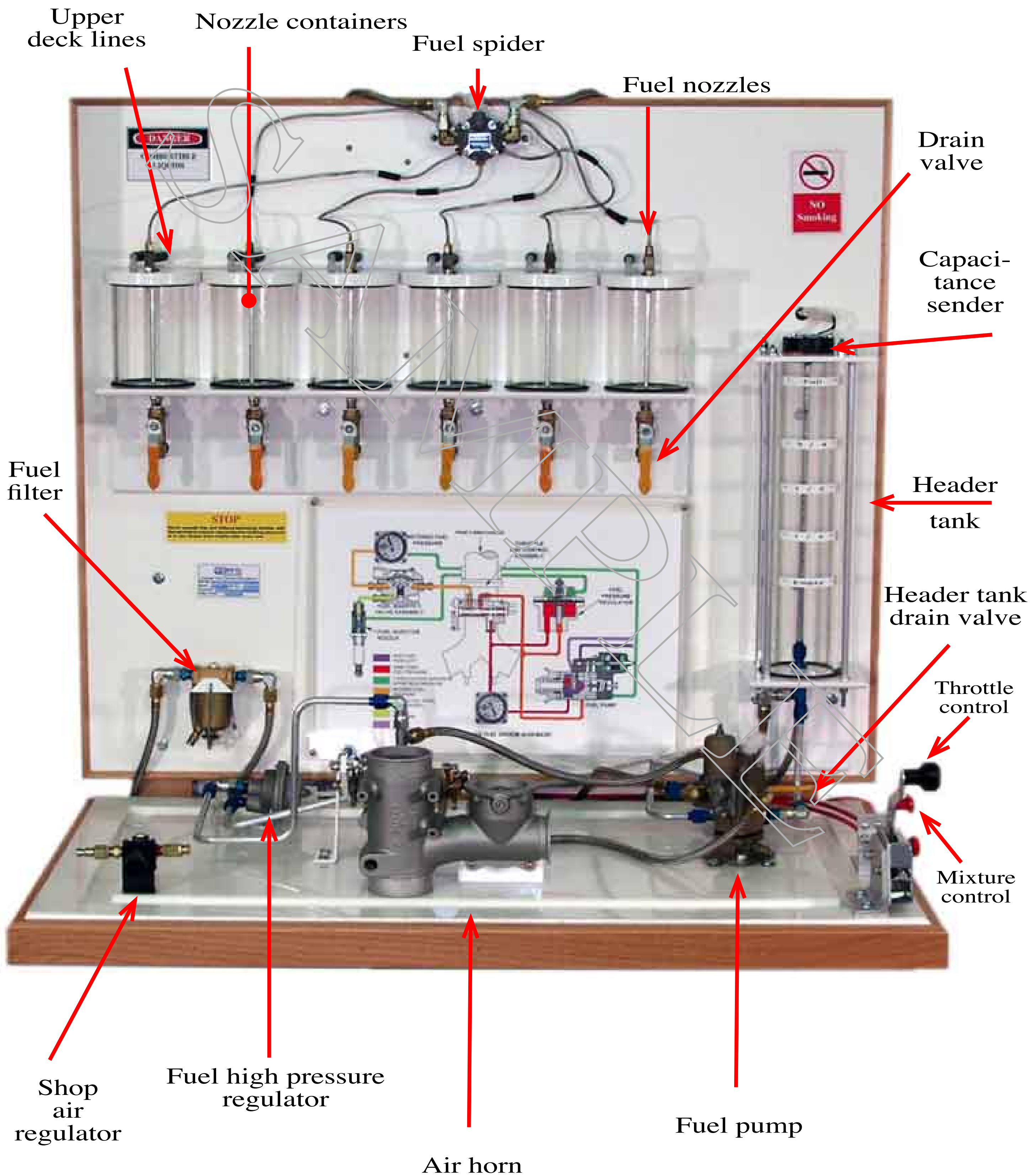
Component Location



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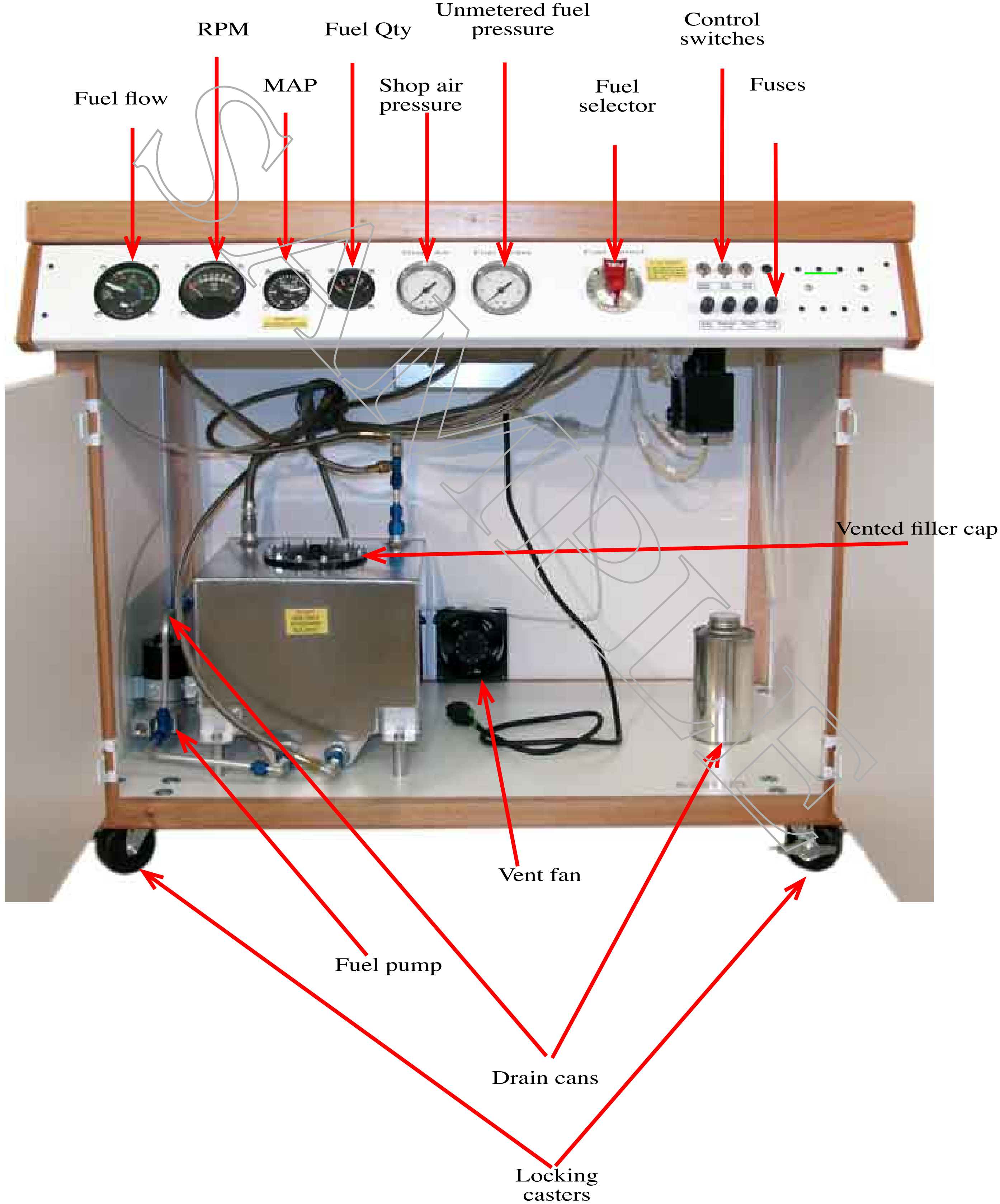

