

# RV Systems (Propane)

Presented

At The

**WBCCI International Rally**

**Du Quoin, ILL**

By

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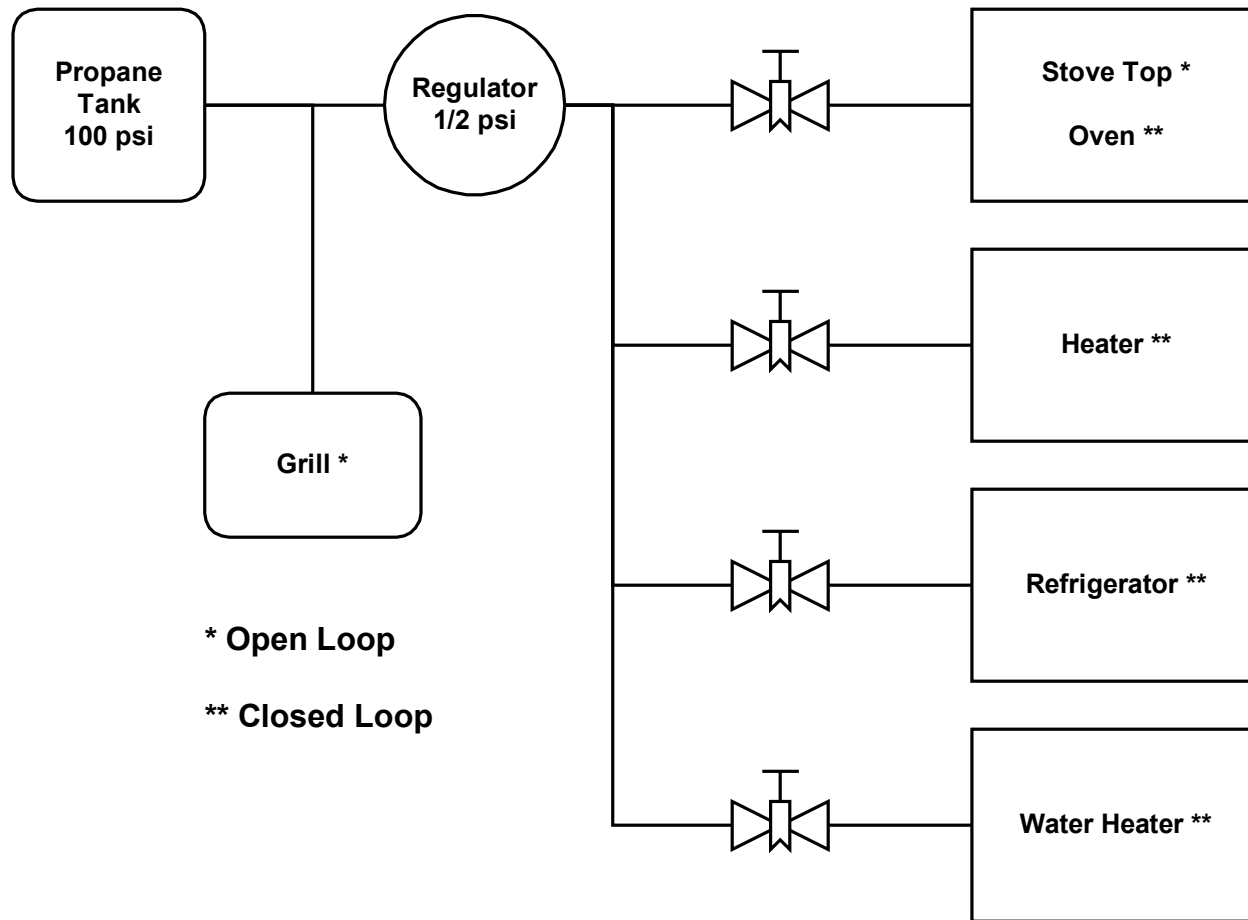
# Gas System Characteristics

	Propane	Water	Electric
Source	Dealer	Tap	AC Receptacle
Storage	Tank (100 psi)	Tank	Battery (+ 12 VDC)
Distribution	Cu Pipe (½ psi)	Cu or Pex Pipe (50 psi)	Cu or Al Wire
Use	Heat	Drink, Wash, Flush	Heat, Light, Rotation
Waste	Heat & Exhaust	Gray & Black water	Heat

