Carburetion Principles

• Air metering principles
• Fuel metering principles
• Fuel distribution principles
• Enrichment/derichment principles
Carburetion Principles

Air Metering

• Air metering is critical to spark ignited engines.
  – because gasoline will combust over a wide range of mixture ratios regulating RPM/power with fuel control only would not be responsive.
  – deceleration won’t occur until the engine suddenly stops firing.
Carburetion Principles

Air Metering

• True rotary engine.
  – no air metering throttle.
  – fuel metering off/on only.
  – take off and cruise was at full power
  – descending and landing was at engine off, no power.
Carburetion Principles

Air Metering

• Air metering
  – the most common device used is a throttle butterfly valve.
  – it is a coin shaped disc that is bisected by a shaft.
  – the shaft rotates opening or closing the throttle bore.
Carburetion Principles
Air Metering

• Most reciprocating engines will consume six pounds of air per hour per brake horsepower
Carburetion Principles

Air Metering

Closed, engine off or at idle
Carburetion Principles
Air Metering

Mid-throttle, engine cruising
Carburetion Principles
Air Metering

Full-throttle, engine full power
Carburetion Principles
Air Metering

• Another uncommon air metering device is the slide throttle.
  – uses a cylindrical tube that slides in or out of the throttle bore, at right angles to the bore.
Carburetion Principles
Air Metering

End View

Fuel Metering Pin

Air Metering Slide

Throttle Bore
Carburetion Principles
Air Metering

- Side View
- Fuel Metering Pin
- Air Metering Slide
- Throttle Bore
Carburetion Principles
Air Metering
Carburetion Principles
Air Metering
Carburetion Principles
Air Metering
Carburetion Principles
Air Metering

• One final function of air metering is to determine which carburetor fuel metering mode or system should be used.
• Most carburetors will have more than one fuel metering pathway.
• Commonly this is a direct function of throttle plate position.
Carburetion Principles
Fuel Metering

• Fuel metering principles
  – measure the rate of air flow
  – provide a pre-metered staging area for fuel to control metering pressure.
  – using predetermined values, meter the appropriate fuel to the distribution devices.
Carburetion Principles
Fuel Metering

• Bernoulli’s Principle
  – a fluid moving through a converging / diverging duct will increase velocity and decrease pressure.
  – by comparing reduced venturi pressure with ambient pressure one has an accurate estimation of fluid volume passing the restriction.
Carburetion Principles Fuel Metering

There is only one rate of airflow for each value of pressure differential.
Carburetion Principles Fuel Metering

• This is known as the Venturi effect.
  – the force created by this pressure differential can be used to directly meter and distribute fuel.
  – or it can be used for metering purposes only, with fuel distribution accomplished elsewhere.
Carburetion Principles Fuel Metering

• Fuel staging area is usually regulated by a poppet valve.
  – provides a collection area where pre-metered fuel pressure is stabilized.
  – can be controlled by floats or pressure diaphragms.
Carburetion Principles Fuel Metering

• Fuel metering is usually accomplished with removable metering ports (jets).
  – is similar to measuring the air flow.
  – controlling a pressure differential across a known restrictor allows accurate metering of fuel flow.
  – venturi differential can be the only source for fuel metering forces
Carburetion Principles Fuel Metering

- Fuel metering ports are removable so they may be replaced with different sizes.
- Drilling to adjust usually destroys them.
- The metered fuel circuit may be vented with an air bleed jet to increase metering force and aid in atomization.
Carburetion Principles Fuel Discharge

- Centrally located in the airstream of the carburetor.
- Primary purpose is to carry metered fuel to the center of the airstream and discharge it.
- Secondary purpose is to atomize fuel as much as possible.
Carburetion Principles Fuel Discharge

• Fuel discharge nozzle can be a simple pipe jutting into the airstream.
• Can include a secondary venturi to provide additional pressure differential and stable airflow.
• May have a concentric nozzle head with equally spaced fuel ports.
Carburetion Principles Fuel Discharge

• Nozzle head may be shaped to increase venturi effect.
• May include an air bleed mixing chamber in discharge head.
• May be located on either side of throttle plate. (pressure vs. float)
Carburetion Principles enrichment / derichment

• Fuel enrichment/derichment is caused by several common techniques.
  – physically alter venturi pressure differential.
  – turn off or on a separate fuel path.
  – turn off or on a separate air path.
  – or any combination of the above.
Carburetion Principles enrichment / derichment

• Two methods for altering venturi pressures.
  – 1. choke = another butterfly valve upstream of the throttle valve and the fuel metering venturi.
  – closing causes greater fuel metering force, thereby enriching the mixture.
  – rarely used in aviation.
Carburetion Principles enrichment / derichment

- 2. Alter fuel staging area pressure at the point where it is metered.
- this can be done several ways depending on carburetor system.
- pre-metered fuel may be at ambient pressure, above ambient. or below ambient.
Carburetion Principles enrichment / derichment

• Turning on or off enrichment air bleed or fuel circuits or pathways is done by:
  – linkages to the throttle control.
  – placement or position of the throttle plate
Carburetion Principles enrichment / derichment

• enrichment / derichment may be used for:
  – hot or cold starting.
  – high altitude / low pressures.
  – full power cooling.
  – fuel conservation.
Carburetion Principles
Automatic Mixture Controls

• These devices are used on all Stromberg Pressure carbs and many of their float carbs.
• Consists of an aneroid bellows filled with nitrogen and or light oil.
• They are responsive to both temperature and pressure changes.
Carburetion Principles
Automatic Mixture Controls

• This means they are density controllers.
• The internal oil in the webs of the bellows act as dampers for vibration
• The plunger valve is cut with two different tapers.
Carburetion Principles
Automatic Mixture Controls

• This helps to correct for the non-linear changes in temperature and pressure in the atmosphere.
Carburetion Principles acceleration systems

• Acceleration systems
  – may be needed to add fuel for rapid crankshaft acceleration.
  – normal fuel metering forces cannot respond fast enough to meet the extra demand.
Carburetion Principles acceleration systems

• Most common system is a “one shot per throttle application” piston pump system.
  – may or may not have a separate distribution path.
  – used more commonly on higher powered systems.
Carburetion Principles acceleration systems

• Pressure Carburetors commonly use a diaphragm type pump.

• Can be mechanically driven by throttle or:

• Can use MAP to drive pump.
  – low MAP draws diaphragm back filling chamber.
  – High MAP releases this into air.
Carburetion Principles
Carburetion Principles
Carburetion Principles
Carburetion Principles
Carburetion Principles
Carburetion Principles

• This can be a one check valve or two check valve pump.
  – the one valve type draws fluid into the pump chamber faster than low pressure venturi air can be back drawn through the distribution nozzle
Carburetion Principles

- The two check valve systems draw fuel in through one valve and push fuel out through the other one.
- These check valves are usually a ball type valve, that may or may not incorporate a spring.
- They fall out and disappear easily during repair or overhaul.
Carburetion Principles

SECTION END