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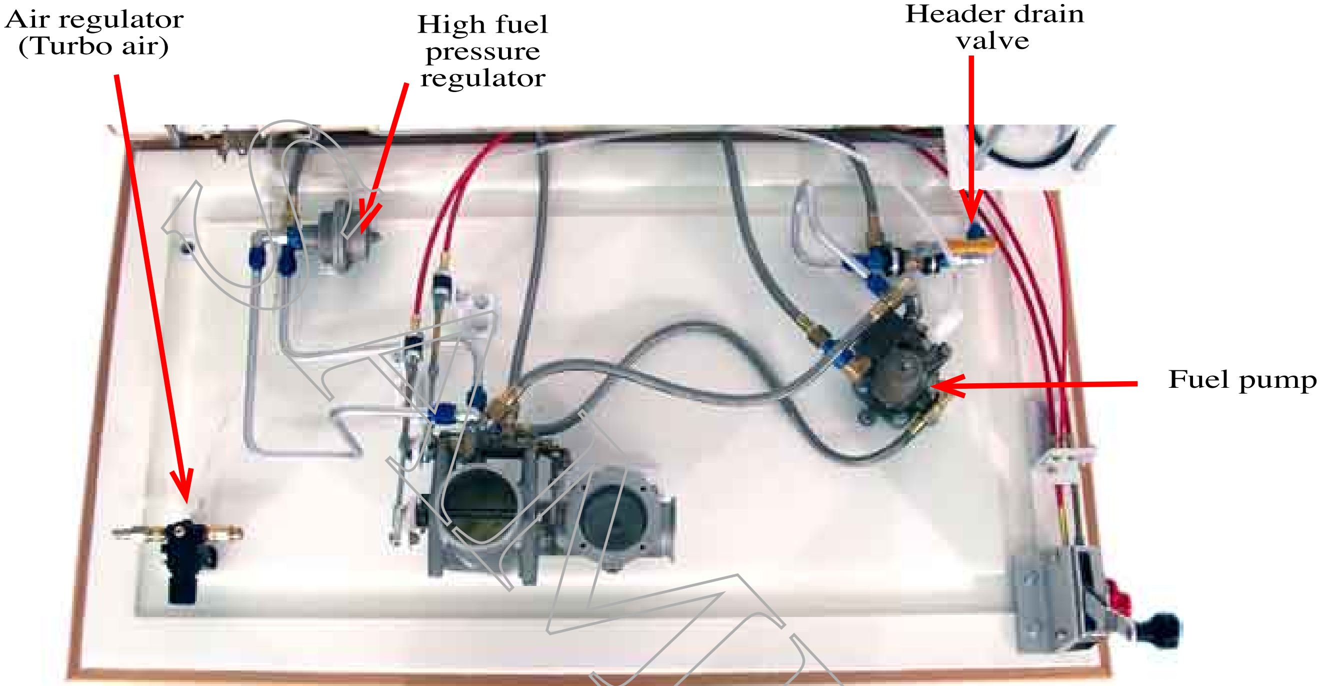
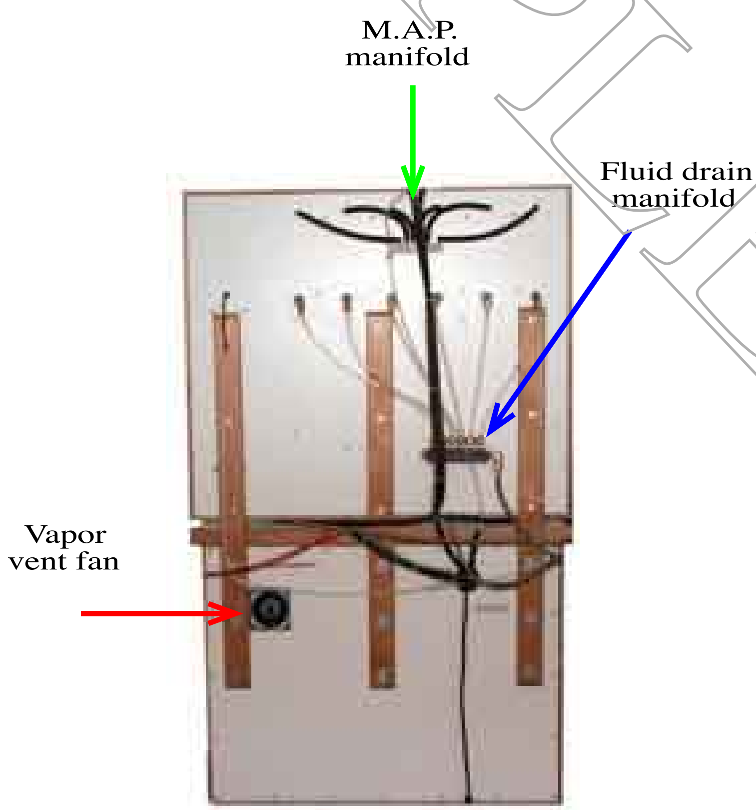




