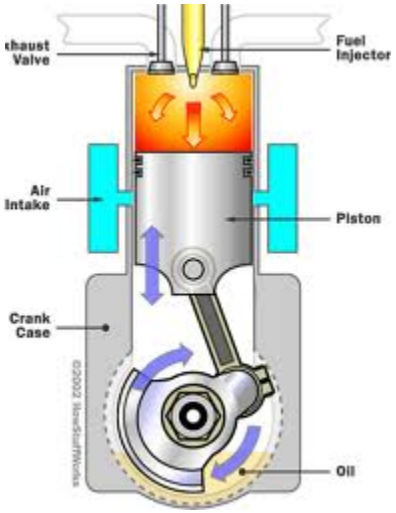
Fuel Supply, Air Induction, and Emissions

Chapter #8

Engine Fuel

- Gasoline
- NG/Propane
- Diesel/Kerosene
  - Storage
  - Additive
  - Cetane – Octane
  - Pros/Cons

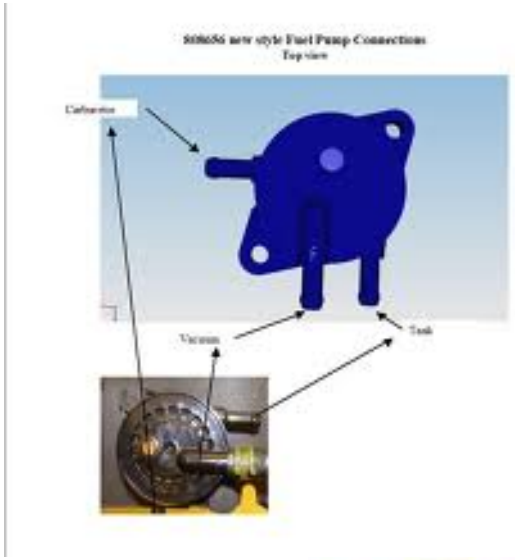


- Fuel Tanks

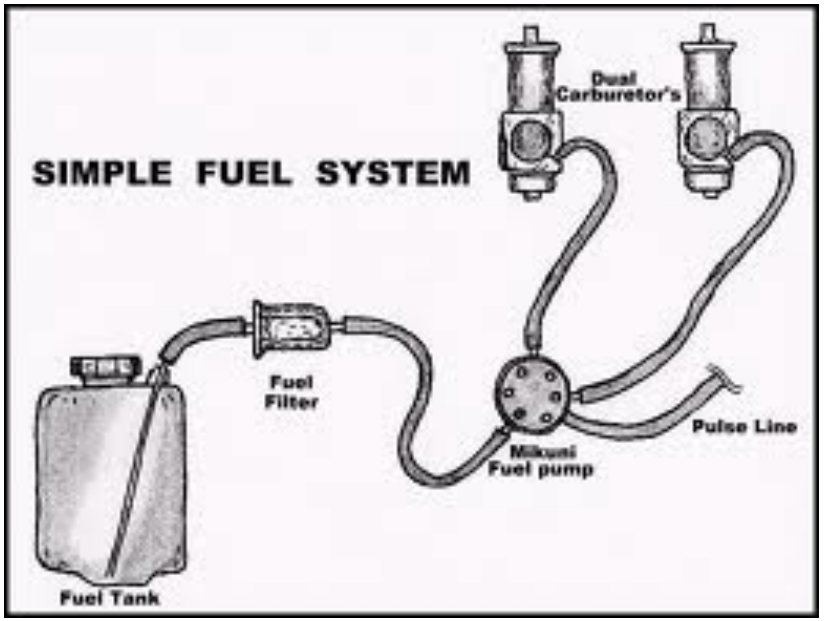
- Fuel lines and fittings

- Fuel Filters

- Fuel Pumps
- Mechanical vs. impulse



- Pressurized Fuel System - Fuel tank located below the level of carb…
- Ex: Outboard engines



- Vapor Return Fuel System
  - To combat vapor lock… use a carb with vapor return line…
  - Figure 8-15, page 161

Air Induction Systems

- Air Filter Housings and Filters

- Air Cleaners an Air Filters
  - Oil-wetted Air Cleaner
  - Dry-Type Air Cleaner
  - Dual Element Air Cleaners

Crankcase Breathers

Mufflers

Emissions

Emissions Control Regulations

- The Beginning
- CARB 1990
- Phase 1 - 1995
- Phase 2 - April 2000
- Phase 3 – April 2007

Carburetion

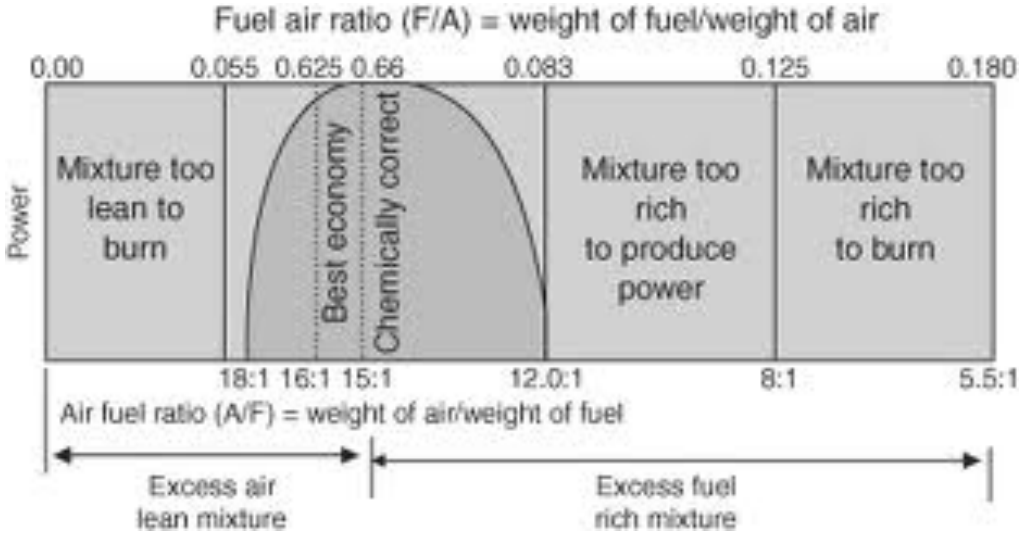
Chapter #9

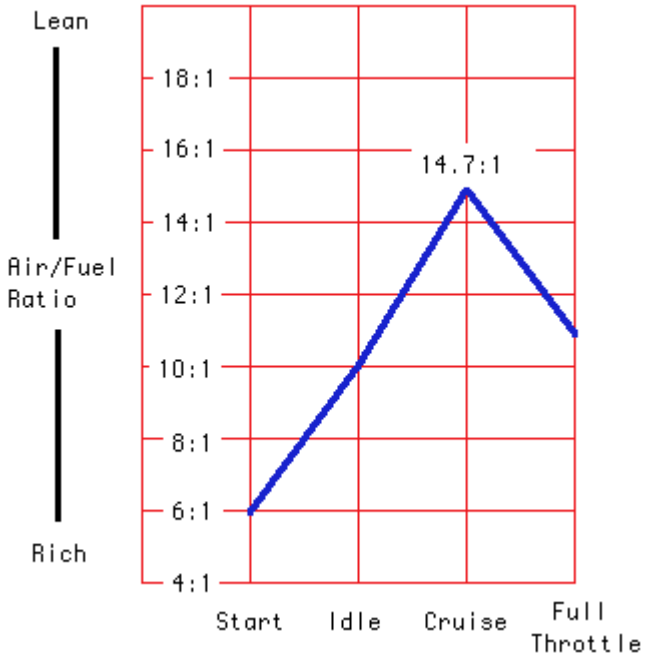
Principles of Operation

- Cold or hot starting
- Idling
- Part throttle
- Acceleration
- High speed operation