# Propane Safety

- Avoid Fire/Explosion & Carbon Monoxide
  - Propane heavier than air – mount detector low
  - No combustibles (critter nests) around flame
  - Mount carbon monoxide detector low
  - Assure working exhaust & air flow

# Propane System Diagram



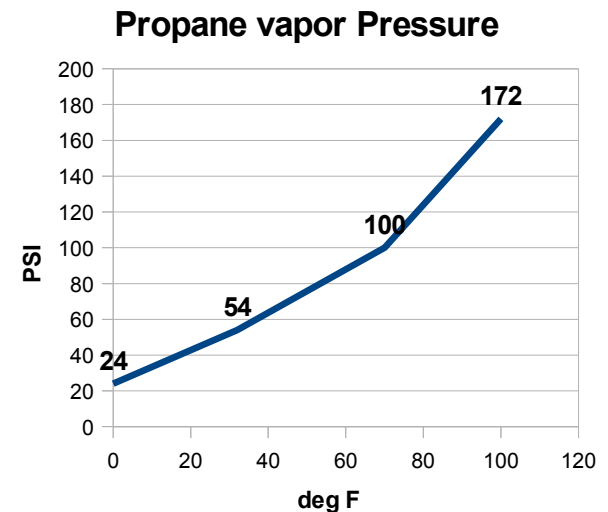
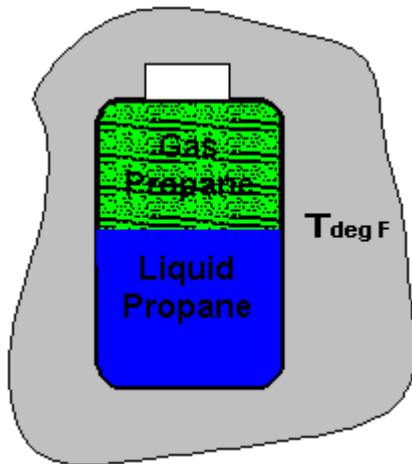


# Inside The Tank - 1

- The Fuel
  - 74% energy of gasoline (*Diesel 110% of Gasoline*)
  - 90,000 BTU/Gal (*Water Heater – 10,000 BTU/Hr*)
  - Boils at -44 deg F (*Water boils at 212 deg F*)
  - Flammable at 2.2% to 9.6% air ratio.
    - 4% optimal
    - <2.5% lean, flame lifts from burner
    - >8% rich, yellow flame

# Inside The Tank - 2

- Vaporization
  - Expands 270X when liquid becomes gas. This intuitively increases Pressure.
  - Pressure increases until boiling stops, which is the “Vapor Pressure”.



# Inside The Tank - 3

- Perfect Gas Law

- $PV=cT$  (Pressure x Volume = constant x Temperature)
- Why does my tank frost?
- Why does my tire pressure increase?
- Why did my beer freeze?

# Tank To Regulator

- Features of Hose with Green Knob
  - Internal bushing melts at 400 deg F (**fire**), and causes OPD (Overfill Prevention Device) valve to stop flow.
- Internal ball valve limits flow if no back pressure (**leak**).