Description and operation

INTRODUCTION

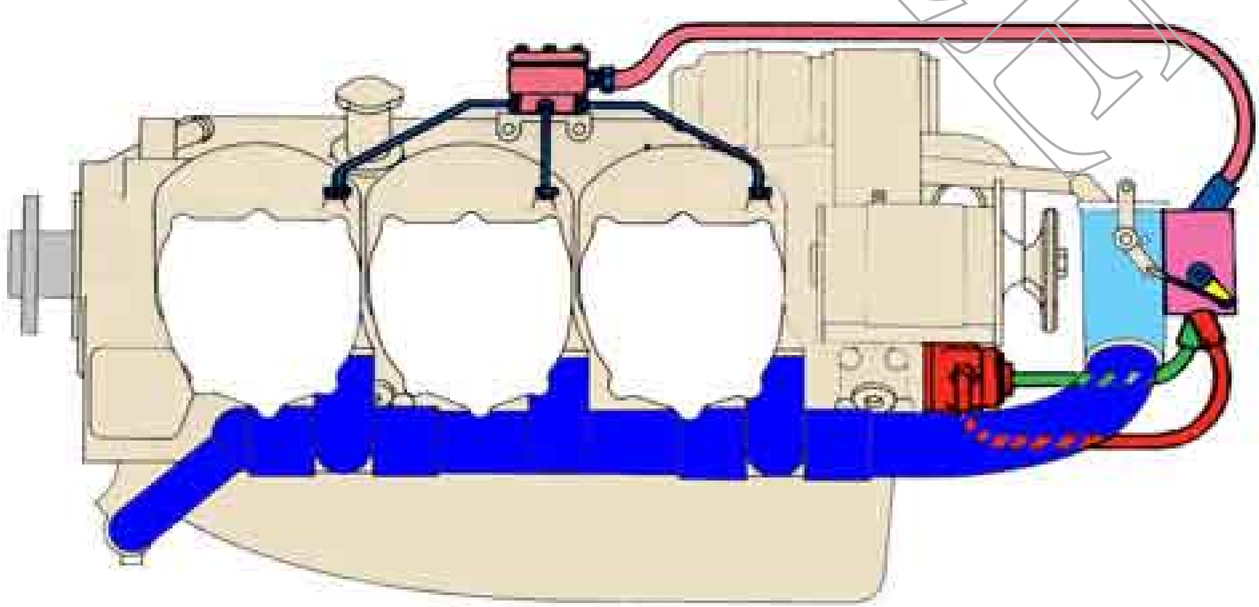
Continental fuel injection is of the multi-nozzle, continuous flow-type which controls fuel flow to match engine air flow. Thus, any change in air throttle position, engine speed, or a combination of both, causes changes in fuel flow in the correct relation to engine air flow. A manual mixture control and a pressure gauge, indicating metered fuel pressure, are provided for precise leaning at any combination of altitude and power settings. As fuel flow is directly proportional to metered fuel pressure, settings can be predetermined and fuel consumption can be accurately predicted. The continuous flow system permits the use of a typical rotary vane pump. With this system, there is no need for an intricate mechanism for timing injection to the engine. By careful design, automatic controls are not required thus eliminating many elements susceptible to maladjustment and to malfunctioning from dirt or gum particles.

Induction system

Mixture control valve, metered fuel pressure & distribution valve

Engine driven fuel pump & ummetered fuel pressure

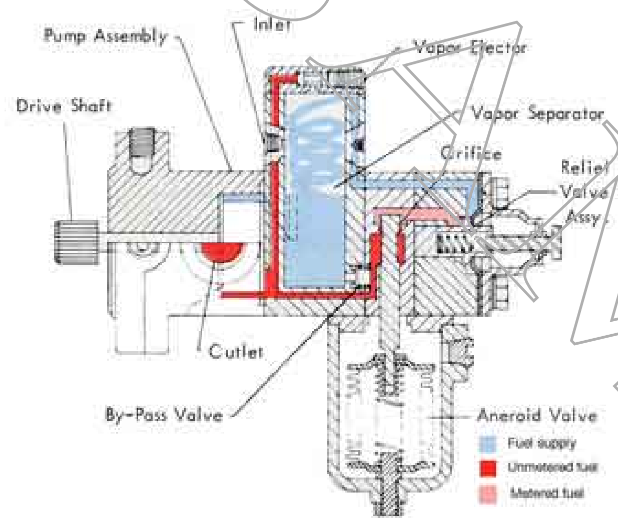
Fuel air horn

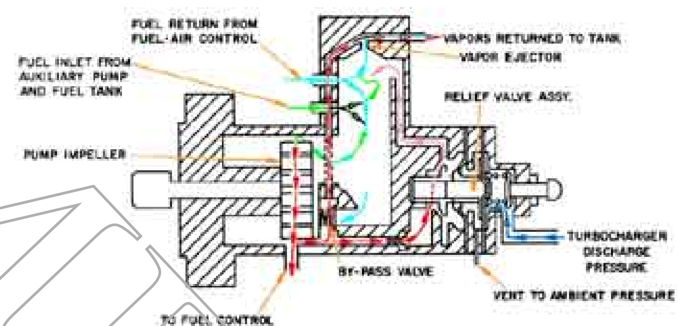


Description and operation

FUEL INJECTION PUMP

Fuel enters the system at the swirl well of the vapor separator. Here, vapor is separated by a swirling motion so that only liquid fuel is fed to the pump. The vapor is drawn from the top center of the swirl well by a small pressure-jet of fuel and is fed into the vapor return line. This line carries the vapor back to the fuel tank. There are no moving parts in the vapor separator, and the only restrictive passage is used in connection with vapor removal. Thus, there is no restriction of main fuel flow.

