Fuel System

Last updated 12-Dec-2019

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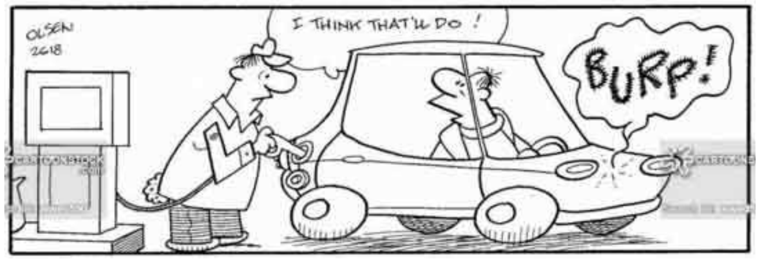


Air Cleaners *November 2014*

Decals

The same basic arrangement was used on twin-carb MGBs, right through production on RHD cars, LHD changed to single carb at various times. One filter can per carb, with a short interconnecting hose, presumably to equalise air pressure between the two. Each can consists of a body with the air inlet, a pressed steel base, and an alloy plate which butts up against the carb flange with a gasket. The filter element is cylindrical which is clamped between the body and the pressed steel base, and there is a rubber gasket that goes between the base and the alloy plate. Long bolts with oversize steel and rubber washers go through steel tubes inside the body of the can, the centre of the filter, the alloy plate, gasket and the carb flanges. The tubes fit inside stepped rubber washers in the top of the can and prevent it and the filter being crushed from overtightening of the bolts. On HS carbs 5/16" UNF bolts 17H2541 go through the carb flanges into U-shaped brackets with threaded bosses, but on HIFs 5/16" UNC bolts screw direct into the carb flanges. The U-shaped bracket on the rear carb (AHH 6372) is a plain U with a threaded boss at each end, but the front bracket (AHH 6371) has an extension finger from one of

the bosses projecting upwards between the carbs. This was used as the attachment point for the choke cable inner on HS carbs and early HIFs.

Initially, on 18G and GA engines without positive crankcase ventilation, there was a hose leading from a port on the rocker cover to the base of the front air cleaner, on the outside i.e. 'dirty' side of the filter, which acted as one half of a crude form of crankcase ventilation, the other half being an open tube hanging down from the front tappet chest cover. This meant that front and rear 'cans' differed, although I can only see the base being different, not the main part of the can. Nevertheless the Parts Catalogue shows the complete cans as being AHH 7354 for the front and BHH 154 for the rear. These seem to have continued until chassis number 258001 - which was the start of the 1972 model year in Aug 71 - even though the hose to the front can was replaced by the PCV valve in Feb 64, and that was replaced by carb ventilation on 1969 models. That would have meant an open port on the front cleaner which would be unusual, although not out of the question as it was on the dirty side of the filter.

Dec 71 UK models changed the cans to BHH 548 and BHH 549, the previously straight air inlet tubes changing to curved. Clausager states "to comply with new noise regulations, similar to those found on non-North American models from car number 258001". Note the carbs remained as HS. For 1972 export models other than North America the can changed to BHH 546 front and BHH 547 rear, which was the same time that the twin carbs changed to the HIF type on those models. As the only part of the filter assembly that touches the carbs is the alloy base, North America also changed for the 1972 model year and HIF carbs - but to BHH 665 front and BHH 666 rear. How these differed from other export cans is not known. All these cans also changed from straight to curved inlet tubes. I can't see any difference between the front and rear cans on my 73.

For 1974 the UK changed to the non-North American export cans i.e. BHH 546 front and BHH 546 rear when they changed to HIF carbs, and stayed that way until the end of production.

None of these cans are currently available from the usual suspects, except ironically the earliest front can AHH 6371 from Brown and Gammons. But apart from that can with the port for the rocker hose, I have not been able to find any difference at all between front and rear cans. Furthermore the only part of the can assembly that touches the carbs is the alloy plate, so one could imagine that changing between HS and HIF carbs. However whilst the usual suspects do list that part (17H 2545) they say it is suitable for all years and don't differentiate between HS and HIF!

There is also the question of why the inlet tubes changed from straight to curved anyway. It did occur to me that the straight one at the rear could foul the remote servo, and that didn't become standard until 1974 i.e. a year after the cans changed, but it had been optional from Feb 1970. Clausager only shows straight pipes with no servo, or curved pipes with the servo. I googled for images of the engine compartment, did find one that showed straight pipes with the servo, but that was described as a 66 model so obviously modified. I then wondered whether curved pipes were fitted earlier when the servo was factory fitted, not mentioned in the documentation until they became standard in 1972. I did find a picture of a 71 with curved tubes and servo that would fit the bill, but then it had a weird radiator with a centre fill but the top hose on the right (alternator/dynamo) side which was a combination never used by the factory, changing from rear fill right side to centre fill left side with the Mk2 in 1967. Which highlights the caution that must be used when looking at owners photos. Then I was able to compare a straight with a curved side by side, and really the curved projects back almost as far as the straight before the bend, any difference would be marginal.