Air – Fuel Mixture

- 14.7 to 1

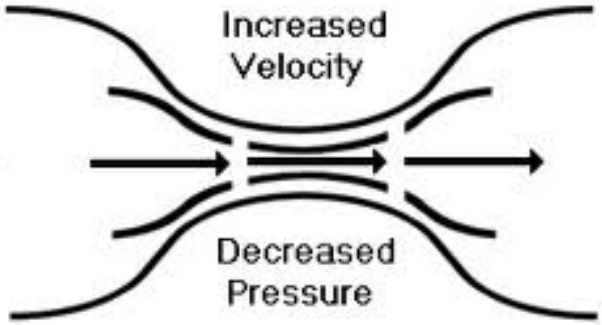


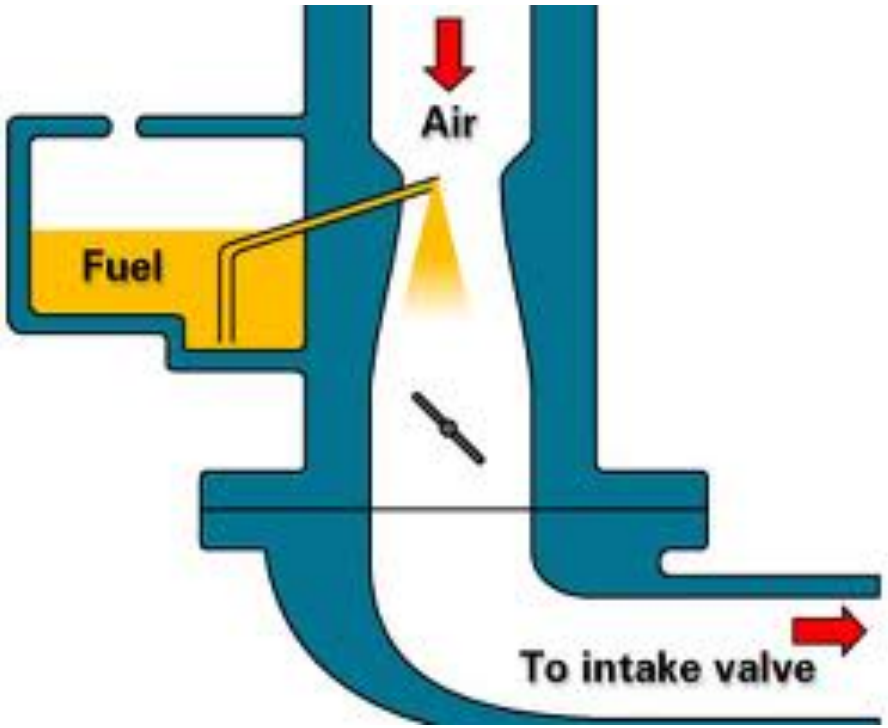


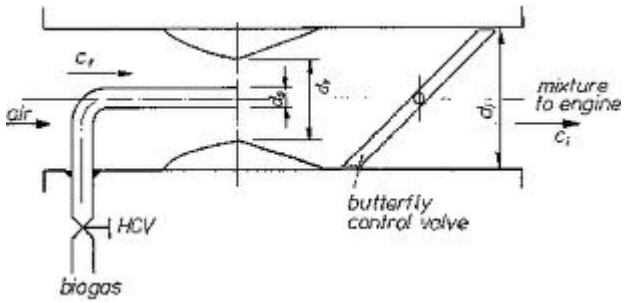
Carb Pressure Differences

- Vacuum – must be present to “draw in” fuel/air charge
  - 2 cycle depends on the crankcases ability to hold pressure… leaking crankshaft seals… Adapter plate & pressurize case to 5-6psi… should hold some pressure… or squirt carb cleaner in plug hold… if runs or a few seconds then case is probably OK…
- Atmospheric Pressure
- Venturi Principle