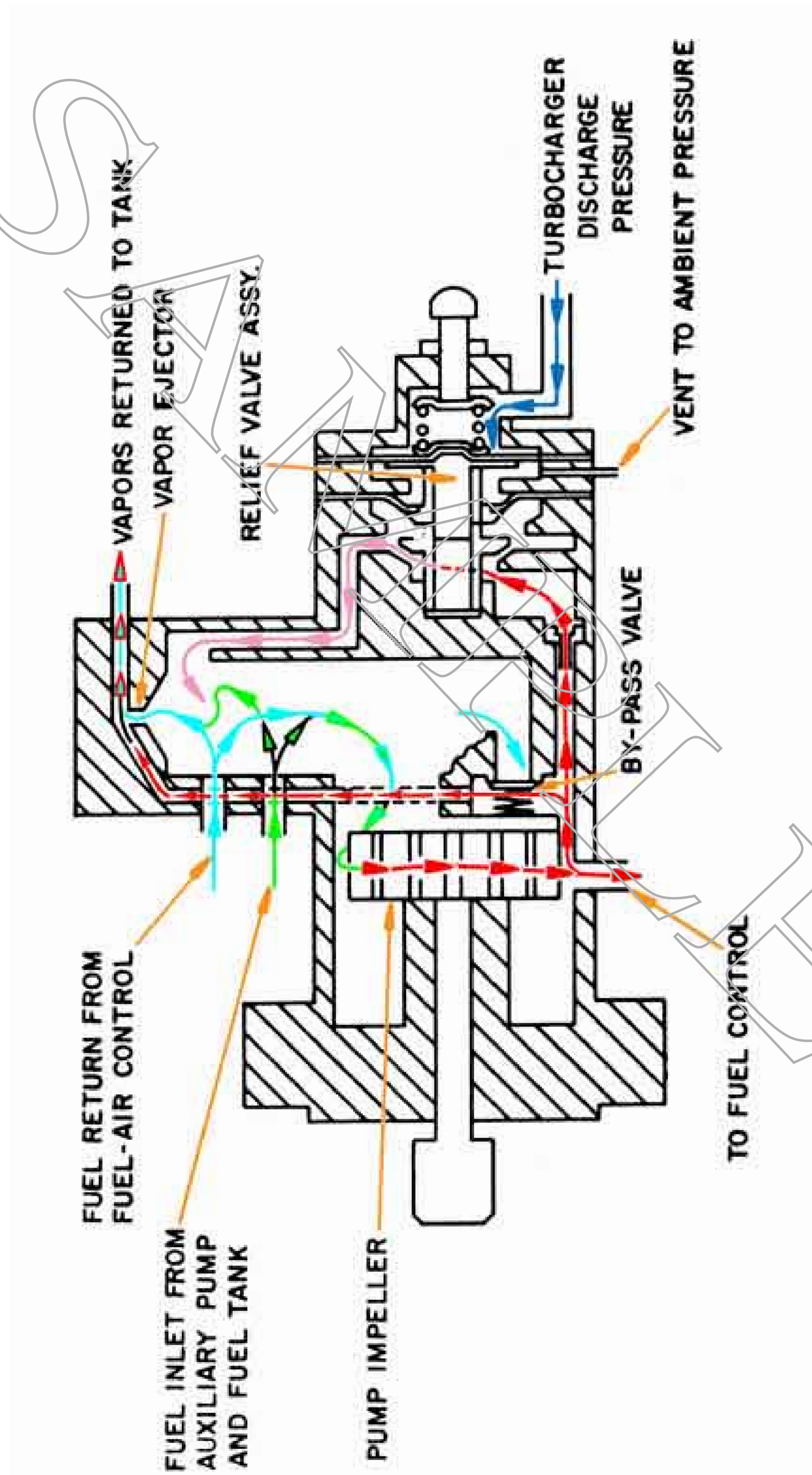




Ignoring the effect of altitude or ambient air conditions for the moment, the use of a positive-displacement, engine-driven pump means that changes in engine speed affect total pump flow proportionally. The pump provides greater capacity than is required by the engine and, thus, a recirculation path is obtained. By arranging a calibrated adjustable orifice and relief valve in this path, the pump delivery pressure is also maintained proportional to engine speed. These provisions assure proper pump pressure and delivery for all engine operating speeds.

A bypass valve is provided so that boost pressure to the system can by-pass the engine-driven pump in starting. This feature is also available to suppress vapor formation under high ambient temperatures of the fuel. Further, this permits use of the auxiliary pump as a source of fuel pressure in the unlikely event of failure of the engine-driven pump.

Description and operation



Description and operation

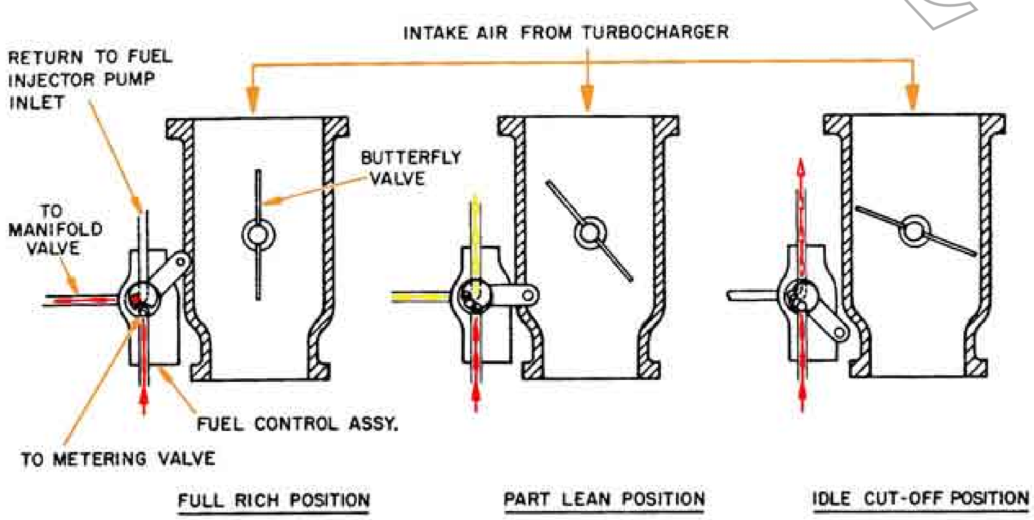
FUEL-AIR CONTROL UNIT

The fuel-air control unit occupies the position ordinarily used for the carburetor, at the intake manifold inlet. There are three control elements in this unit, one for air in the air throttle assembly and two for fuel in the fuel control assembly, which is mounted on the side of the air throttle assembly.

