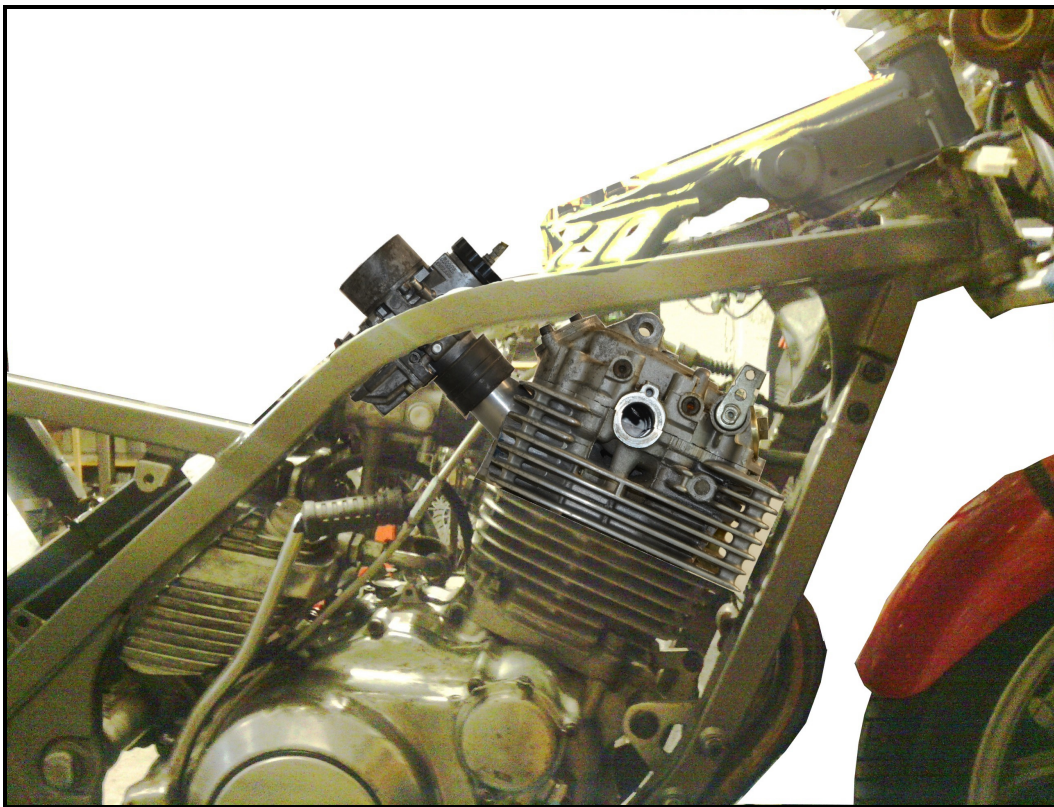
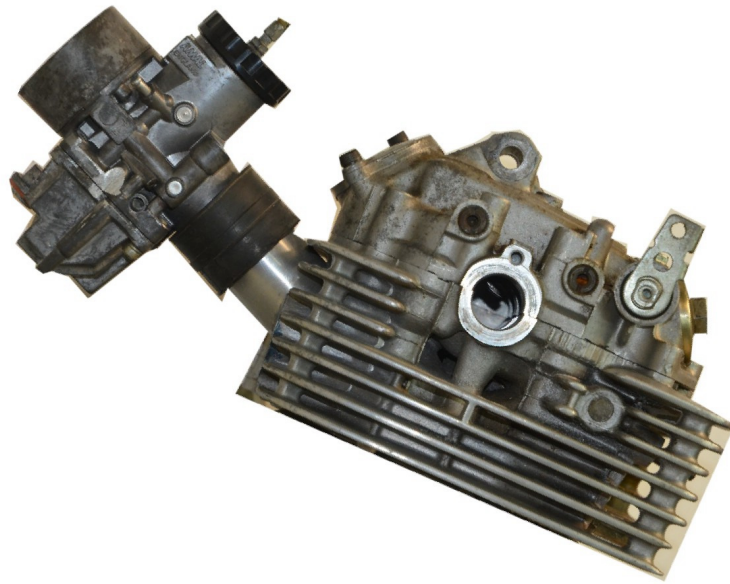


