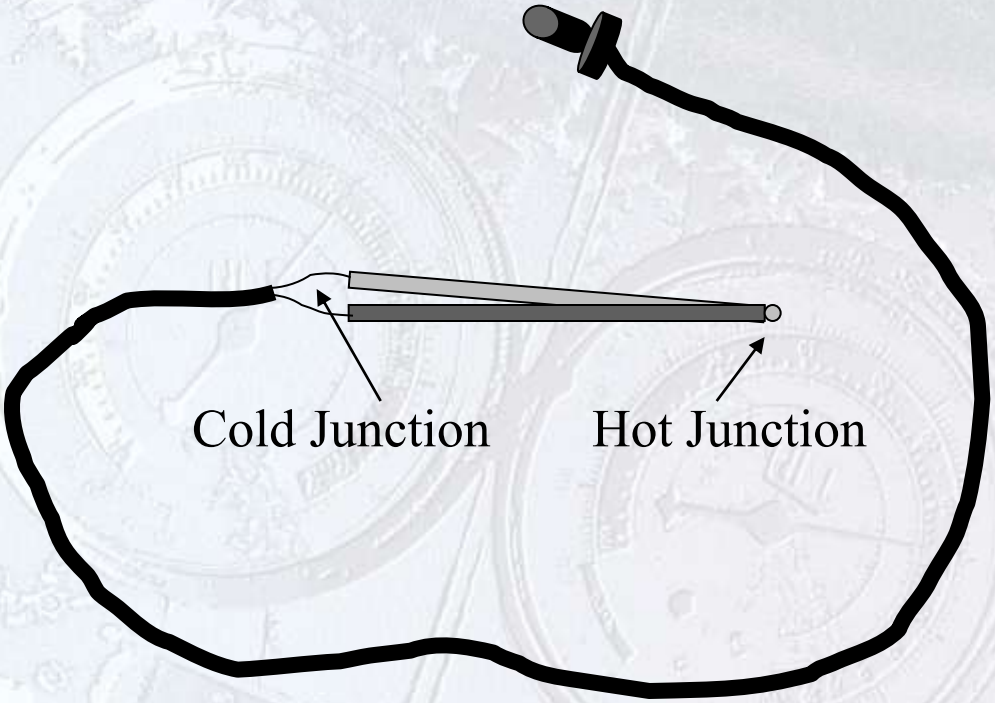


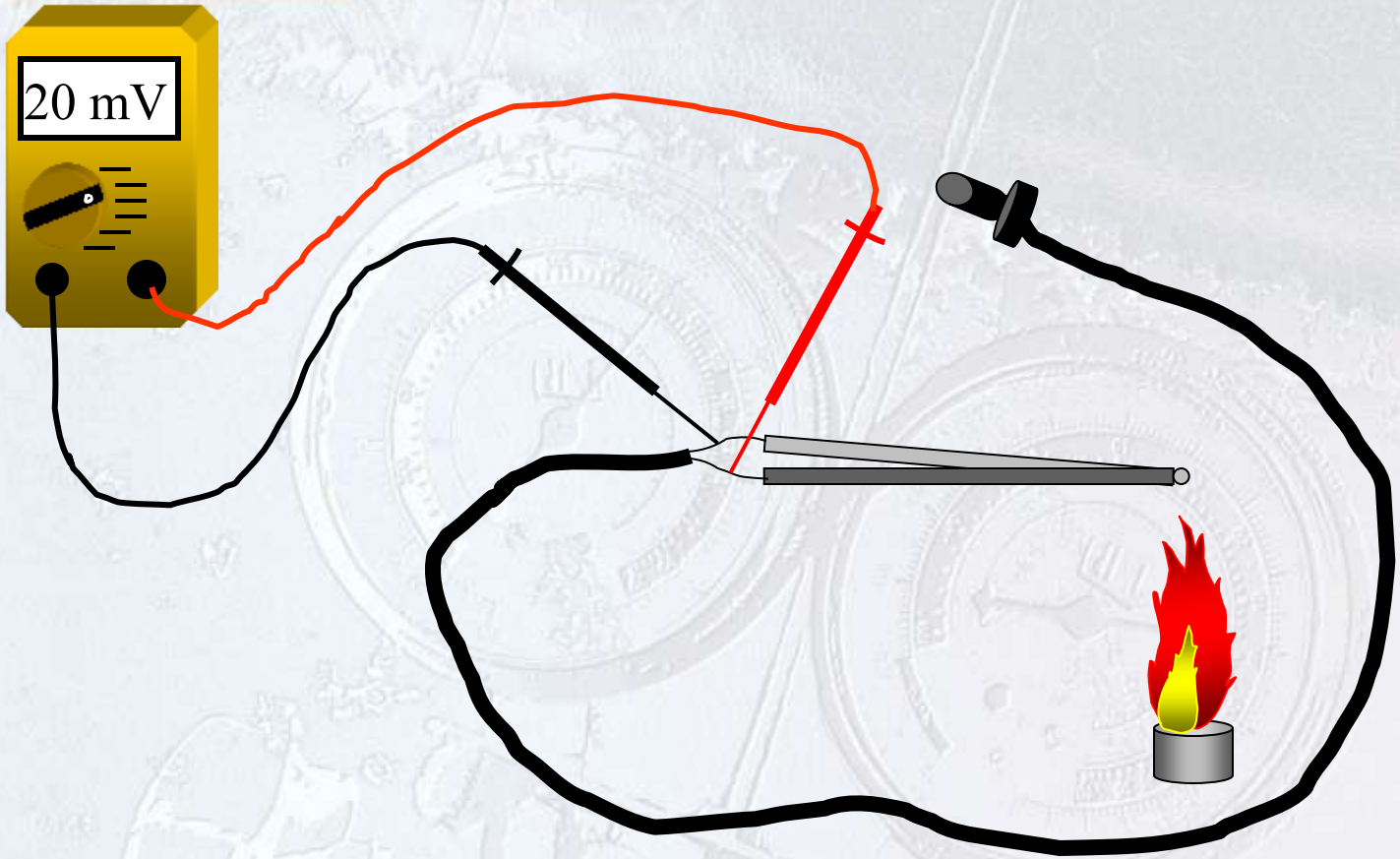


The bellows is used when more movement is needed

THE THERMOCOUPLE

- Consists of two dissimilar metals joined end to end
- Thermocouple has a hot and a cold junction
- Heat applied to the hot junction causes current flow
- Generates about 20 millivolts when heated
- Used in gas appliances to detect pilot light flame
- The millivolt signal permits main gas valve to open
- Thermopiles are comprised of multiple thermocouples
- Thermopiles generate 500 to 800 millivolts





When heated, voltage is generated across the cold junction

ELECTRONIC TEMPERATURE SENSING DEVICES

- Thermistors are electronic, solid-state devices
- The resistance changes in response to temperature
- Used in electronic circuits to modulate responses
- Can be used to provide temperature readings
- The positive temperature coefficient (PTC) increases the resistance as the temperature increases
- The negative temperature coefficient (NTC) decreases resistance as the temperature increases

UNIT SUMMARY

- Automatic controls can be electric, mechanical, electromechanical or electronic
- Thermostats/safety devices respond to temperature changes
- Bimetal strips warp with changes in temperature
- Fluid expansion controls convert increases or decreases in pressure into usable motion
- Heating a thermocouple generates a millivolt signal
- The PTC and NTC change resistance with temperature changes