It could have been to move the front intake away from the hole in the radiator surround, which would have allowed more dirt onto the filter element, but also allowed cold air to reach the carbs. Normally a good thing - cold air is denser so carries more fuel with it for a bigger bang, but under cold and damp conditions it can cause carb icing. In the past I've deliberately piped cold air directly into carbs of a daily driver, and so has a pal on his supercharged MGB, neither of us having icing problems. But maybe the factory did get a few complaints in their tens of thousands of cars and decided to make the change. Why change the rear as well? Maybe that is just more confirmation that the two are the same!

While looking into this for a pal I took Bee's cans off to compare them side by side from all sorts of directions, and in doing so I discovered a crack where the inlet tube joined the main body, which had extended as far as the flange joining the two halves of the tube together. No big deal from a filtration point of view as it is on the 'dirty' side of the filter, but I took the opportunity to tack-weld it in a couple of places inside.

Choke Control

There was a manual choke control for twin SU carbs, the North American single Zenith from 1975 on had a coolant-operated automatic choke.

HS set-up
HS components
HIF set-up
HIF enrichment valve
V8 set-up

The manual choke was originally a round knob engraved with the letter 'C', changing to one with a 'fan' symbol (representing a shutter-valve) and the word 'LOCK' with an arrow. There were two types - one in hard plastic, and another with a soft rubber moulding holding a disc with the legend and picture. One can imagine this was the later type provided for safety reasons, and is one I can

remember on Minis in the 70s. North America got a 'T-handle' choke knob for the 1970 model year, with the word 'CHOKE' as well as 'LOCK' and the arrow, and all (Clausager, but see below) cars got this type from the start of rubber bumpers.

I had assumed that early versions of the 'C' knob at least were 'push-pull' rather than 'twist to lock' based on my (from memory!) 64 Mini, but Dave O'Neil has sent me a scan of a Mk1 handbook which describes it as the 'twist to lock' type. There were two types - BHH526 for North America, Sweden and Germany, and BHH653 for elsewhere. BHH526 has a safety symbol in the Parts catalogue so I suspect that was a soft knob, with the other being hard.

The shutter-valve symbol is not very appropriate and neither is the word 'choke', as they really apply to fixed-jet carbs where mixture enrichment is performed by restricting the air supply, whereas SU carbs perform enrichment by adding fuel to the same air volume.

Which type of knob (hard or soft) was provided when - and even what part number they were is pretty confusing. According to the Parts Catalogue the original UK choke cable changed from BHH653 to BHH651 with HIF carbs (and the new 18V 779/780 engines) at chassis number 332033 (some) to 336650 (all). It changed again to BHH650 at chassis number 3602301 and the start of rubber bumpers, and the 77 and later catalogue lists it as BHH2064 which suppliers show as the T-handle. However Clausager says the T-handle type was provided on all cars from the start of rubber bumpers, whereas BHH650 as indicated by the catalogue is shown by suppliers as the soft 'shutter' type. Various suppliers list the two 'shutter' types interchangeably, and even the 'hard' shutter type is shown by some for the earliest UK cars - a case of "what we have is the one you want", I'm sure.

September 2019:
The V8 inner is different in that it has a nipple on the end that fits into a slot in a trunnion between the carb choke cams, and the outer is clamped to the air-box to set the correct adjustment. It may also be shorter than the 4-cylinder cable as the carbs are right at the back of the engine compartment. But after that it gets confusing. My 75 has a T-handle and an original brochure shows the same, although the brochure is for the RB models. Clausager shows a 74 with a T-handle but says it probably should have a round knob. The Parts Catalogue only shows one - BHH1121, and Googling that comes up with a round knob from most suppliers, you have to search on BHH1121a for the T-handle. For the 4-cylinder the Parts catalogue lists both - round knob changing to T-handle with the RB, so if the V8 was the same I'd have expected that to have two entries as well. The drivers handbook dated 1976 shows a CB on the front and only the CB front lights, but it's drawings initially show the T-handle ... until it comes to using the choke, then it shows a round knob, and for the remainder of the handbook, even though it shows the V8 binnacle. The only CB V8 brochure I have seen doesn't show the V8 dash, and modern pictures online are no help as they could well have been replaced.

After many years use due to wear the choke control can fail to lock at all, or in some cases lock but suddenly release at inopportune moments. In some cases, with the 'twist to lock' type, this can be due to twisting of the cable inner tending to turn the choke knob in the anti-clockwise (i.e. unlocking) direction, and so if the inner is released from the carbs and turned in the appropriate direction the twist can be made to aid the locking action rather than oppose it. But mostly it is simply due to wear in the locking mechanism as indicated in the accompanying photos and descriptions (click the thumbnail on the left). Note these only apply to 'twist to lock' types, not friction lock types (which may never have been used on MGBs) although these also eventually suffer from a failure to lock. Putting a twist in the cable so the knob is turned **towards** the locked position, rather than **away** from it, will help prevent it becoming unlocked spontaneously.