- Venturi Principle

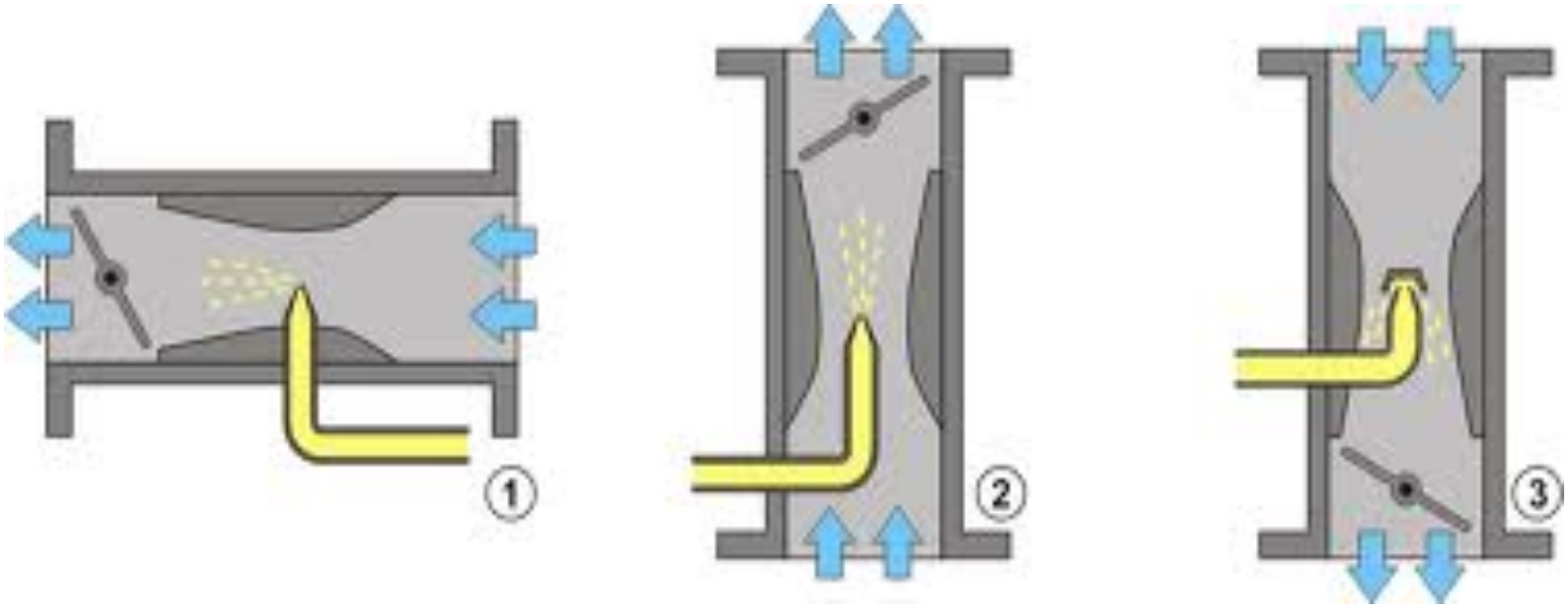






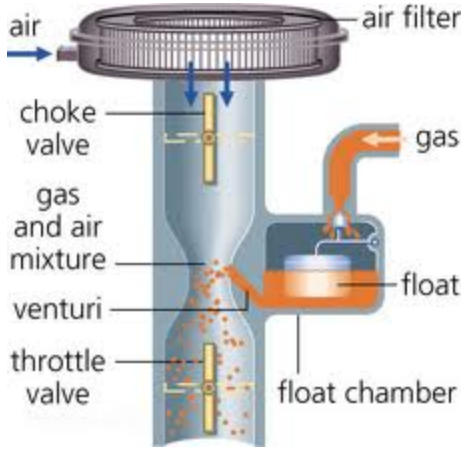
Types of Carbs

- Position

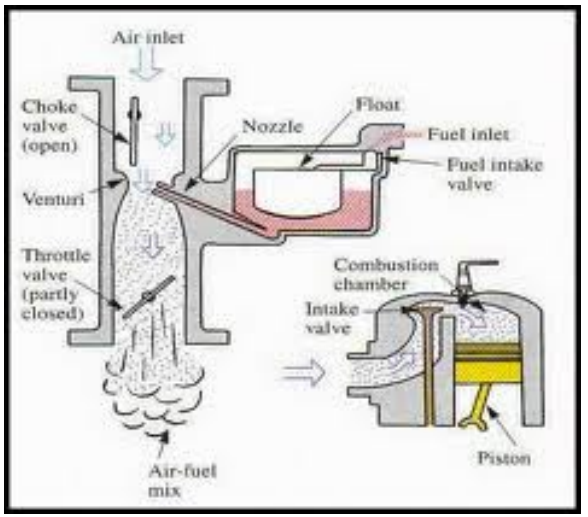


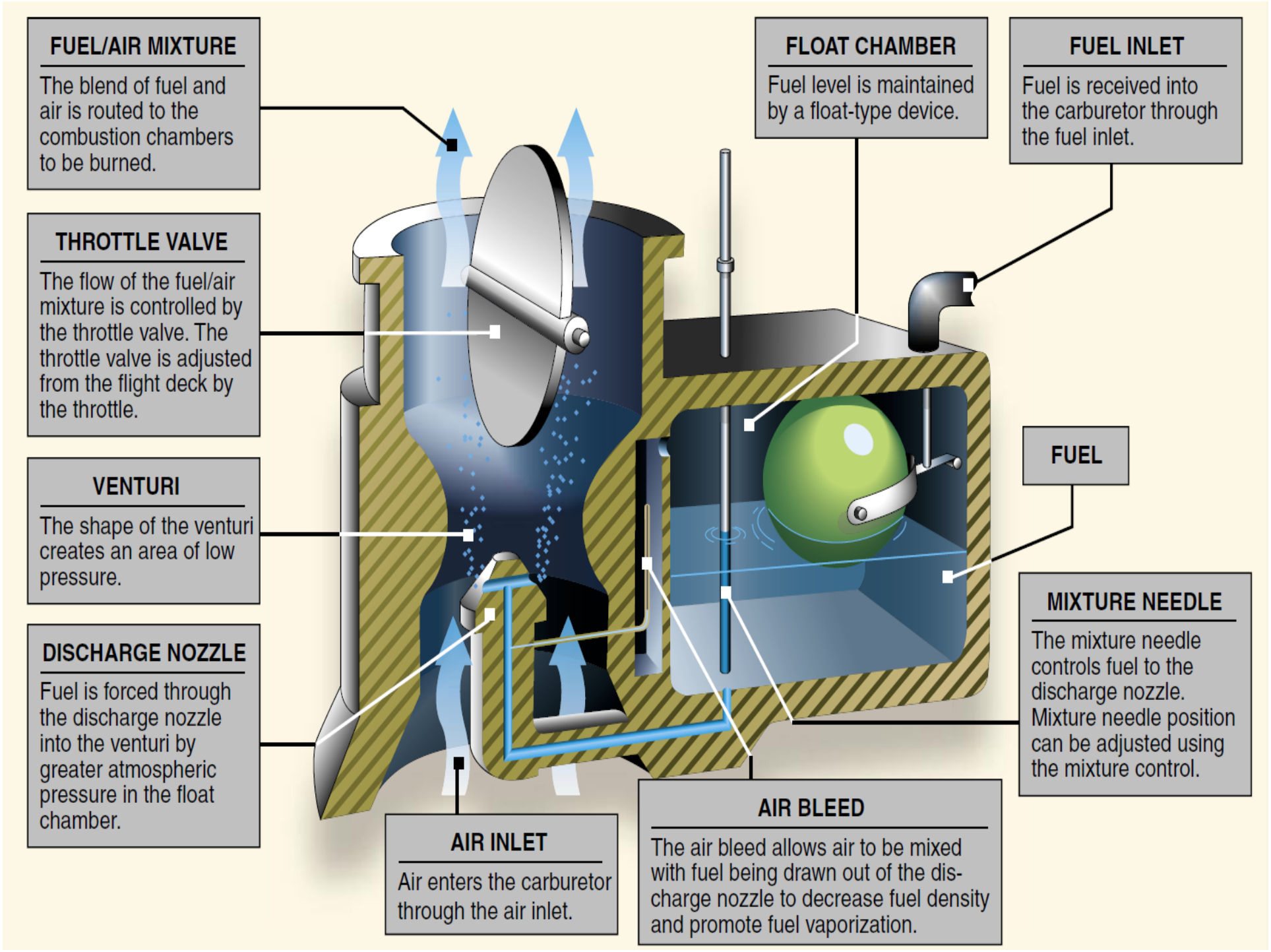
Types of Carbs

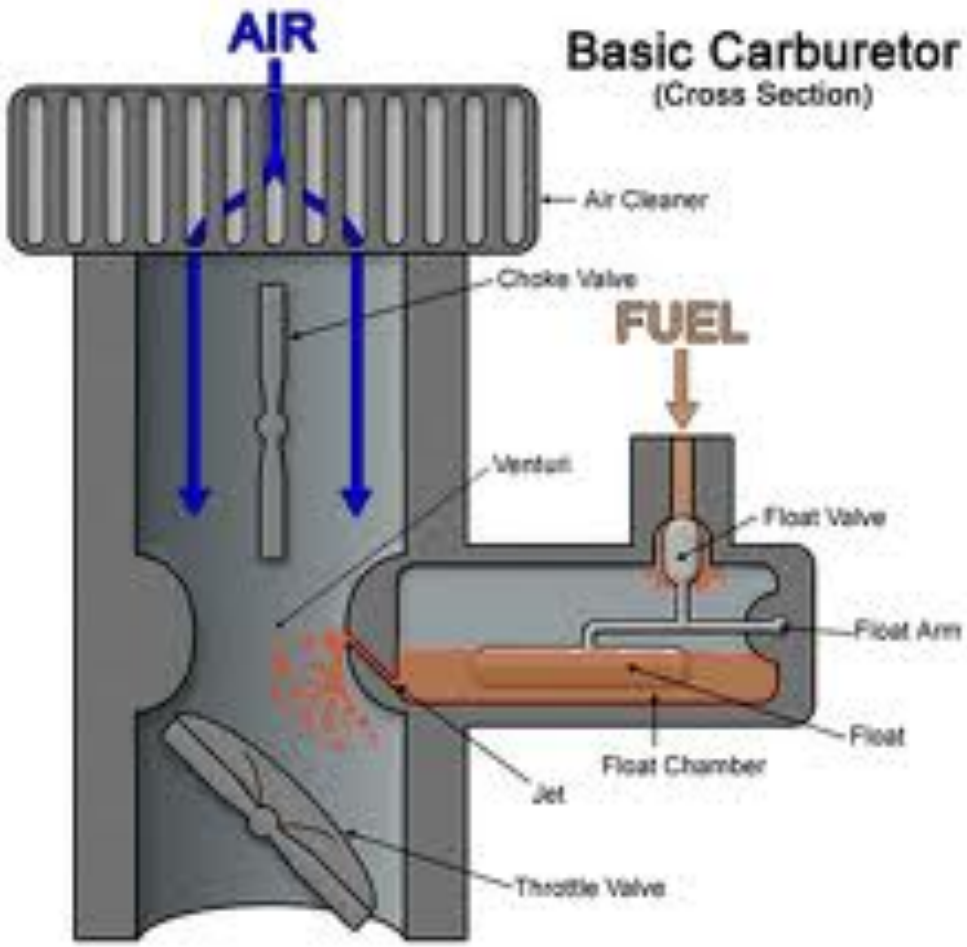
- Float
- Diaphragm - works at any angle, hand-held tools
- Suction Lift - carb mounted directly on fuel tank