## **Amal Mk.2. carburettors.**

### **Considerations for running at high downdraft angles.**

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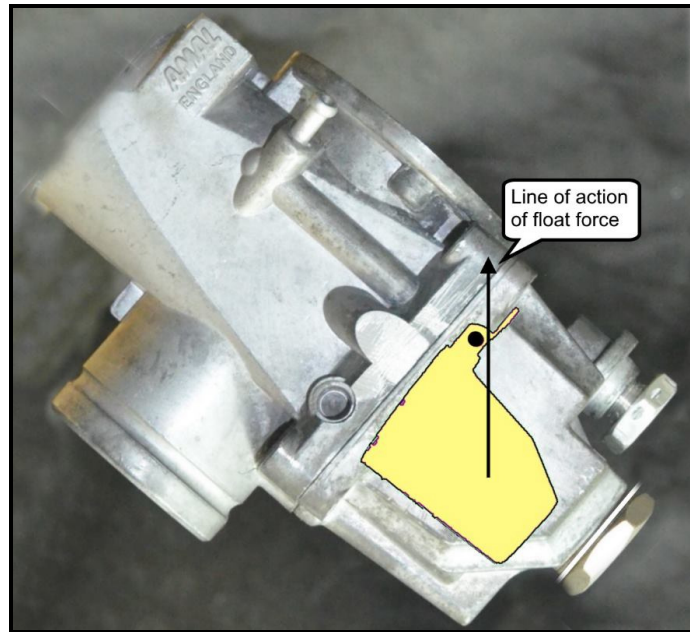
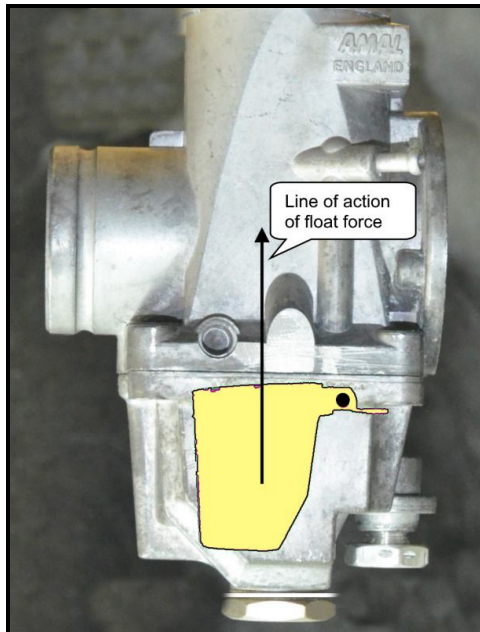
I recently modified the ports in a Yamaha SRX 600 to help breathing for classic racing. Tubes were inserted to steepen the ports. The combined down draft angle and forward tilt of the engine resulted in an extreme carburettor downdraft angle beyond their design envelope. This note describes the problems of such a down draft and the modifications to the carburettor to solve them.



The head and carburettors shown at the working angle. The extreme downdraft angle is clearly shown.

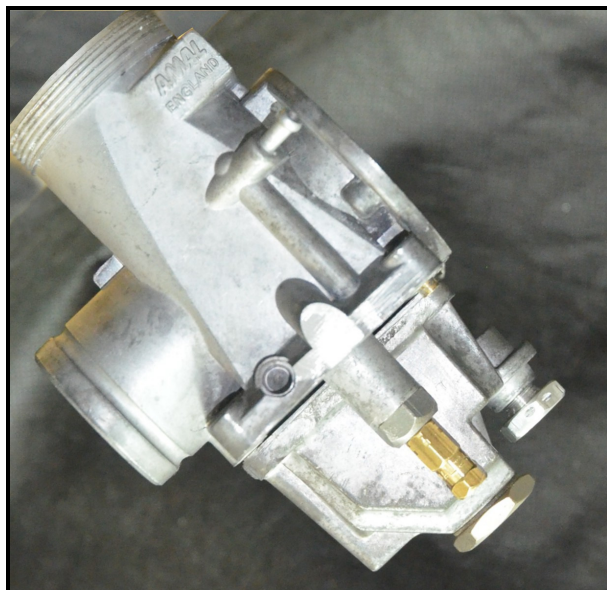
## Initial evaluation.

Initial static tests showed that the float and needle could not be relied on to shut off the fuel at 45 deg. or greater downdraft. In fact the action of the float was reversed, instead of closing off the needle valve as the fuel level rose it would tend to hold the valve open with severe flooding being the obvious result. The use of an external float chamber such as the Amal Matchbox would solve this problem. The float needle or float and needle would need to be removed from the carburettors.

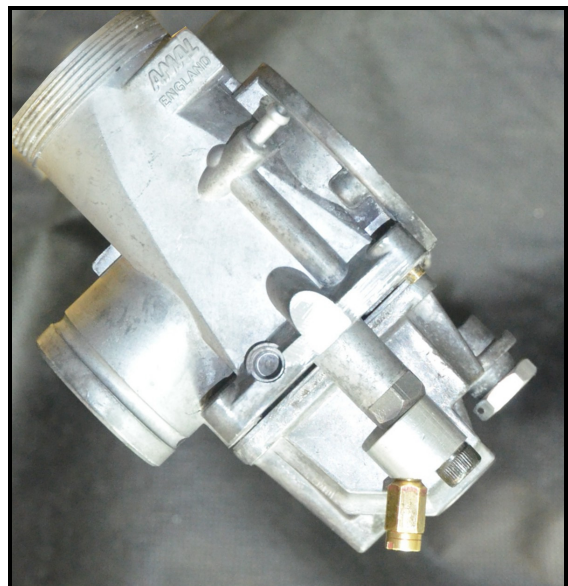


Carburettor mounted in designed orientation, the centre of the float buoyancy force is to the left of the float pivot. This results in a clockwise moment which shuts the needle valve.

Here we can see that at high down draft angles the float moment is reduced and may even become anti-clockwise which will hold the needle valve open not closed, resulting in flooding. An external float bowl would be immune from such problems.



Standard carb. at 45 degrees showing the jet/bowl relationship.