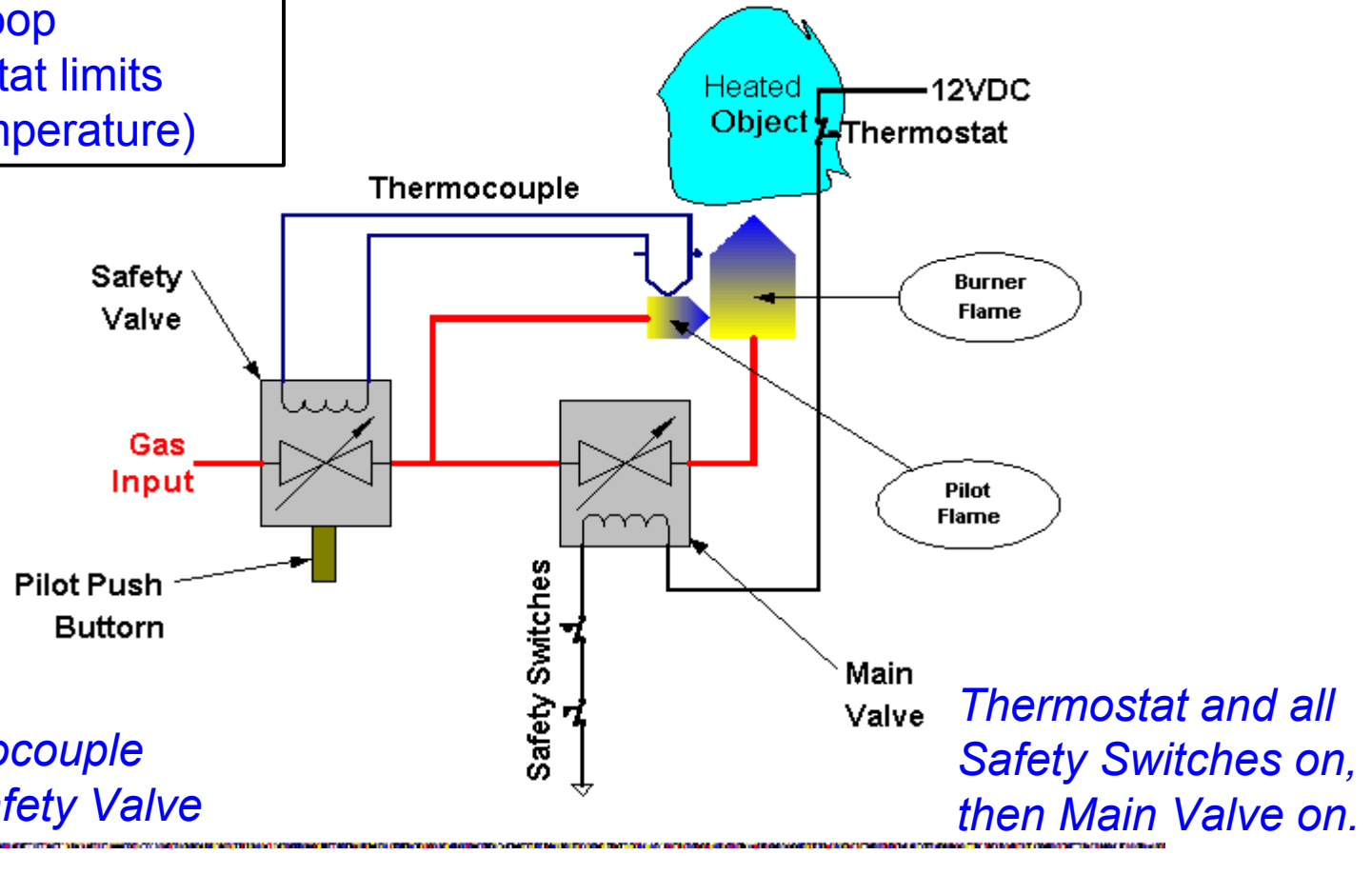


# Propane Regulator

- Two stage automatic change over
  - 1<sup>st</sup> stage output is 10 psi
  - 2<sup>nd</sup> stage output is 11 water column inches
  - Change over will draw vapor from second tank when first is empty
  - Lever point to empty tank, Red Flag
  - Lever point to non-empty tank, Green Flag