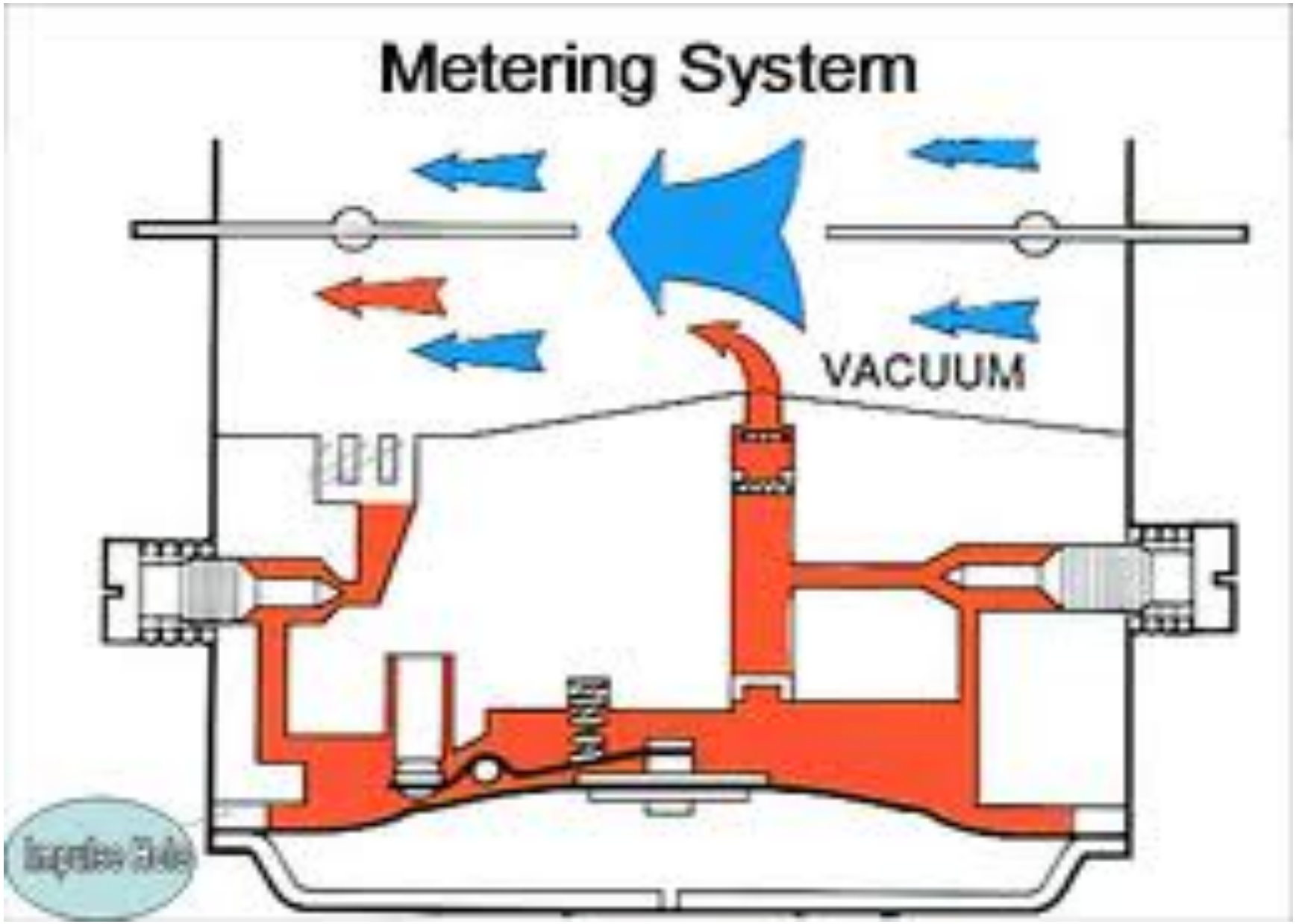
- Float Type
  - Float bowl ventilation
  - Choke system
  - Throttle system
  - Load adjustment
  - Acceleration system
  - Acceleration well
  - Economizer circuit
  - Idling circuit
  - Part-throttle; full throttle sequence

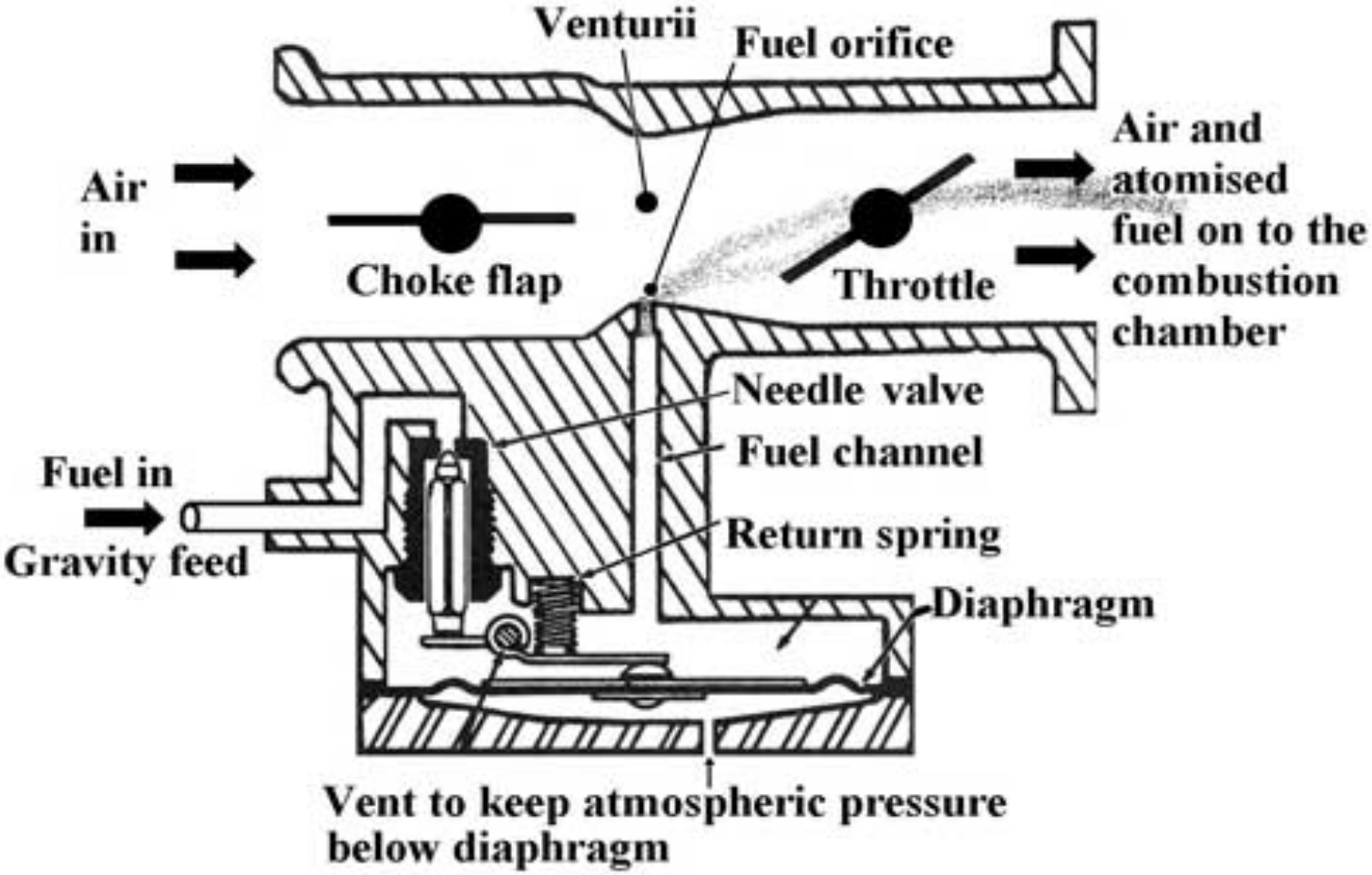



FUEL/AIR MIXTURE
The blend of fuel and air is routed to the combustion chambers to be burned.
THROTTLE VALVE
The flow of the fuel/air mixture is controlled by the throttle valve. The throttle valve is adjusted from the flight deck by the throttle.
VENTURI
The shape of the venturi creates an area of low pressure.
DISCHARGE NOZZLE
Fuel is forced through the discharge nozzle into the venturi by greater atmospheric pressure in the float chamber.
FLOAT CHAMBER
Fuel level is maintained by a float-type device.
FUEL INLET
Fuel is received into the carburetor through the fuel inlet.
FUEL
MIXTURE NEEDLE
The mixture needle controls fuel to the discharge nozzle. Mixture needle position can be adjusted using the mixture control.
AIR INLET
Air enters the carburetor through the air inlet.
AIR BLEED
The air bleed allows air to be mixed with fuel being drawn out of the discharge nozzle to decrease fuel density and promote fuel vaporization.