Modified jet position showing the packaging problem. A shorter jet would fit inside the bowl but the tolerance to fuel level height variation would be reduced compared to a longer jet.

However, as the following illustrations show, flooding due to the floats acting beyond their designed angle is not the only problem. Main jet flooding or fuel starvation at the jet and the pilot circuit feed could occur under hard braking. Fuel starvation in itself might not seem to be a large problem during braking, but it would remove control over engine braking, and the transition back to a demand for instant power delivery would be severely compromised. Flooding would be undesirable both during braking and immediately afterwards.

A possible solution to the main jet problem is the inclusion of an adaptor piece to allow relocation of the jet to a vertical orientation with the jet entrance farther forward. However, there is limited space in the standard float bowls for a vertical jet (i.e. vertical with a 45 deg. down draft) and it would not address the high and dry pilot circuit. Illustrated above. The solution to both of these problems is a new redesigned fuel bowl.

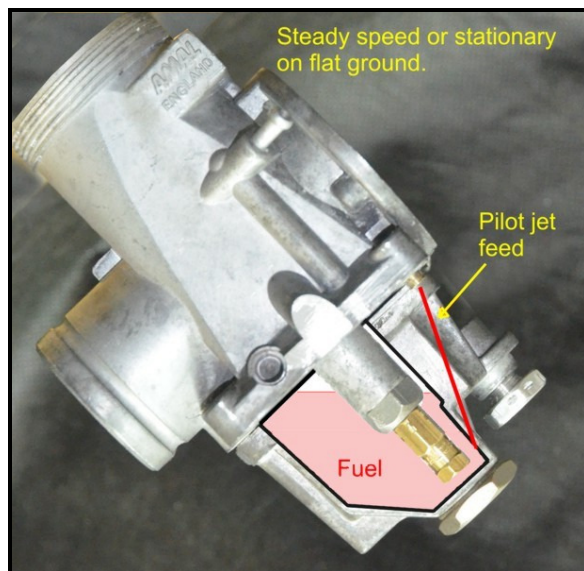
Let's look at the three cases of travelling at

1. Constant speed on a horizontal surface.
2. Acceleration of 1g.
3. Braking at 1g.

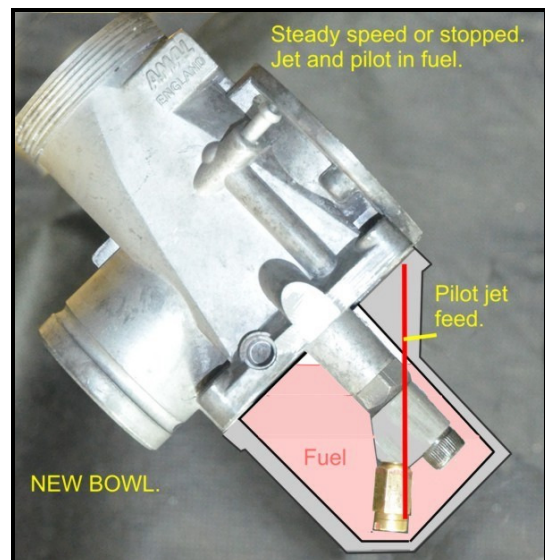
We will see clearly that the braking case is the critical one which drives the design of the modifications.

### **Straight and steady on horizontal surface.**

Both the main jet and pilot jet pickup are under the fuel level in the original and new bowls. Either should work equally well under these conditions.



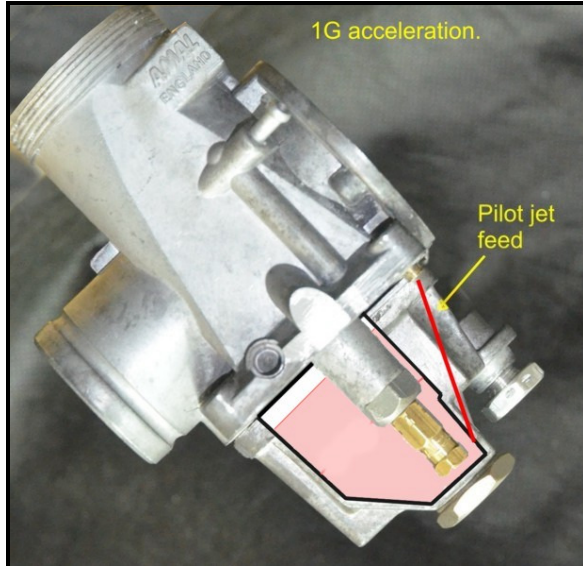
Standard carb. at 45 deg. downdraft angle, showing that both the jet and the pilot jet feed are submerged, when stationary or travelling at a steady speed, both cases on a horizontal surface.