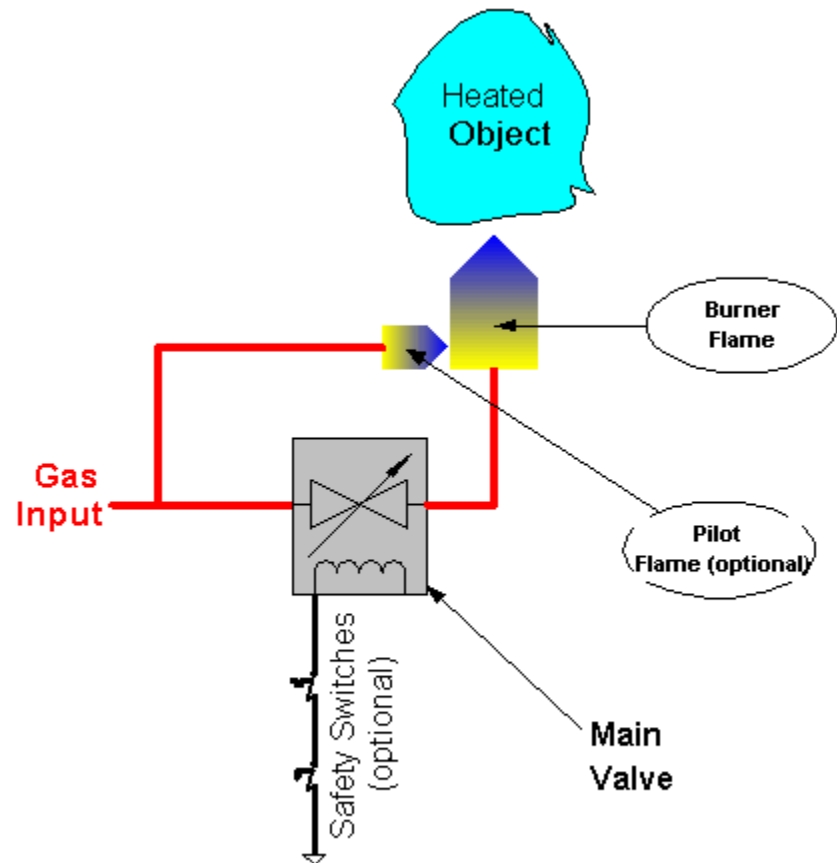
# Gas Controller Diagram -1

Closed Loop  
(Thermostat limits  
object temperature)



# Gas Controller Diagram -2

Open Loop  
(It's on, or it's off)