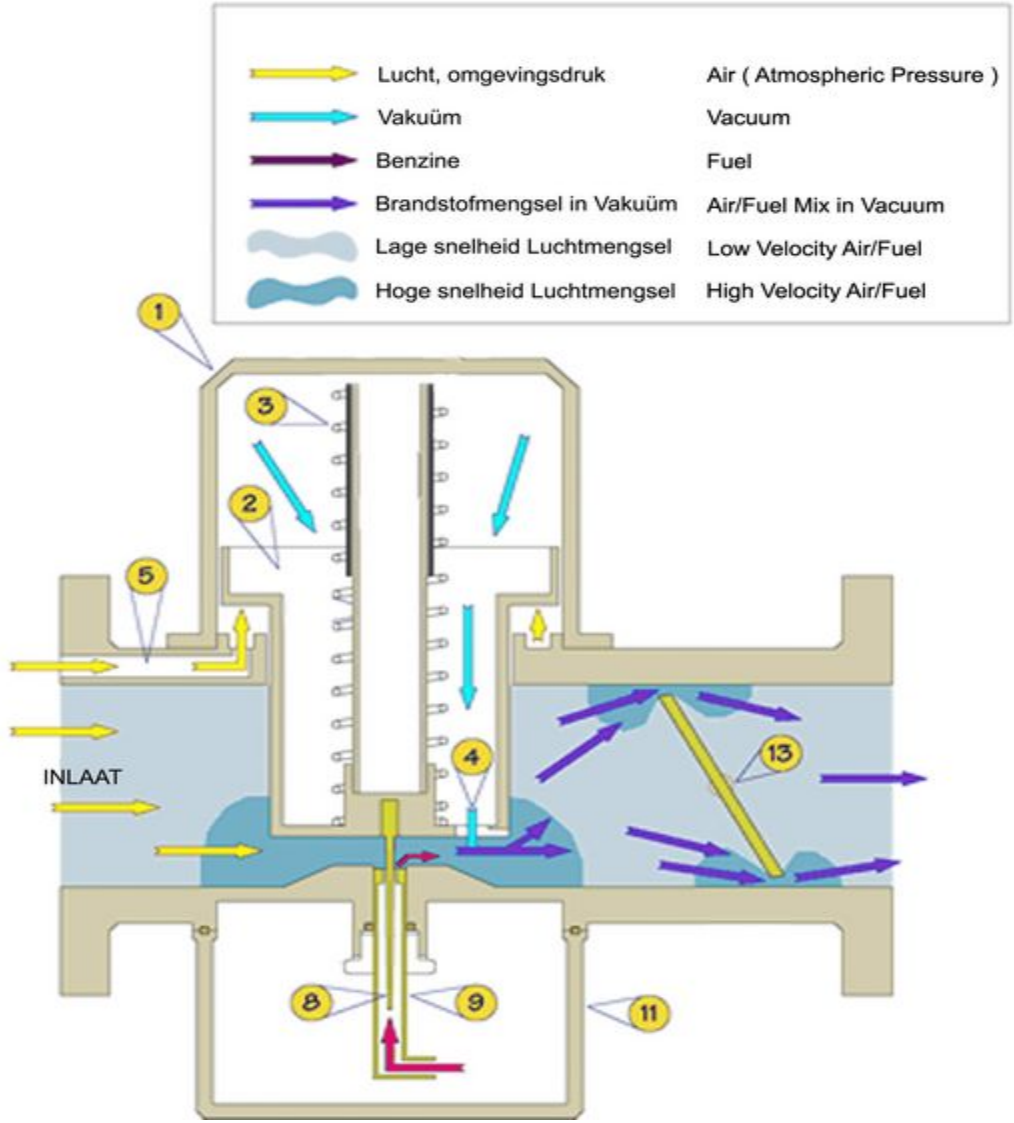

AIR
Basic Carburetor
(Cross Section)
Air Cleaner
Choke Valve
FUEL
Venturi
Float Valve
Float Arm
Float
Float Chamber
Jet
Throttle Valve

- Diaphragm-Type Carburetors
  - No float
  - Difference between atmospheric pressure and vacuum created in engine pulsate a diaphragm
  - Variation – two diagrams

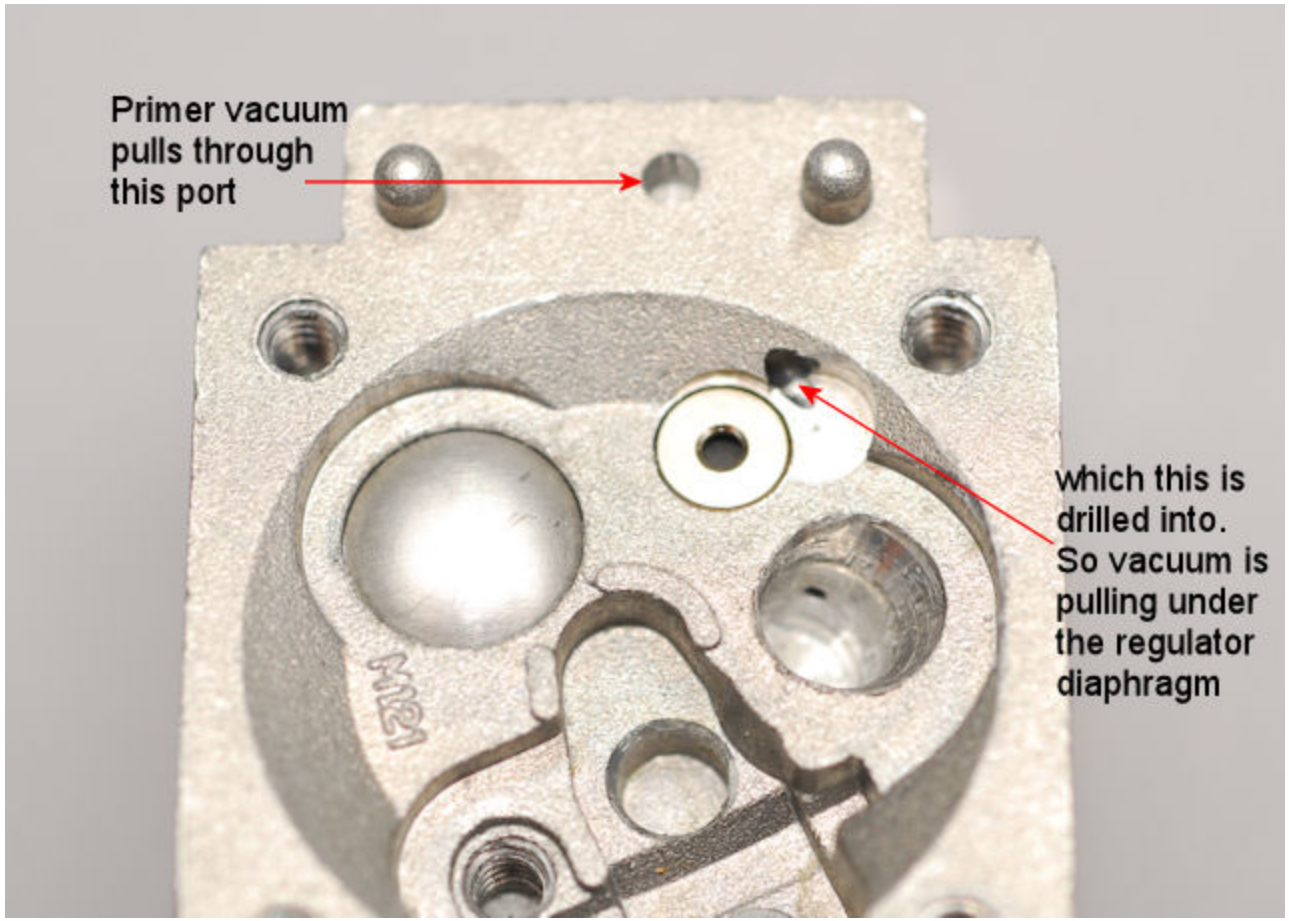

Metering System
VACUUM


Venturii
Fuel orifice
Air
in
Choke flap
Throttle
Air and
atomised
fuel on to the
combustion
chamber
Needle valve
Fuel channel
Fuel in
Gravity feed
Return spring
Diaphragm
Vent to keep atmospheric pressure
below diaphragm