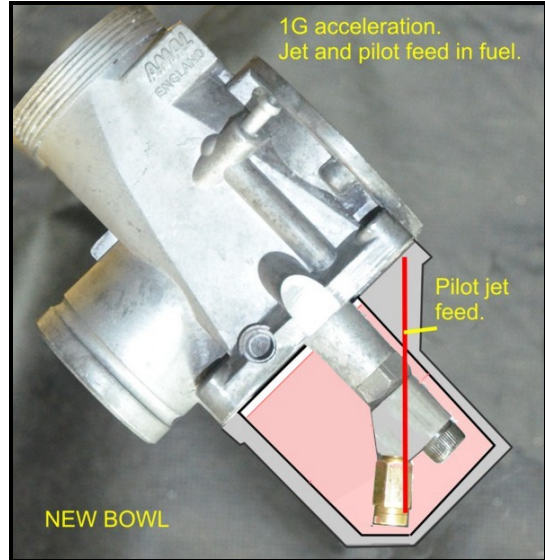
Proposed new bowl for use with a remote float chamber and repositioned main jet. Note the altered drilling for the pilot feed. Both pilot and main jet are submerged.

## Acceleration on horizontal surface.

Under 1g. acceleration the fuel surface will adopt an angle of 45 deg. to horizontal which, in the case of carburettors with a 45 deg. downdraft, means that the fuel surface will be parallel to the base of the carburettor, which of course, is the designed configuration for a carburettor mounted with zero downdraft. Hence we should expect no problems under these conditions with both the standard and modified versions.



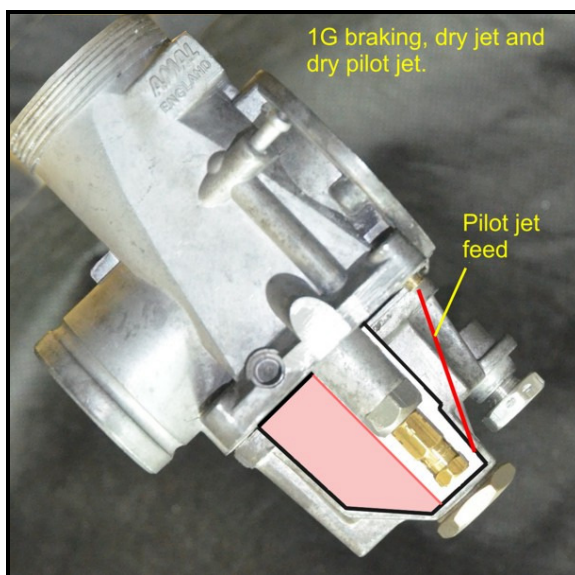
Standard carburettor, showing fuel level at 45 deg. feeding the main jet and pilot circuit.



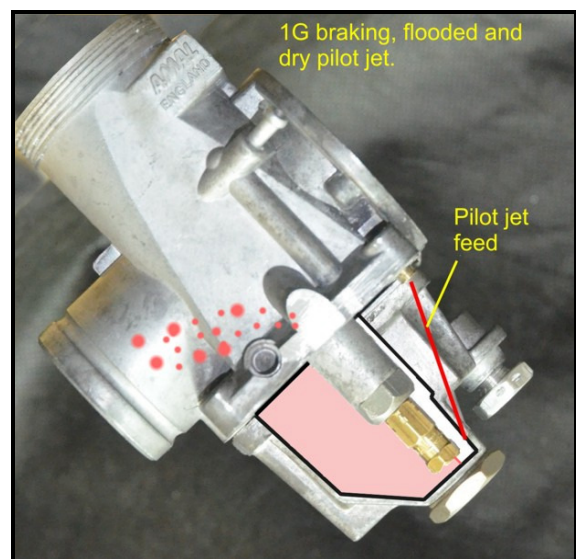
The modified carburettor showing pilot feed and main jet submerged.

## Braking at 1g. on horizontal surface.

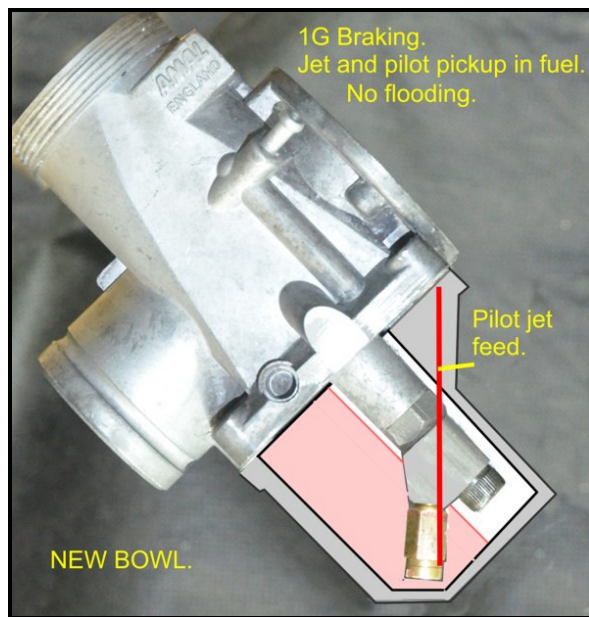
Under 1g. braking the fuel surface will adopt an angle of - 45 deg. to horizontal which, in the case of carburettors with a 45 deg. downdraft, means that the fuel surface will be normal to the base of the carburettor, this is most definitely not the designed configuration. Depending on the amount of fuel in the bowl this can result in either fuel starvation or flooding as these illustrations of the standard carburettor show. Neither, result is acceptable. In either case the pilot circuit will be starved of fuel.