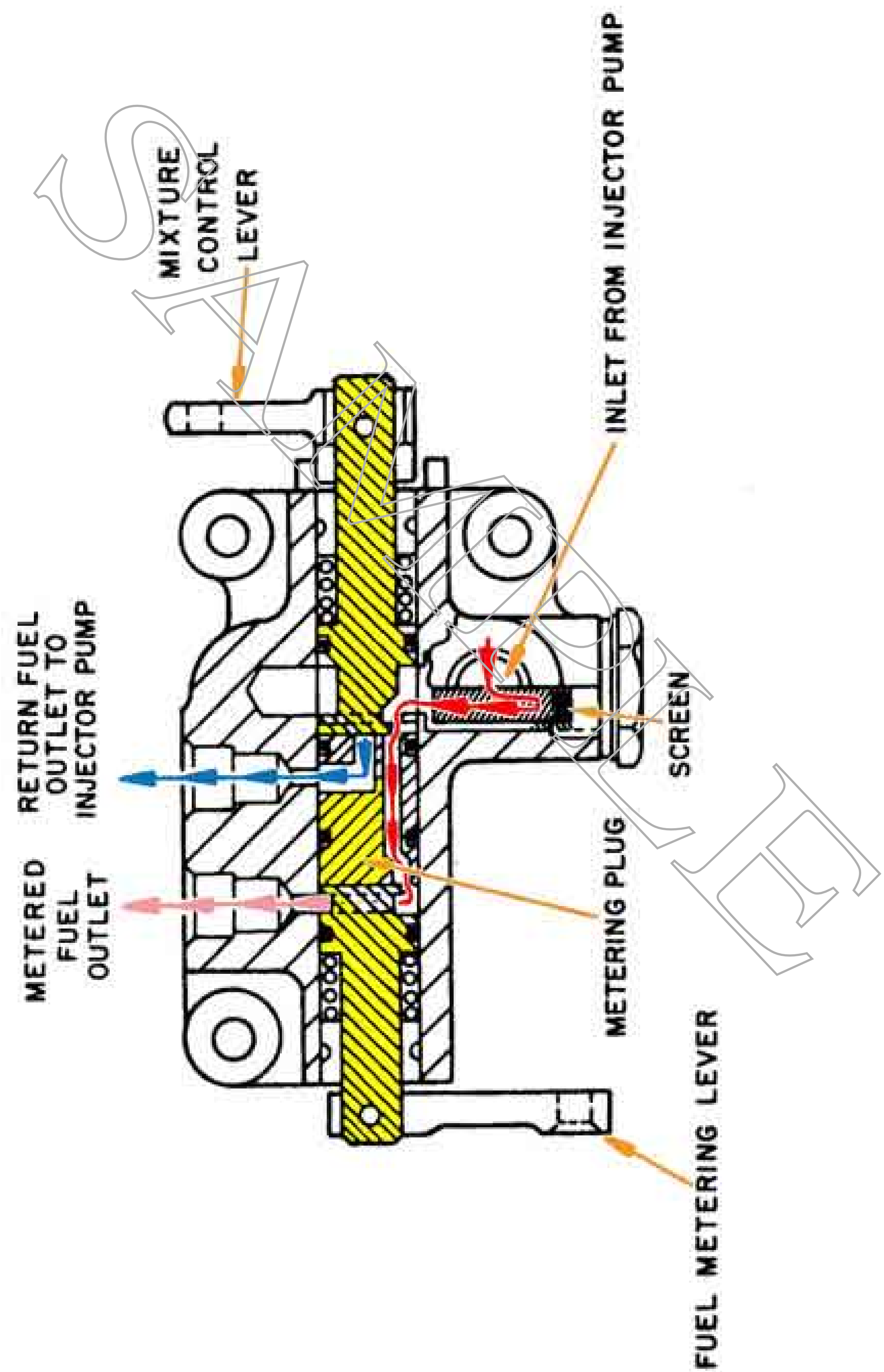
The air throttle assembly is an aluminum casting which contains the shaft and butterfly-valve assembly. The casting bore size is tailored to the engine size and no venturi or other restriction is used. Large shaft bosses provide more-than-adequate bearing area for the throttle shaft. Wave washers provide protection against vibration. The conventional idle speed adjusting screw is provided in the air throttle shaft lever and bears against a stop pin in the casting.

The fuel control body is made of bronze for best bearing action within the stainless steel valves. Its central bore contains a metering valve at one end and a mixture control valve at the other end. These rotary valves are carried in oil-impregnated bushings, and are sealed against leakage by O-rings. Loading springs force the valve ends against a fixed plug installed in the middle of the central bore. This bronze plug has one passage that mates with the fuel return port, and one through passage that connects the mixture control valve chamber with the metering valve chamber. O-rings seal this plug in the body. Each stainless steel rotary valve includes a groove which forms a fuel chamber. A contoured end face of the mixture control valve aligns with the passages in the metering plug to regulate the fuel flow from the fuel chamber. A control lever is mounted on the mixture control valve shaft for connection to the cockpit mixture control. In the metering valve, a cam-shaped cut is made on one outer part of the end face. A control lever (mounted on the metering valve shaft) connects to the linkage to the air throttle.

The fuel return port in the bronze body connects to the return passage of the center plug, and the registration of the mixture control valve with this passage determines the amount of fuel returned to the fuel pump. An easily removed plug at the fuel inlet port includes a filter-screen. This serves to remove foreign particles and dirt before the fuel passes into the valves proper.