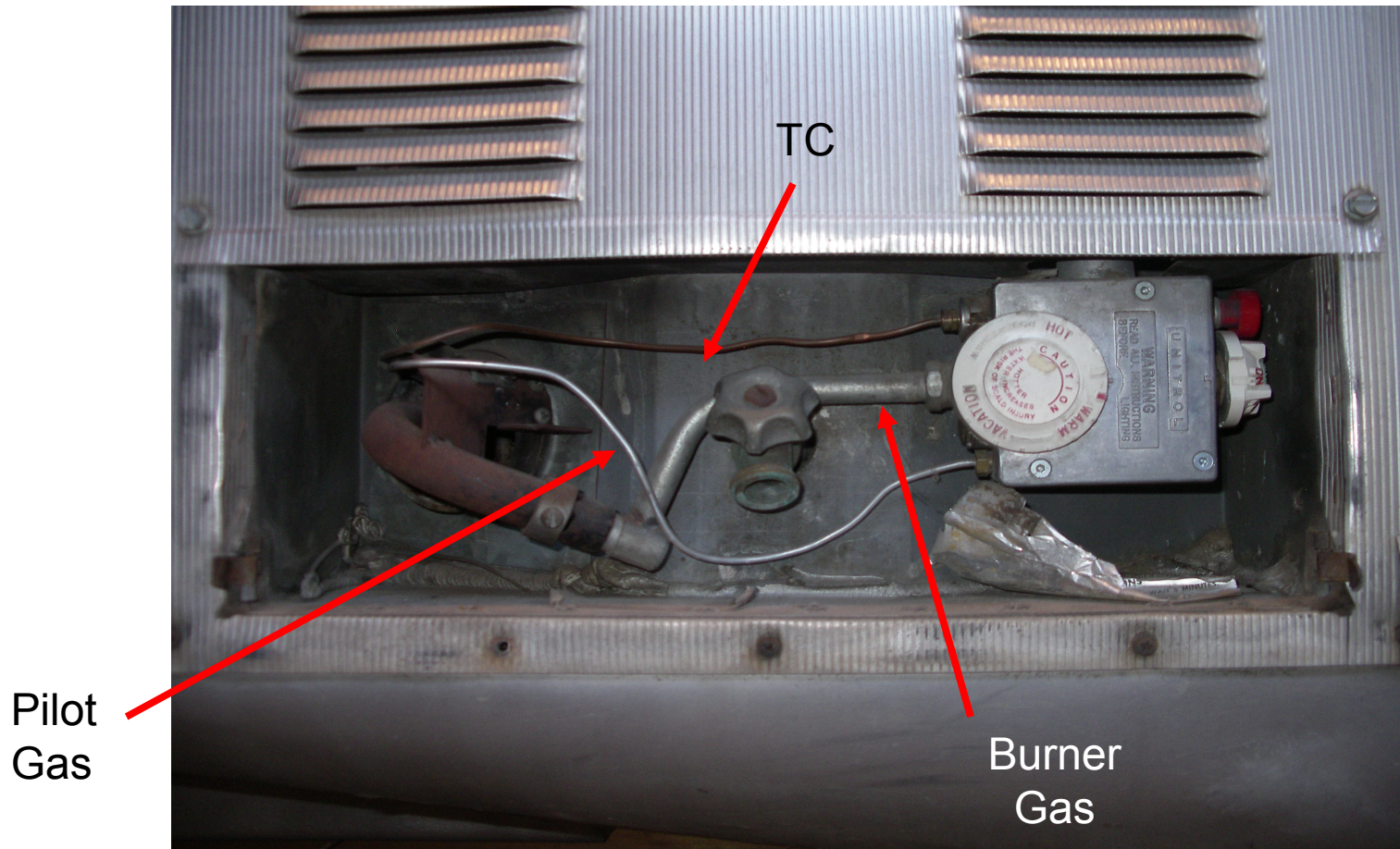


# Water Heater

- Closed Loop System
- Heat Flows From Hot To Cold (2<sup>nd</sup> Law)
- Conduction (heat source contacts object)



# Water Heater - Picture



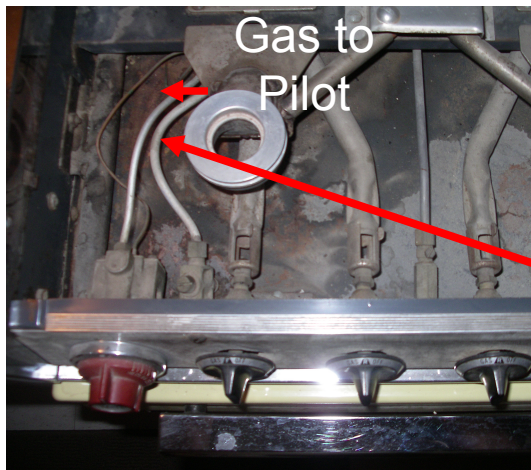
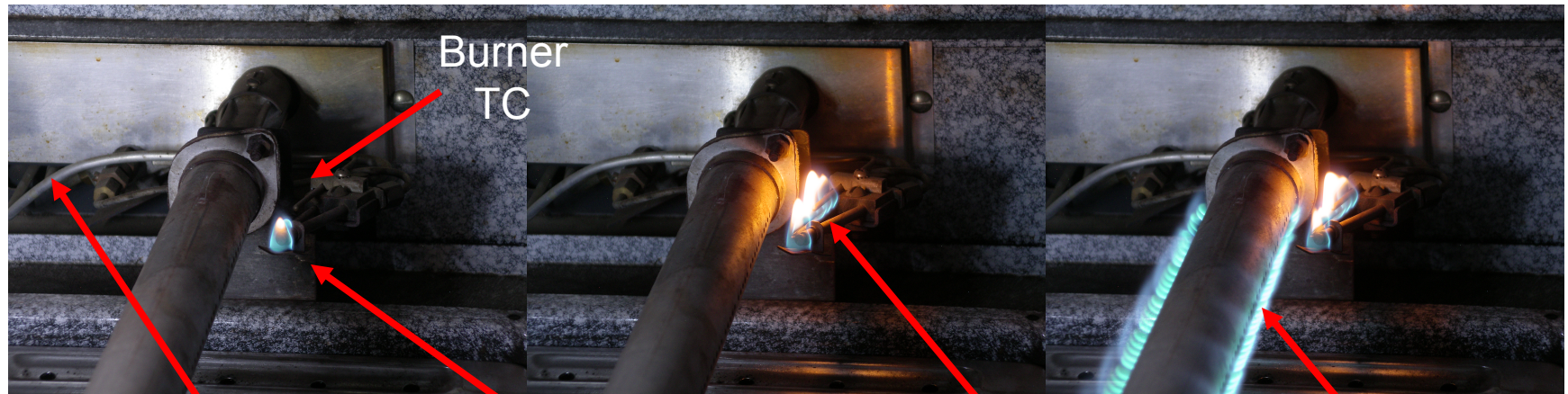
# Cook Top

- Open Loop
- Heat Flows From Hot To Cold (2<sup>nd</sup> Law)
- Conduction (Heat Source Contacts Object)

# Oven

- Closed Loop
- Heat Flows From Hot To Cold (2<sup>nd</sup> Law)
- Convection (Heating Air)
- Note: Always on pilot, without thermocouple, ignites larger pilot, which lights burner.