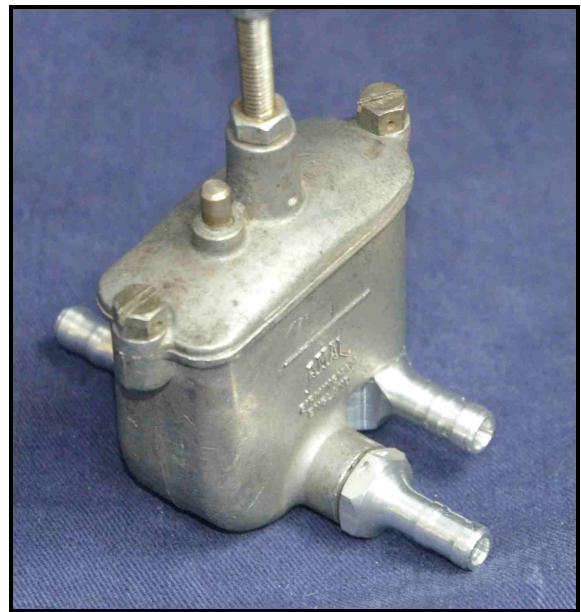
If the fuel level is too low then both the main jet and pilot will be starved of fuel.



If the fuel level is too high then fuel will flood through the main jet.



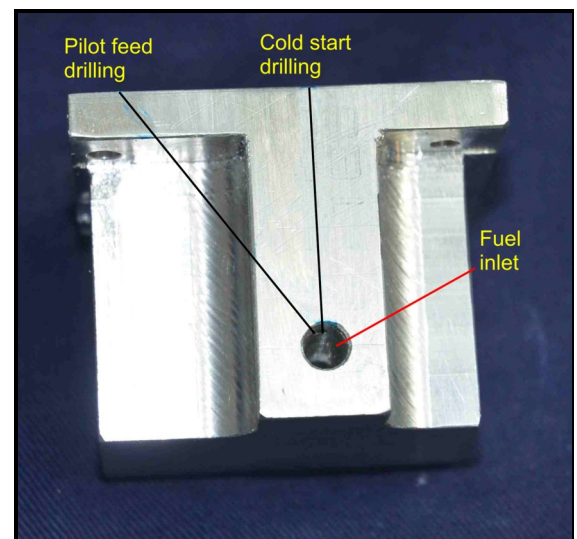
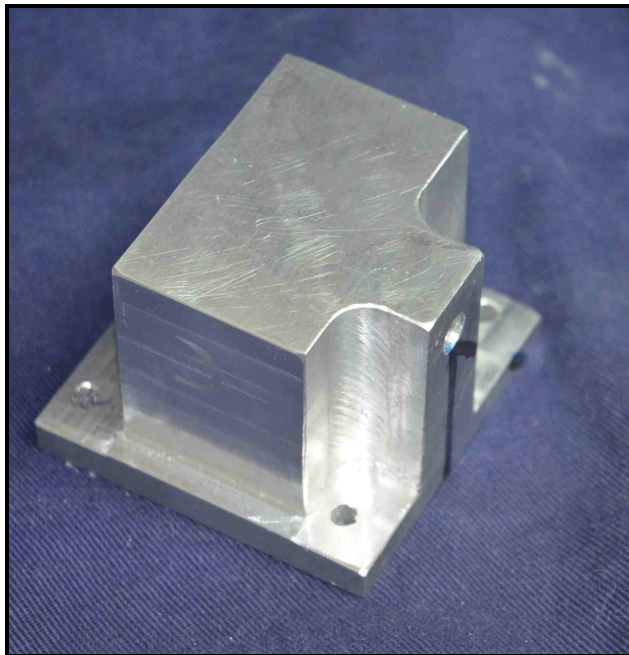
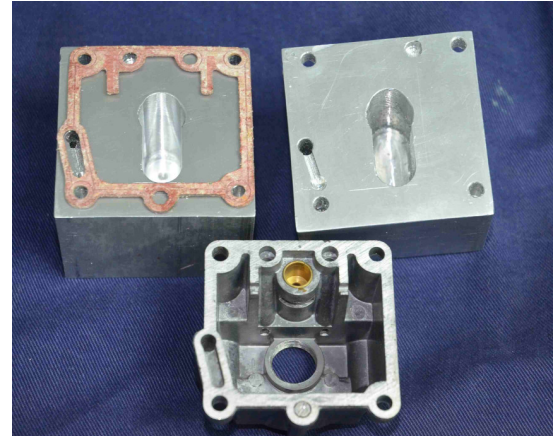
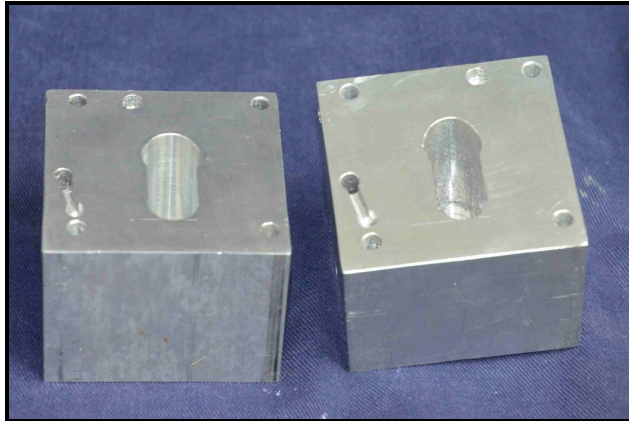
With the new bowl and jet orientation there is quite a large tolerance on the fuel level with both jet and pilot remaining wet and avoiding flooding.