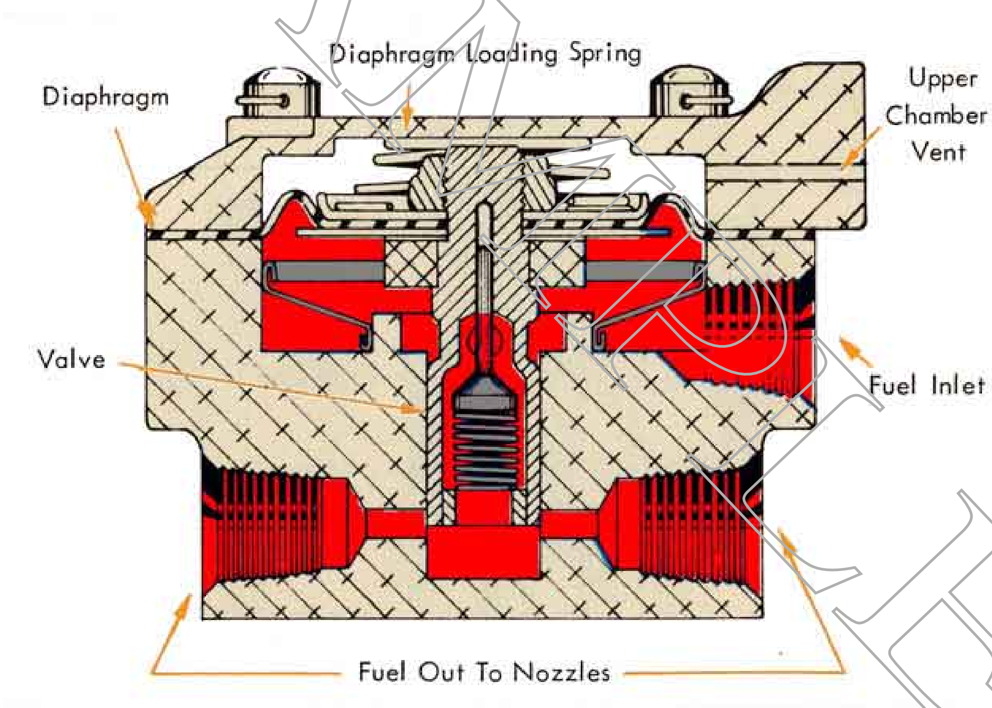
Description and operation



Description and operation

FUEL MANIFOLD VALVE

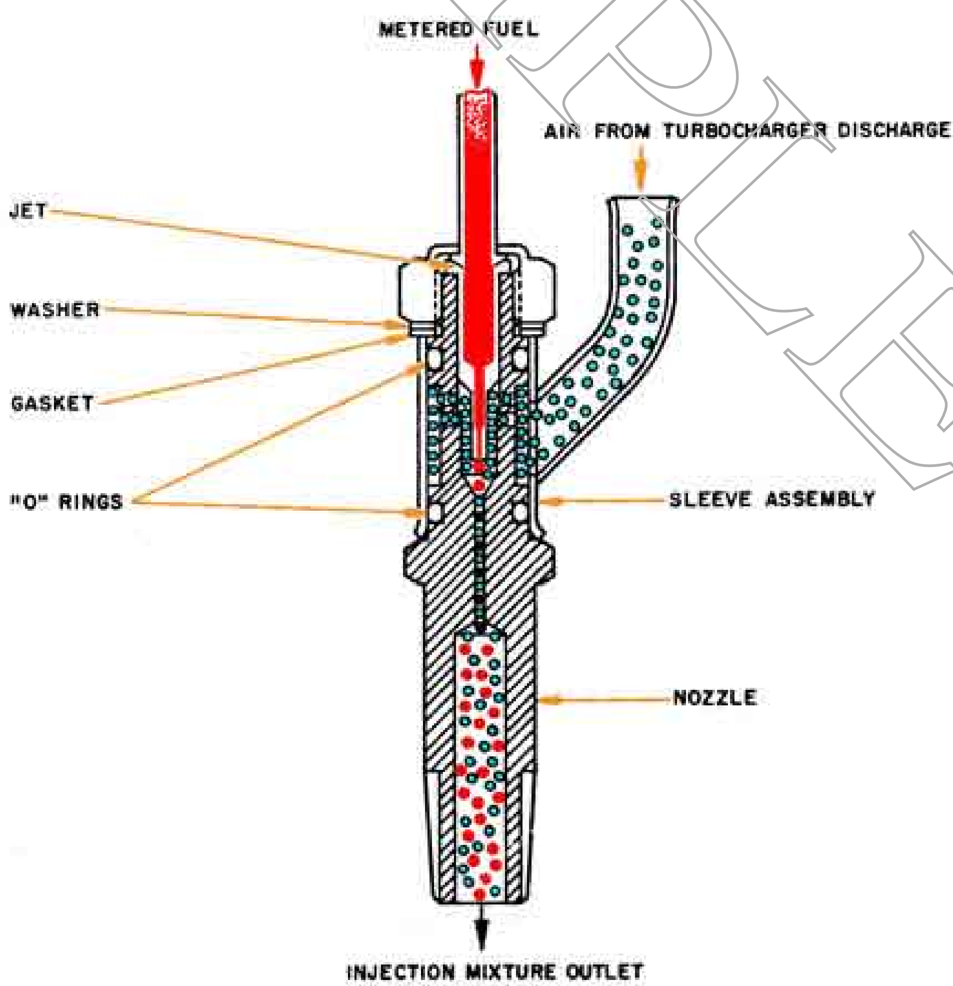
From the fuel injection control valve, fuel is delivered to the fuel manifold valve (or fuel spider) which provides a central point for dividing fuel to the individual cylinders. In the fuel manifold valve, a diaphragm and plunger valve raises or lowers (by fuel pressure) to open or close the individual cylinder fuel supply ports simultaneously. A ball check valve under the plunger serves to insure that the plunger fully opens the outlet ports before fuel flow starts. Thus, there is no unbalanced restriction to flow in the fuel manifold valve. A fine mesh screen is included in the fuel manifold valve as additional protection of the injection nozzles against dirt or foreign matter.



Description and operation

FUEL DISCHARGE NOZZLES

From the fuel manifold valve, individual fuel lines carry the metered fuel to the fuel discharge nozzles, one for each cylinder. These are installed in the cylinder heads outside each intake valve. While a calibrated orifice is used, there is no valve and no structure of closely-fitted moving parts to be sensitive to dirt or icing.
An air bleed arrangement is incorporated in each nozzle. This aids in vaporization of fuel and, by breaking the high vacuum at idle, maintains the fuel lines solidly filled and ready for instant acceleration of the engine.
Turbocharged air is supplied to the fuel nozzle for better fuel atomization and provides the fuel nozzle with a controlled altitude so the fuel nozzle will not lean with altitude in a turbo charged engine.



System Operation POWER ON

Operation #1

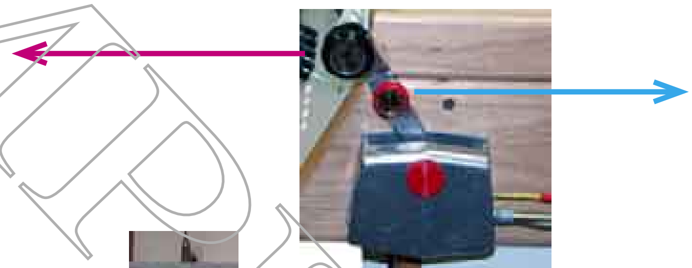
Fuel nozzle flow check

A minimum of 2 people are required to use this trainer, one must be the instructor. Locate one person at the control panel, and place one as fire guard.

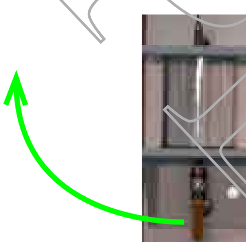
1) Move the fuel selector to the "left" position.

2) Ensure all switches are down and off

3) Check throttle and mixture levers for freedom of movement. Set the throttle to full aft position and the mixture to full rich mixture (forward).



4) Close all 6 nozzle fuel tank drain valves by moving the yellow handle to the 9 o'clock position.



5) Turn on the master switch on (up).

6) Prime the system, set the boost pump to on then turn on the engine pump switch and advance the throttle lever (black) and set the idle RPM to 450, note the small amount of fuel exiting the fuel nozzles.

7) Leave the manifold air pressure (MAP) at standard day. Do not boost.

System Operation POWER ON

Operation #1

Fuel nozzle flow check (cont)

8) Note the fuel pressure fluctuates when at idle. This is typical of the TCM fuel system and can be seen on most aircraft when performing fuel system setups.