# Oven Burner - Picture



Burner  
TC

Pilot  
(no TC)

Burner Pilot  
(TC in flame)

Burner  
On

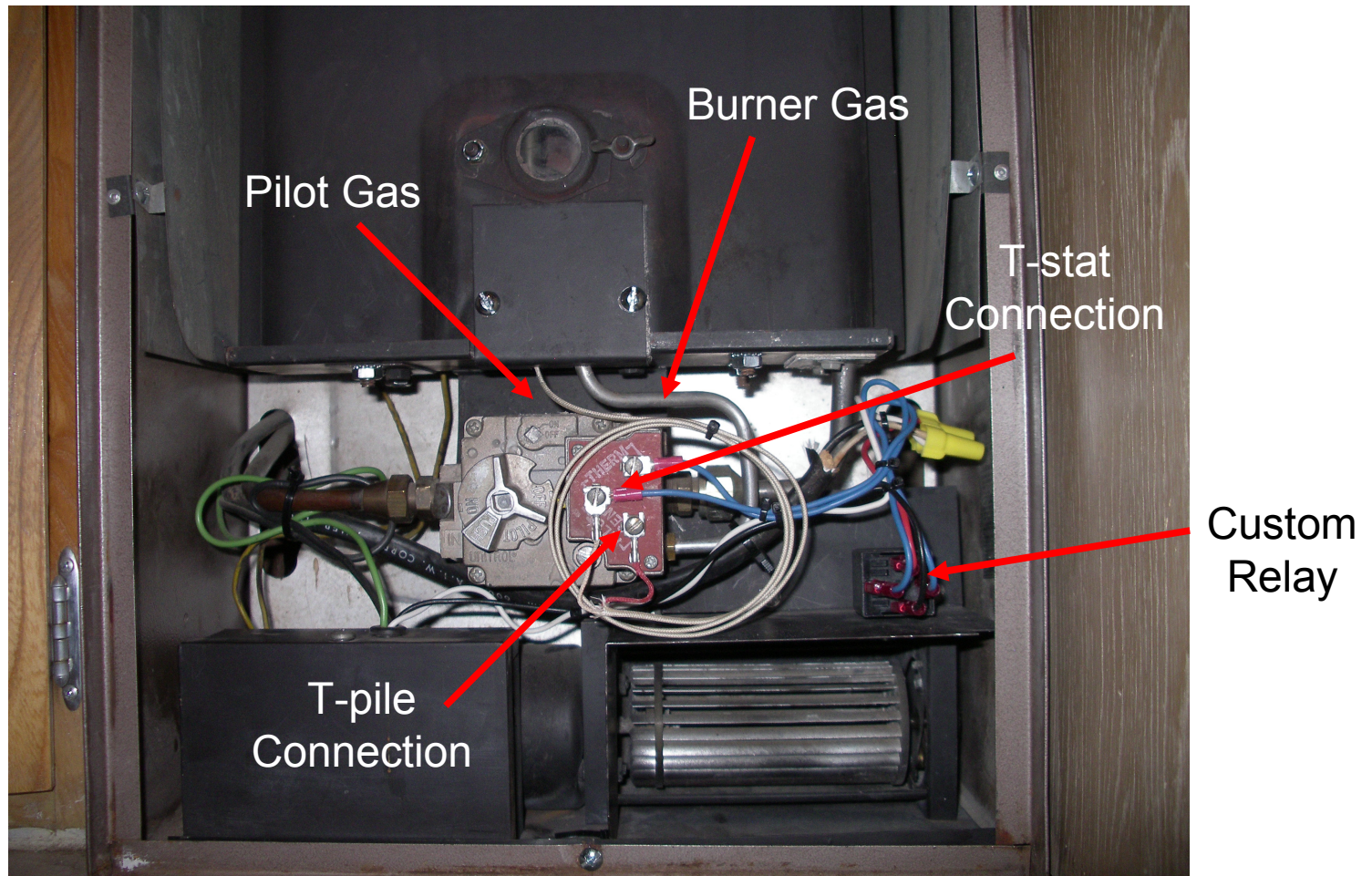
Pilot Shutoff



# Heater

- Open or Closed Loop
- Heat Flows From Hot To Cold (2<sup>nd</sup> Law)
- Convection or Radiation, Not Conduction
  - Convection heats air as it flows over hot surface.
  - Radiation emits energy waves that heat objects.
- Note: Thermocouple may be Thermopile