The Amal "Matchbox" remote float chamber.

## Implementation of the new bowl design.

The following photos show the various stages in the machining of 2 bowls. The internal volume and distribution of same was subject to measurement and experiment to determine the optimum. Without floats there is little reason to carry a lot of fuel in the bowls, the level will be controlled by the remote float chamber. Earlier Amal racing carburetors, with remote or side mounted float chambers, had only minimal fuel volume surrounding the jet. Once the fuel volume had been determined additional external machining was done to give suitable wall thickness to minimize weight. The path of the drilling for the pilot jet feed is shown. Both the pilot and cold start feeds are arranged so that they can be fed from the hole for the fuel inlet union.



Initial machining of new bowls. The illustration above Shows how the pilot and cold start passages meet in a side view with the fuel inlet hole. This eliminated any need for additional drillings and/or plugging.



**New redesigned bowls finished.**



**New bowls fitted to carburetors.**

## PS. Elimination of float bowl.

Since writing the foregoing, there has been an evolution of thought which will allow for the elimination of the float bowl as the mechanism for maintaining the desired fuel level.

It was always intended that this bike will use an under-seat fuel tank and a Mikuni pulse operated fuel pump to lift the fuel up to the carburetors.

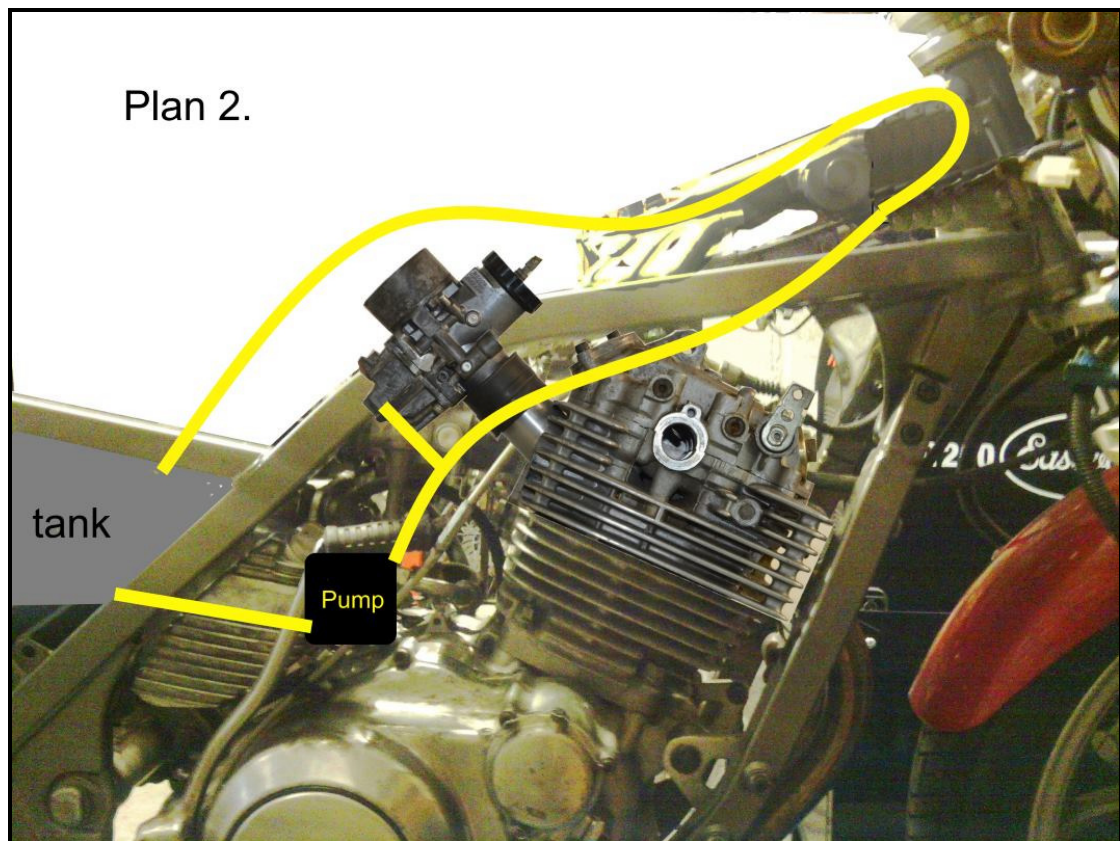
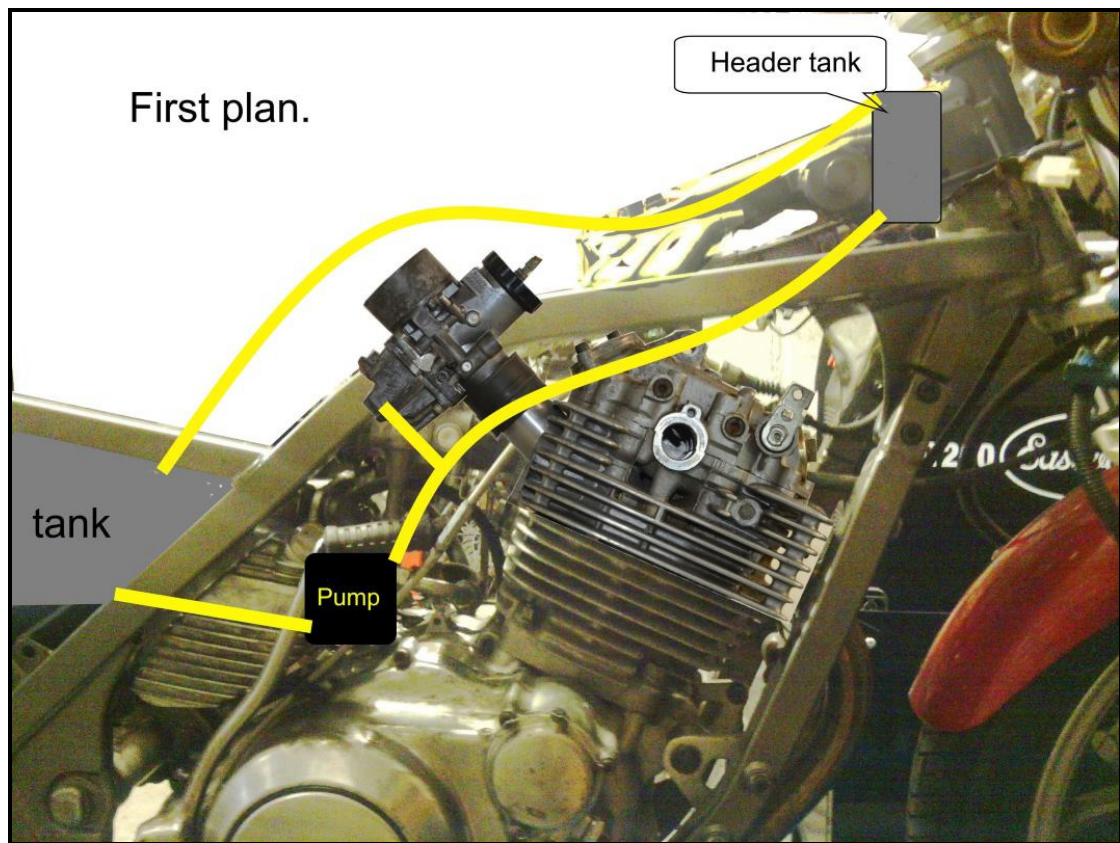