9) Slowly throttle up the RPM to maximum.

- Note the fuel nozzle spray. Fill the glass cylinders completely full.
- Slowly increase the manifold pressure to 35" and note the change in the nozzle spray pattern. This demonstrates the fuel nozzle atomization due to upper deck air being injected into the nozzle shroud and mixing with the fuel. Also note the Fuel flow gauge increase and decrease with the manifold pressure,
- Return the throttle back to idle.
- Discuss the fuel levels and any discrepancies with them.

10) Once this discovery process is finished reduce the M.A.P. to standard day, open all the drain valves and allow all the fluid to return to the tank. Return the throttle full aft and move the mixture valve full aft.

System Operation POWER ON

Operation #2

Unmetered fuel pressure check

1) Move the mixture control all the way to full rich or forward.

2) Turn on the engine pump switch.

3) Advance the throttle until you read 450 to 500 RPM on the tachometer.

NOTE: If the fuel pressure will not increase and no, or very little fuel is being dispensed by the nozzles you may have to actuate the electric boost pump until pressure stabilizes.

4) Once you have stabilized fuel pressure and the electric pump is turned off read your unmetered pressure. It should be 5.5 to 6.5 PSI

NOTE; The unmetered gauge has to be installed by the technician in the field and located as close to the same level to the fuel pump as possible. Or the reading will be affected. The unmetered fuel gauge is a permanent part of this trainer.

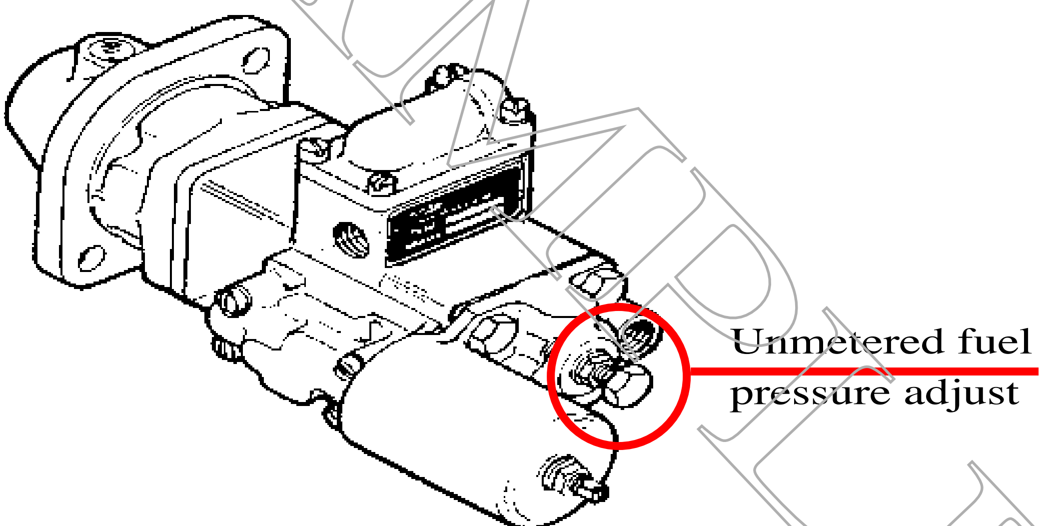
System Operation POWER ON

Operation #2

Unmetered fuel pressure check (Cont)

5) If adjustment is necessary loosen the jam nut on the fuel pump unmetered adjustment screw.

Caution: very light pressure (approximately 7-10 inch pounds) is required to lock the adjusting jam nut, overtightening will strip the threads in the housing.



- If unmetered pressure is to high adjust to a lower pressure by turning the adjustment screw counter clockwise.
- If unmetered pressure is to low adjust to a higher pressure by turning the adjustment screw clockwise.

6) Turn off the pump switch and return the mixture to Idle cutoff.

System Operation POWER ON

Operation #3

Fuel idle mixture check

Although it's not possible to perform an actual engine fuel mixture check we want to demonstrate how it typically is performed on a Cessna 421C with a GTSIO 520 L Continental engine installed.

1) Running the aircraft set idle to 450 to 500 RPM
2) Mixture lever full rich
3) Aux pump on low

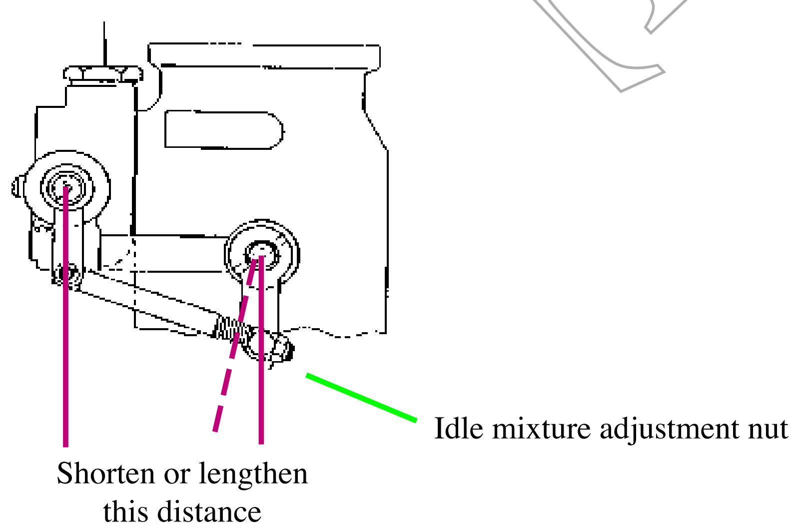
✈ Slowly reduce the mixture until the engine starts to quit. Just before the engine quits you should see a 10 to 30 RPM rise

✈ Advance the throttle to 1300 RPM then slowly reduce the mixture to idle cut off and note the rise, it should be 10 RPM

Note: If RPM rise increases above the specifications then the idle mixture is too rich. If the RPM rise is not enough then its too lean.

✈ Idle mixture adjustment procedure:

The idle speed adjustment is a linkage with a friction nut that by turning either shortens or lengthens the linkage. If you want a leaner mixture you shorten the linkage by adjusting the nut tighter. A richer mixture is obtained by backing the nut off and lengthening the linkage.