- Vacuum Carburetors

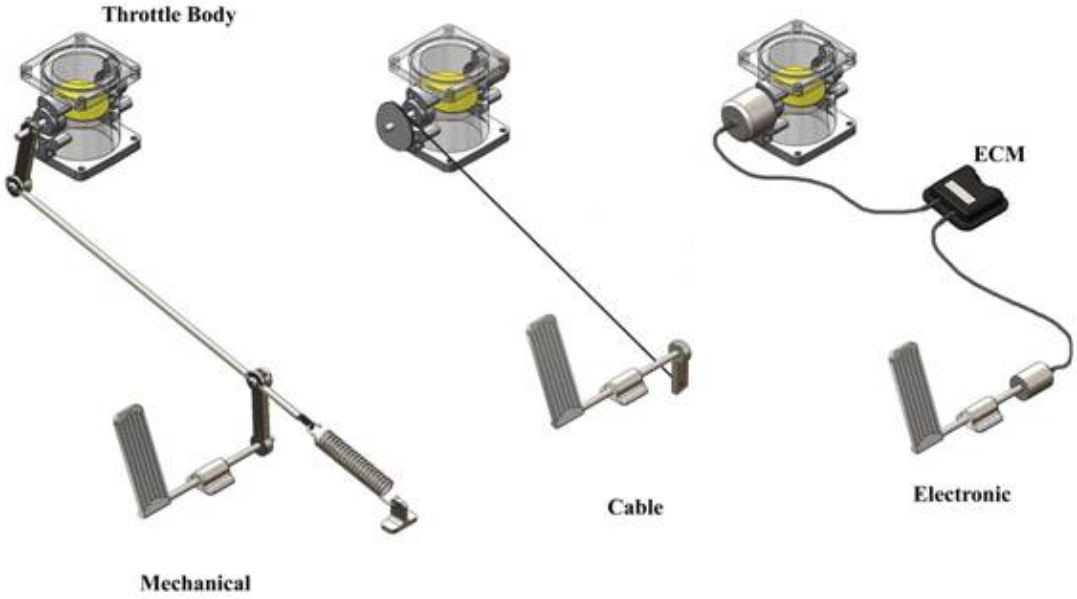


Primers

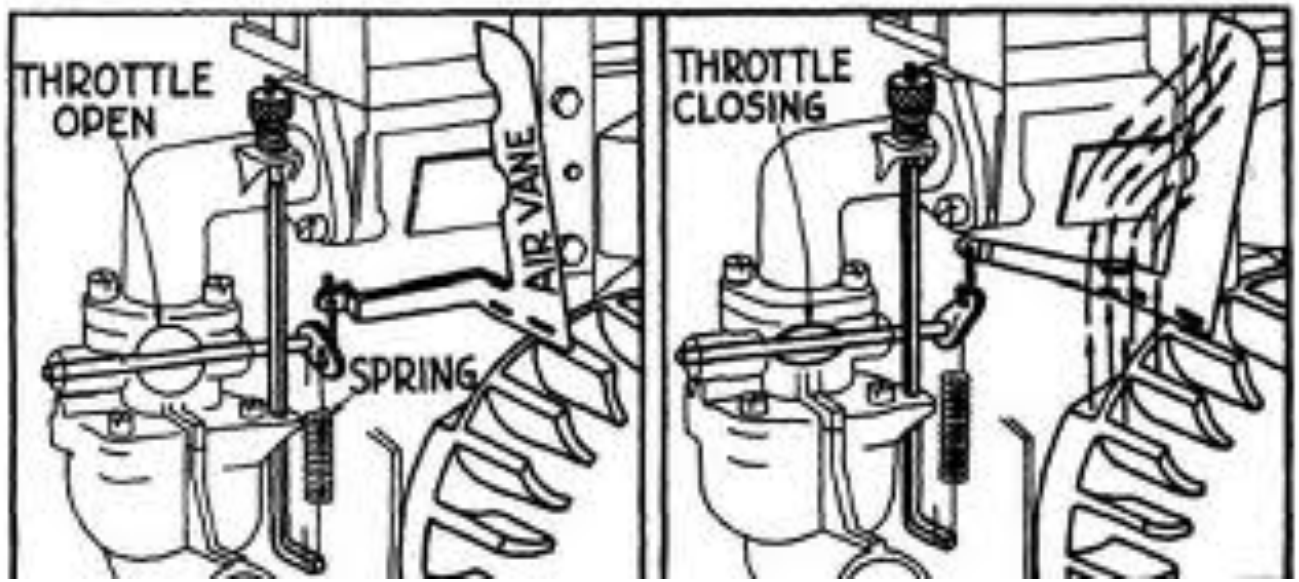

Primer vacuum pulls through this port
which this is drilled into. So vacuum is pulling under the regulator diaphragm


Walbro WT-813 Big Bore Carburetor

Manual Throttle Control



Governor Throttle Controls

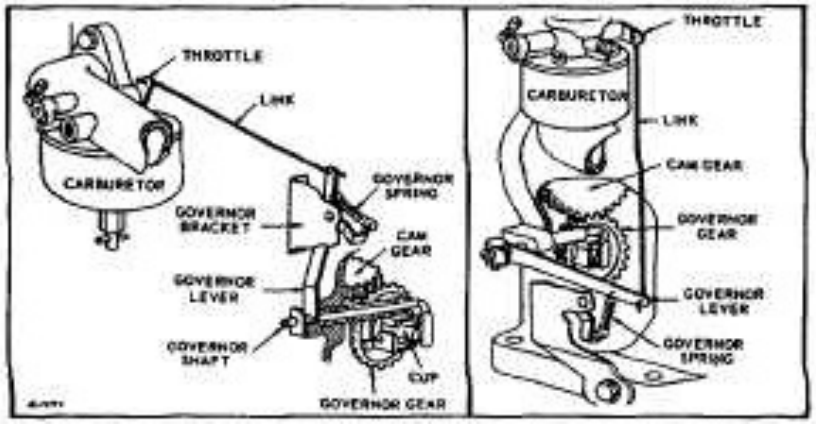


Types of Governors

- Air-Vane
- Centrifugal – flyweights on revolving shaft
- Vacuum – farm/industrial engines, between carb & intake
- Changing governor speed setting – knurled knob, cable, spring, vane length
- Hunting – improper carb adj.

Governor

- Speed
- Power
- Stability
- sensitivity



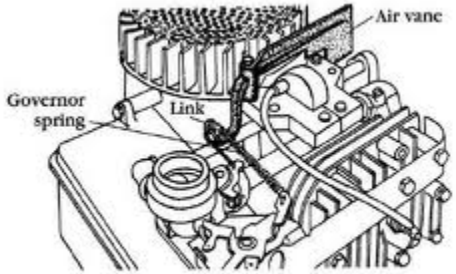
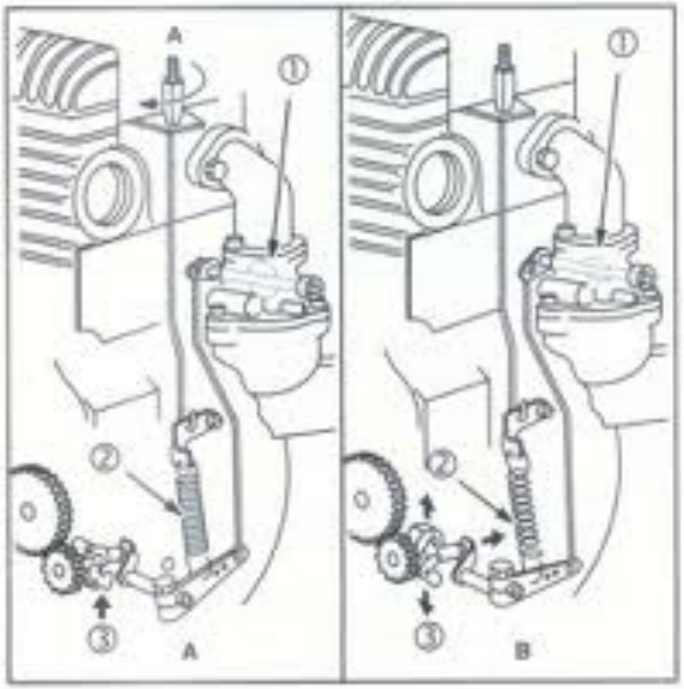


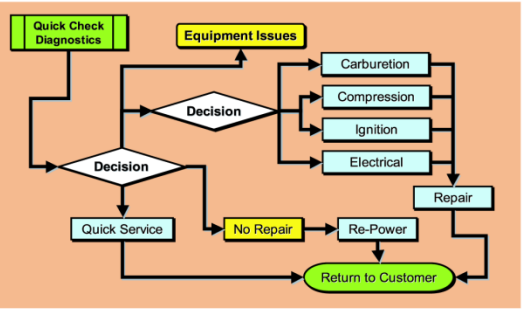
FIG. 4-29. *The typical Briggs & Stratton governor uses a plastic vane loosely secured with metal tabs.*