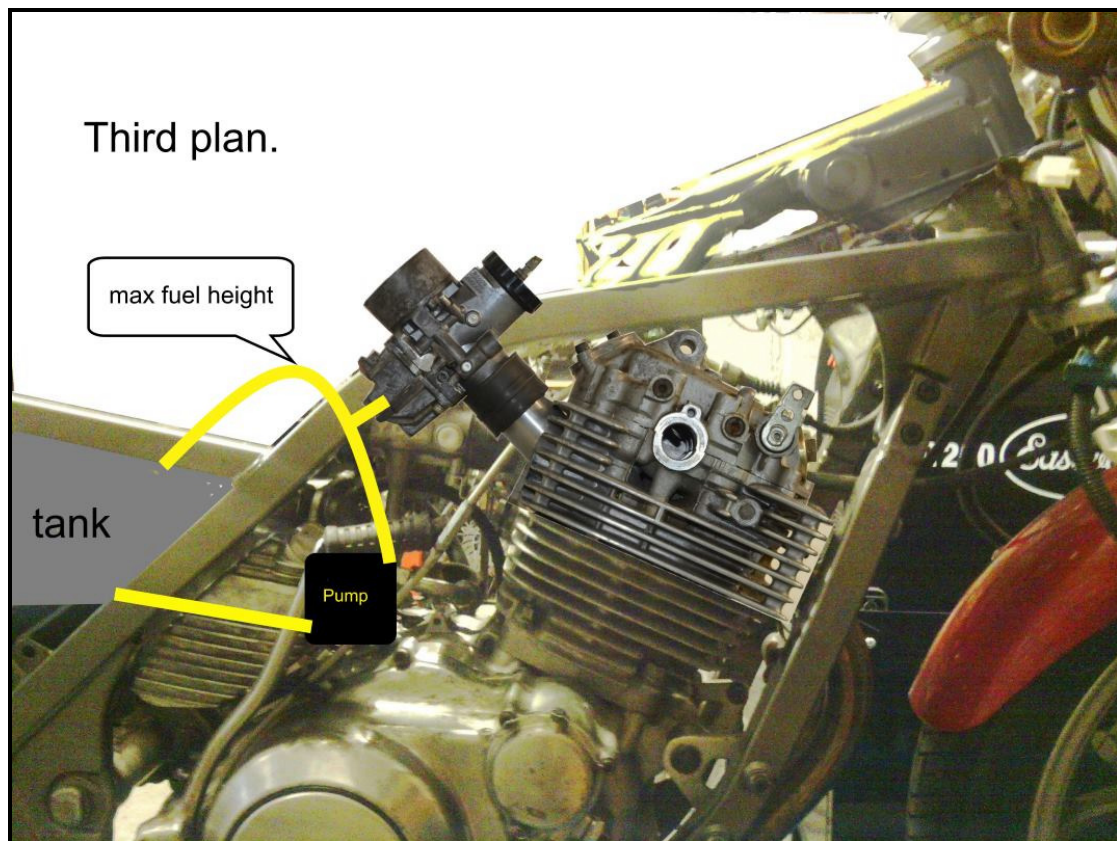
Range of Mikuni pulse fuel pumps.