System Set Up POWER OFF

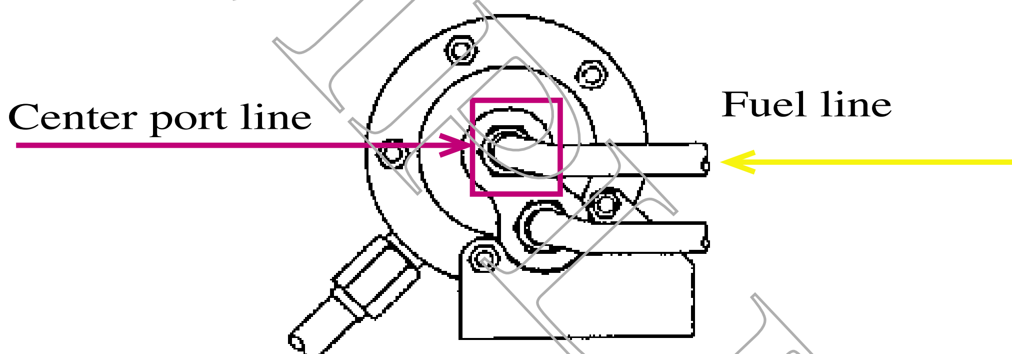
Operation #4

Fuel pump maximum unmetered fuel pressure adjustment

CAUTION

Power off and the trainer unplugged before proceeding with these adjustments.

1) Before you can check the high unmetered fuel pump pressure you must disconnect the fuel line connected to the center port of the high pressure regulator. Remove and plug and fuel line, then cap the port with a blue aluminum cap, tighten securely.
Caution; clean all solvent spills and allow to dry before proceeding to the re-adjustment section.



2) Adjust the MAP to 35". The adjustment may wander so diligence is required to keep all settings at their correct targets.

3) Turn on the master switch and engine pump switch

4) Move the mixture control cable to full rich and the throttle to maximum RPM. Maximum fuel pressure should be 260 pounds per hour on the fuel flow gauge.

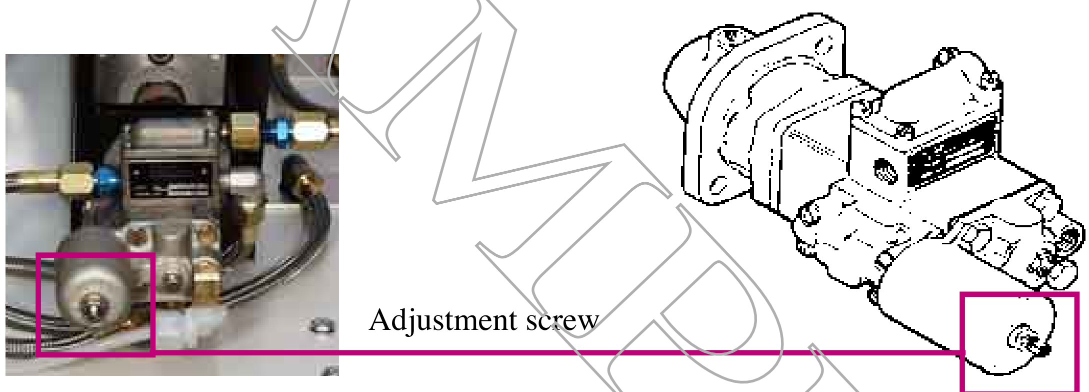
System Set Up POWER OFF

Operation #4

Fuel system maximum unmetered fuel pressure adjustment (cont)

5) If the fuel flow is not within tolerances, adjustment of the aneroid bellows must be made.

6) If the fuel flow is too low, loosen the jam nut and adjust the screw counter clock wise. If the adjustment is too high turn the adjustment screw clockwise. Re-secure the jamb nut after adjustment.



Caution: Very light pressure (approximately 7-10 inch pounds) is required to lock the adjusting jam nut, overtightening will strip the threads in the housing.

Note:

When adjusting either the low unmetered fuel pressure or the high unmetered pressure it is necessary to recheck both as one can effect the other.

7) Reconnect the fuel line previously connected to the center port of the high pressure regulator.

Caution:

Clean all solvent spills and allow to dry before proceeding to another section.

System Operation POWER ON

Operation #5

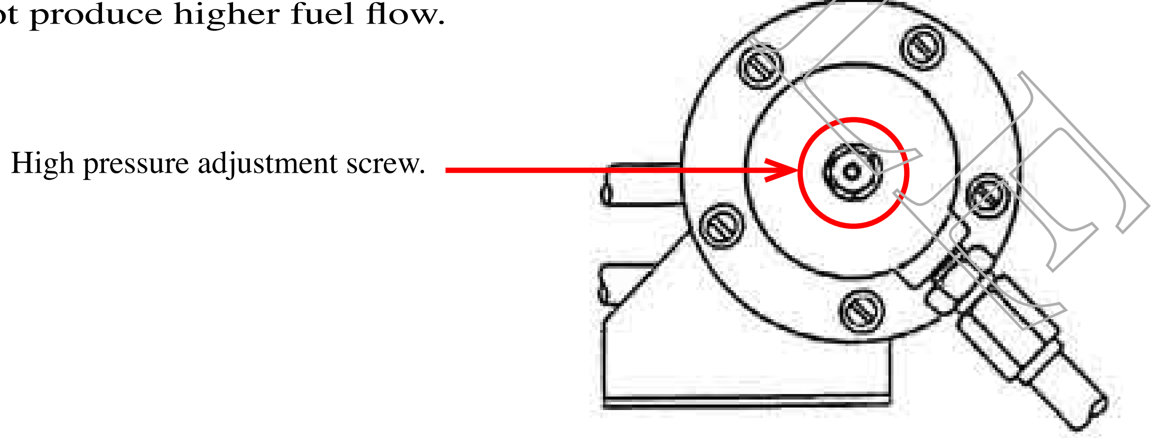
Fuel pump pressure regulator adjustment

1) Turn on the master switch and engine pump switch

2) Run the fuel injection system with the mixture lever to full rich, the throttle maximum RPM, and the MAP at red line.

3) The fuel flow gauge should read 255 pounds per hour (PPH).
NOTE: This is approximatly 5 PPH lower then the 260 set on the high unmetered fuel pump setting. This ensures the fuel pump is providing slightly more than is required by the engine.

If the fuel flow is low adjust the high pressure regulator by loosening the jamb nut and turning the adjustment screw in to increase. If the fuel flow is too high turn the aneroid bellows screw out to decrease.
NOTE: If the fuel pump unmetered presssure is too low this adjustment will not produce higher fuel flow.



Caution: Very light pressure (approximately 7-10 inch pounds) is required to lock the adjusting jam nut, overtightening will strip the threads in the housing.

4) After the adjustments are made and the targets are achieved gently tighten the jamb nut with very light pressure.