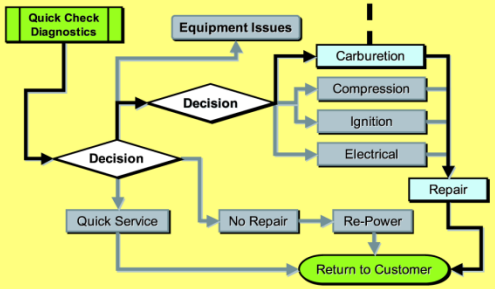
Carburetion Troubleshooting Quick Reference Guide

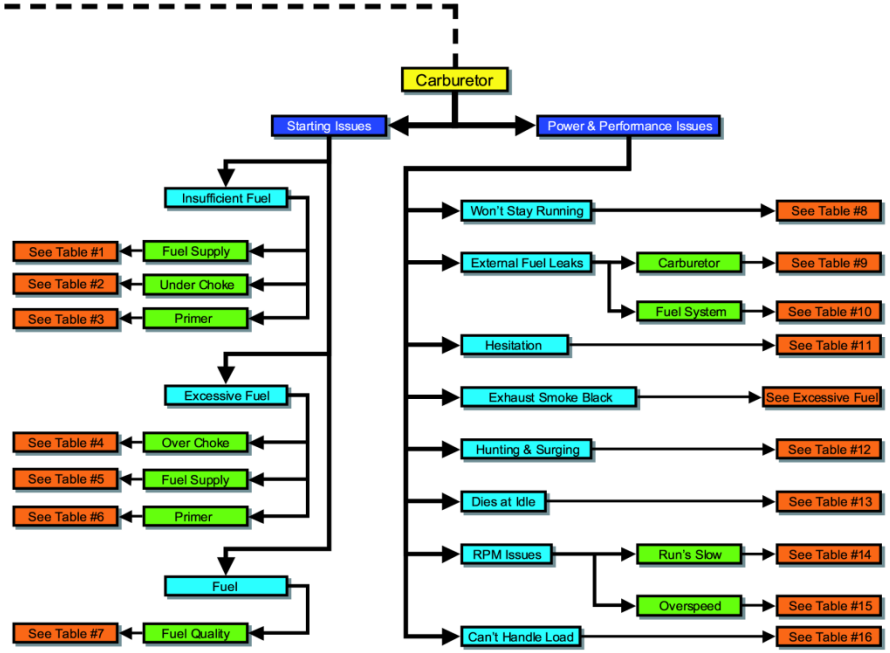
SERVICE DIAGNOSTIC OVERVIEW

A logical, planned approach can move service work through a repair center in a smooth and efficient manner. Fueled by information from a thorough Quick Check, the nature of the repair work required can be quickly established.



Once the problem is established as an engine issue, the process continues through a system of checks or tests until the affected engine system is determined. A skilled technician will accurately establish the symptoms of the problem and drill down to the root cause such as those listed in the tables below.





Failure Table #1 Fuel Supply
- No Fuel in Tank
- Fuel Shut-Off Valve
- Kinked Fuel Line
- Fuel Filter, Restricted
- Fuel Level Low
- Fuel Tank Mounting Low
- Fuel Pump
- Fuel Solenoid
- Vapor Lock

Failure Table #2 Under Choke
- Choke Cable
- Choke Control Cable
- Choke Linkage
- Choke Shaft
- Inoperative Choke Plate
- Manifold Gasket
- No Human Intervention

Failure Table #3 Primer
- Primer Bulb
- Check Valve
- Primer Line
- Backing Plate Gasket
- Restricted, Passage
- No Human Intervention
- Manifold Gasket

Failure Table #4 Over Choke
- Choke Cable
- Choke Control Cable
- Choke Linkage
- Choke Shaft
- No Human Intervention
- Air Cleaner, Restricted
- Air Intake, Restricted
- Bi-Metal Choke Spring
- Automatic Choke

Failure Table #5 Fuel Supply
- Head Pressure
- Pump Pressure
- Inlet Needle & Seat
- Float
- Porous Casting
- Fuel Quality

Failure Table #6 Primer
- Human Intervention

Failure Table #7 Fuel Quality
- Stale/Old Fuel
- Wrong Type Fuel
- Contaminated
- Seasonal Fuel Issues

Failure Table #8 Won't Stay Running
- Float Level
- Fuel Filter, Restricted
- Fuel Delivery Volume, Low
- Kinked Fuel Line
- Debris in Carburetor

Failure Table #9 Won't Stay Running, Carburetor
- Bowl Gasket
- Bowl Nut
- Bowl Vent
- Air Cleaner Manifold
- Porous Casting
- Warped Tank
- Gaskets
- Loose Screws

Failure Table #10 External Fuel Leaks, Fuel System
- Hole in Tank
- Loose Fitting
- Loose Fuel Line Clamp
- Human Intervention
- Fuel Line
- Fuel Filter, Leaks
- Sediment Bowl Gasket
- Fuel Shut-Off Valve

Failure Table #11 Hesitation
- Float Adjustment
- Debris in Carburetor
- Jet, Main Fuel
- Mixture Screws
- Jet, Pilot
- Idle Speed, Mis-Adjusted
- Parasitic Load
- Fuel Quality
- Air Cleaner, Restricted

Failure Table #12 Hunting & Surging
- Jet, Main Fuel
- Restricted, Passage
- Jet, Pilot
- Governor

Failure Table #13 Dies at Idle
- Restricted, Passage
- Jet, Pilot
- Welsh Plug
- Mixture Screws
- Idle Speed, Mis-Adjusted

Failure Table #14 RPM Issues, Runs Slow
- Throttle Control
- Throttle Control Cable
- Throttle Shaft
- Idle Speed, Mis-Adjusted
- Governor

Failure Table #15 RPM Issues, Overspeed
- Throttle Control
- Throttle Control Cable
- Throttle Shaft
- Idle Speed, Mis-Adjusted
- Governor

Failure Table #16 Can't Handle Load
- Float Adjustment
- Debris in Carburetor
- Jet, Main Fuel
- Mixture Screws
- Parasitic Load
- Fuel Quality
- Air Cleaner, Restricted
- Fuel Filter, Restricted
- Kinked Fuel Line
- Fuel Delivery Volume, Low

CE8123-11/03

No fuel delivery

- Solenoid-operated fuel shut-off valve found on some Walbro and Nikki (float) carbs requires a minimum of 7.3V to function. Test by replacing the valve w/ the standard brass float-bowl fastener.
- Diaphragm carbs – often need diaphragm replacement
- Check valve on siphon feed carbs tends to stick
- Suction-Lift – stretched pump diaphragm
- Defective needle and seat – float type carb

External Adjustment

- Classic carbs have 3 adjustments – idle rpm, idle mixture, & high speed mixture
- Emission compliant carbs w/ limiter caps or no adjustments. Some have single screw adjustment
- Initial adjustment - 1 ½ turns out from fully seated
- Final adjustment – if only idle rpm & idle mixture, adjust for best idle
- Final adjustment- 3 adjustments, operating temp, throttle ¾ open, high speed mix screw back out small increments (1/8 turn) when speed falters too rich, tighten in small increments, stop at threshold of lean roll, note difference in number of turns and spilt the difference, close throttle & adjust idle mix screw for fast idle, snap throttle, hesitation can be compensated by slight rich mixture, test under load, experiment, most like slight rich mixture…

Hard Hot Start

- Vapor lock
  - Winter grade gas = rich mixture – higher volatility
- Ignition coil failure – most often the cause

Air-Cleaners

- Replace - paper
- Clean - polyurethane

Fuel System Service

Chapter #14

Troubleshooting the Fuel System

- Identify the symptoms
- Speak to the customer
- Use troubleshooting chart

Hard Starts

- Spark and air?
- Fuel in tank?
- Examine plug
- Is fuel stale or contaminated – test fuel for ethanol %
- Fresh gas?
- Further diag. required