# Heater - Picture



# Refrigerator

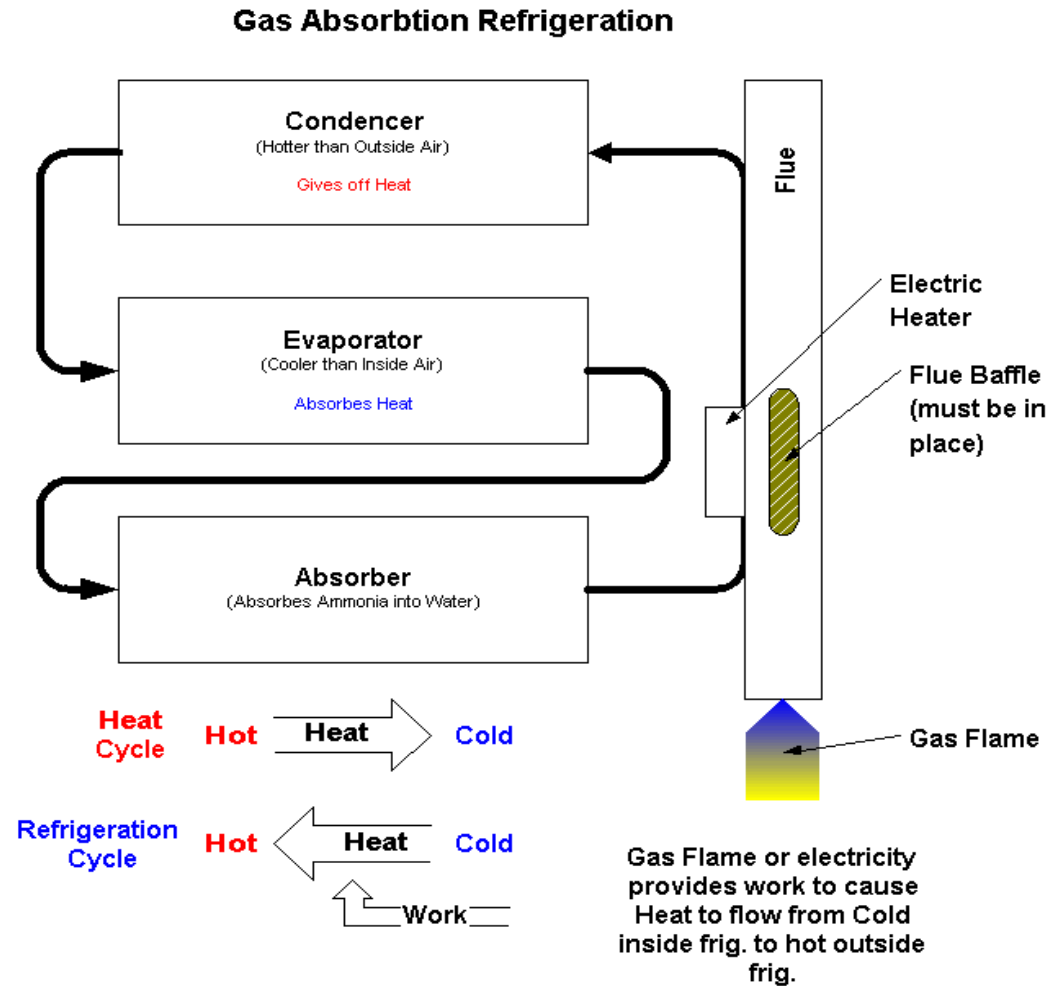
- Closed Loop
- Heat Flows From Cold To Hot (Requires energy to satisfy 2<sup>nd</sup> Law)
- Electricity (120VAC) or Gas provide the Energy

# Refrigerator Cooling Unit

- Closed System Containing Ammonia and Water
- Heat at one location causes cooling at another.
- Pressure change and Thermodynamics (perfect gas law, vapor pressure, and evaporation) employed.