The first iteration of the thought process involved pumping the fuel up to a small header tank with an overflow return to the main tank. This would thus feed the carburettor with a constant head of fuel. This system has been used by several others in the past. Further thought indicated that there was no need for the header tank. As long as the fuel loop passed by the same height as the header then the pressure of fuel on the fuel bowl would remain the same. I like simplicity. Then the penny dropped, if the maximum height to which the fuel was pumped was equal to the required fuel level in the carburetors then there would be no need for the float chamber. Also the amount of fuel sloshing at the carburetors would be minimized. Ever more simplicity.

If a simple "Tee" piece was inserted in the fuel line to feed the carburetors there would be the possibility that the fuel flow from the pump back to the tank would suck fuel out of the carburetors rather than let it flow inward. To avoid this venturi effect I have made a micro header-tank which slows the fuel velocity as it passes the carburettor tapping.

The following sequence of pictures shows the evolution of the fuel circuit design.





The previous three pictures show the evolution of the final fuel circuit design which eliminates the need for a float chamber in the final configuration.

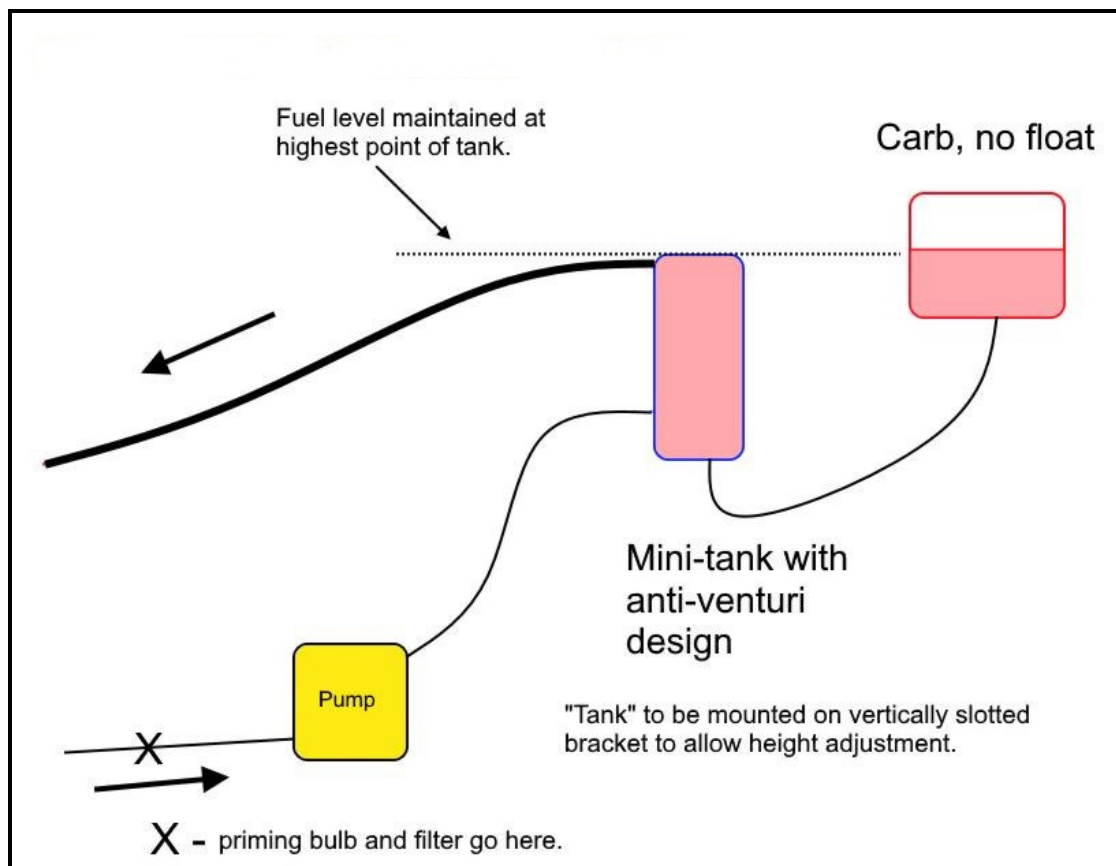


Diagram showing the final fuel circuit design.



**The Micro header-tank to eliminate a venturi effect from sucking fuel out of the carburetors. Shown alongside is a carburettor with the new (non-float) bowl for size comparison.**



**Micro header tank showing large flow passage diameter to reduce/eliminate any venturi effect.**