Checking Air-Fuel Mixture

- Rich
- Lean
- Flooded

- Check spark plug
  - Black rich
  - White lean
  - Light tan - OK

Checking Gravity-Fed Fuel Supply

- Disconnect fuel line at carb and check for flow…

Checking Fuel Pump

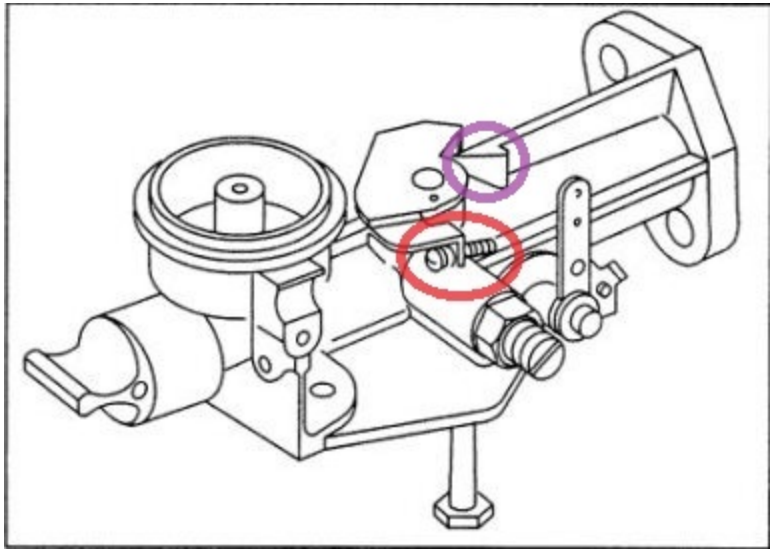
- Disconnect fuel line at carb and check for fuel flow…

Other Checks

- Vacuum leaks – carb cleaner test
- Use a auxiliary fuel supply
- Vapor lock

Carburetor Adjustment

- Covered earlier, in carb unit…



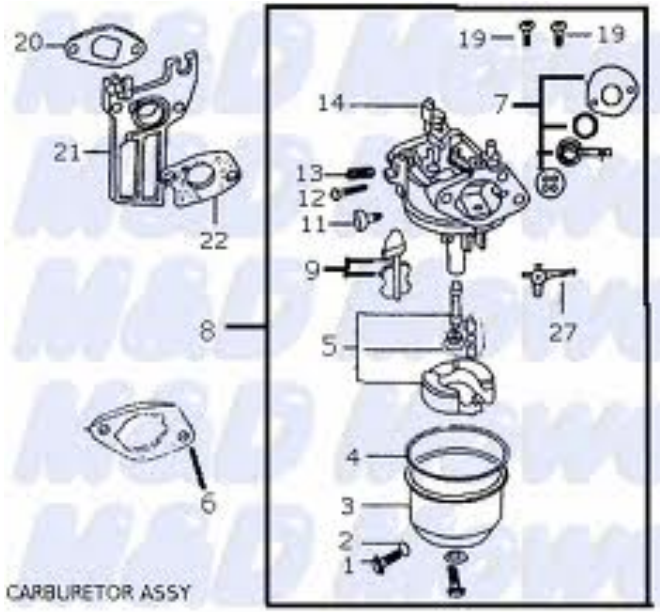
High Speed and Idle Mixture Adjustment

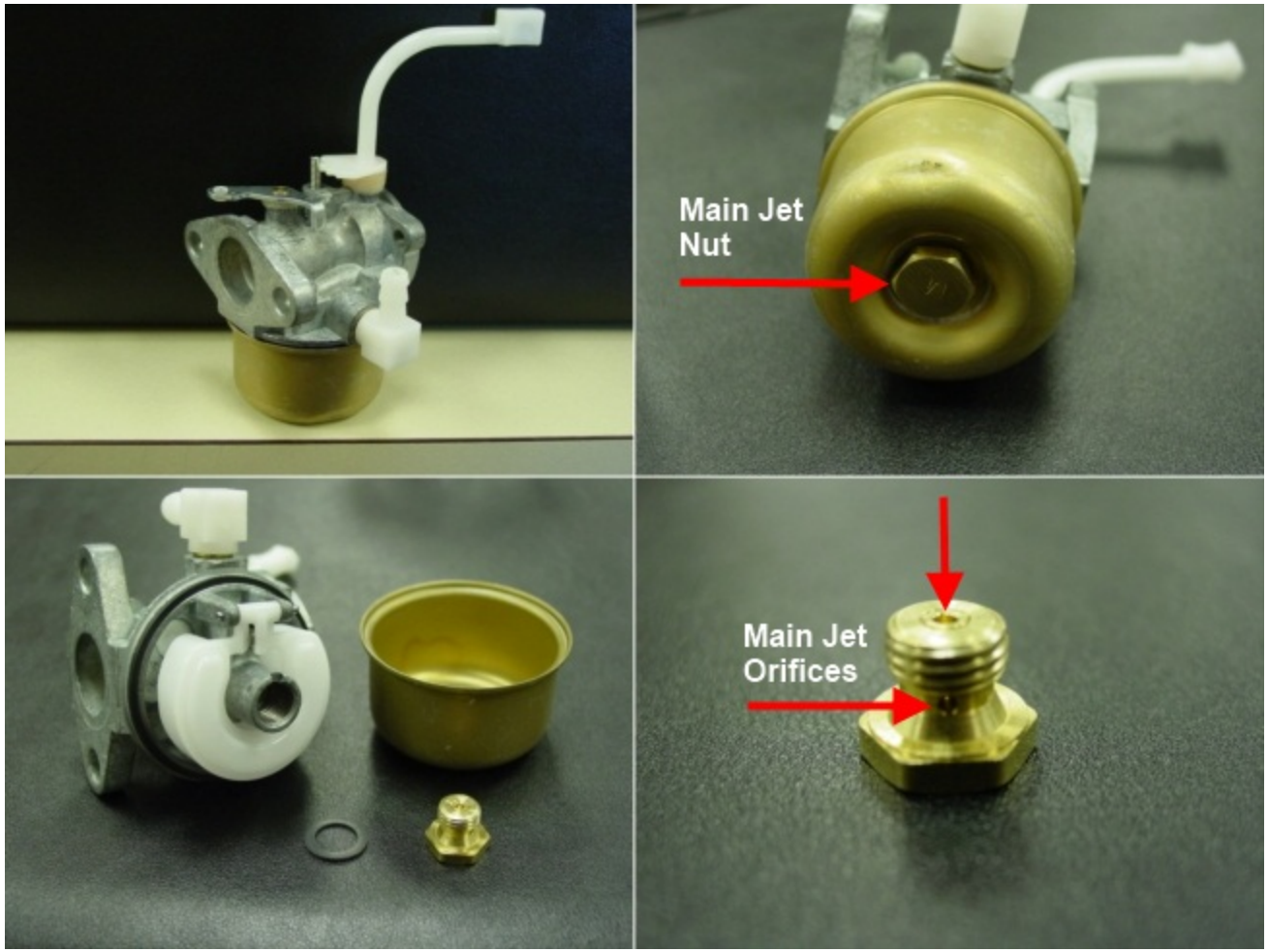
Carburetor Overhaul

- See textbook & service information
- Demo…
- Practice…

Carburetor Removal

Carburetor Disassembly




Main Jet
Nut
Main Jet
Orifices

Cleaning the Carburetor

Engine Governor Service

- Resetting the centrifugal governor system
- Adjustment
  - Bending attachment arm – special tool
  - Changing springs
  - Lever clamp

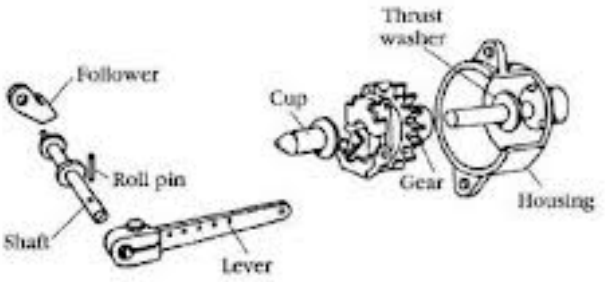


FIG. 4-31. *The governor mechanism used for 60000, 80000, and 140000 engines. The housing, accessed from outside of the engine, is unique to this engine family; all other centrifugal governors live inside of the crankcase. The pinch bolt that secures the lever and shaft is the main adjustment point for this and most other Briggs & Stratton governors and* ***should not be disturbed during normal service activities, including engine overhaul.***

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