# Refrigerator Cooling Unit Diagram



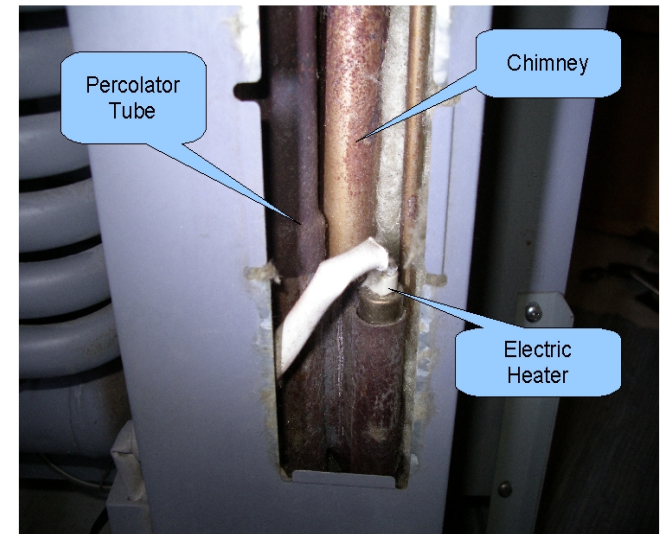
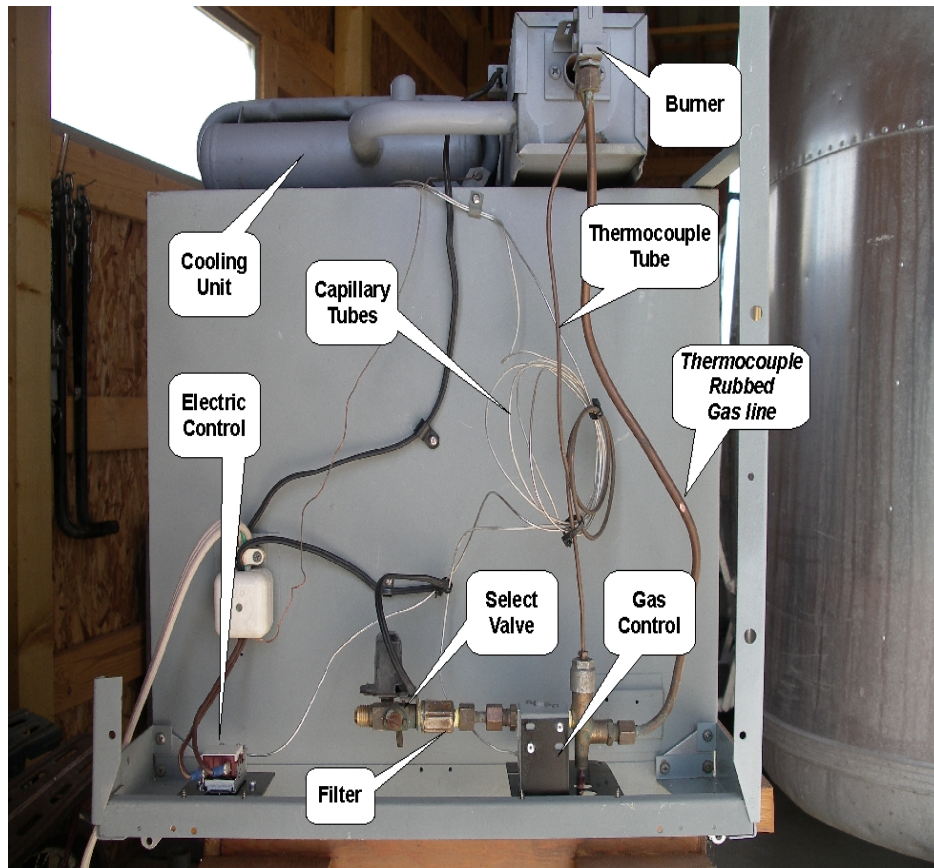
# Refrigerator Electric Side

- Simple thermostat with capillary tube sensing temperature inside refrigerator
  - Tube is “gas” filled.
- Heater element about 150 watt draws 1 ¼ amps at 120vac
  - Resistance about 96 ohms
- Note: If Cooling Unit works on 120 vac, it is not the problem if frig. doesn't cool on gas

# Refrigerator Gas Side

- Simple thermostat with capillarity tube
  - Tube is “gas” filled
- Burner likely to combine both pilot and main flame
  - Pilot flame small, main is larger. Should see and hear difference.
- Flue Baffle must be in place
- Note: Vintage burner irreplaceable

# Refrigerator - Picture



# Propane Big Deals

- Disrupted Air Flow
  - Intake Air
  - Exhaust
  - Cooling (refrigerator)
- Carbon monoxide (heavier than air)
- Failed Thermocouple or Capillary Tube
- Partial plugged burner orifice
- Leaks

# Propane Troubleshooting

- Pilot Flame and Main Flame
  - Adjustment (fuel/air ratio)
  - Thermocouple Position
  - Orifice
- Thermostat
  - Connections
  - Working?
- Air Flow
- Leaks
  - Gas Detector
  - Bubbles
  - Manometer (low pressure meter)



# Gadgets, Gas