On the 'twist to lock' types wear occurs on both the knob shaft and a 'wedge' clipped into the body that attaches to the dash. So by purchasing a new cable it is possible to fit the inner and the 'wedge' from the new cable to the old outer, leaving the run of the outer in position and just undoing the nut on the back of the dash to pull the outer forward to access the wedge, rather than removing the whole thing then having to thread the new cable (inner and outer) through the most advantageous path to get smooth operation. Of course if the old outer is damaged, or is stiff in operation because it is poorly routed, then you will have to remove and replace the whole thing anyway. May be advantageous to pull out the knob, put a spot of grease on the shaft, push it back in till the grease lines up with the wedge and twist it back and fore a few times to distribute it. Then pull the knob in and out a few times wiping the shaft each time to wipe off any excess or you will get grease on the handles of your handbag.

May 2011: John Tait in Australia found his new choke cable failed to lock after just 10 starts. Opening it up he found the locking wedge is made of plastic and had deformed!

Martin Roberts's tool to aid removal of the cable from the dash.

June 2008:

Chrome bumper cars had a curious arrangement - which often causes confusion - at the carb end where the cable inner was fixed, and it was the movement of the outer sliding up and down the inner which lifts the lever on the choke interconnecting shaft. It's quite a neat way of running the cable to avoid clutter above the carbs, but does mean there has to be space for the outer to move around without fouling anything or it can make the choke control stiff. It also makes the cable very easy to adjust -= you just slacken the trunnion screw and pull the inner through it to the required position.

September 2018:

When export models from 1971 (18v engines) and UK cars part way through the 1974 model year gained HIF carbs, they retained the 'upside down' HS choke arrangement even though the throttle cable bracket had provision for a choke cable, which was used to secure the inner.

February 2009:

Rubber bumper cars (and all V8s) the factory used the more conventional arrangement of fixed outer and moving inner using a top-down choke cable. However it's more tricky to adjust - you have to slacken the trunnion screw as before, lift the choke lever up to the required position while pulling the inner down, then tightening the trunnion screw with your third hand!

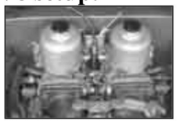
HS choke components:

Quite complicated with no less than 11 components. At least they are (nearly) all visible, unlike the HIF carb.

HIF choke set-up:

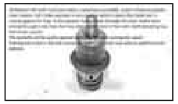
Although the external components of the HIF choke are much simpler than the HS things still need to be assembled and adjusted correctly for the choke to work properly.

V8 setup:



Simpler again, with a nipple on the end of the inner lifting a trunnion that engages directly with the enrichment and fast-idle cams. The only adjustment consists of a simple clamp on the cable outer so you just have to slacken that while pulling the outer up to the required position, then tightening the clamp.

HIF choke valve:



John Maguire in Oz rigged up a bench-test after having problems with a float valve towards the end of a full restoration. As part of that he took the choke valve out and describes its operation here.

Emissions Limits (UK) *added November 2012*

Spark ignition:

- *First used before 1st August 1975* - visual only
- *First used between 1st August 1975 and 31st July 1986* - CO <=4.5%, HC <=1200ppm

- *First used between 1st August 1986 and 31st July 1992 (passenger cars)* - CO <=3.5%, HC <=1200ppm
- *First used 1st August 1992 onwards,* petrol - CO<=0.2%, HC<=200ppm, Lambda between 0.97 and 1.03. **If it fails:**
    - *First used between 1st August 1992 and 31st July 1995* - unless there is a specific figure for the vehicle use CO<=3.5%, HC<=1200ppm
    - *First used between 1st August 1995 and 31st August 2002* - unless there is a specific figure for the vehicle use CO<=0.3%, HC<=200ppm, Lambda between 0.09 and 1.03
- *First used 1st August 1992 onwards,* LPG - CO<=3.5%, HC<=1200ppm
- *First used 1st August 1992 onwards,* CNG - CO<=3.5%
- *First used 1st September 2002 onwards* - unless there is a specific figure for the vehicle use fast idle (2500-3000rpm) CO<=0.2%, HC<=200pm, Lambda between 0.97 and 1.03, idle (450-1500rpm) CO<=0.3%

Updated November 2018: ~~For cars with a non-original engine, test according to which is older - engine or vehicle.~~ I'm positive that used to be the wording, but in the latest (Section 8.2.1.2 in Version 3.1.4 as of 2018) the rules have changed according to whether the vehicle was first used prior to 1st September 2002 or not:

> If a vehicle first used before 1 September 2002 is fitted with an engine that's older than the vehicle, you must test it to the standards applicable for the engine. The vehicle presenter must have proof of the age of the engine.
>
> If a vehicle first used on or after 1 September 2002 is fitted with a different engine, you must test it to the emissions standards for the age of the vehicle.

Note this only seems to apply to vehicles first used on or after 1st August 1975, so cars earlier than that should still be exempt even with a later engine. And there is no mention of what to do if a more modern engine is fitted, so presumably that is the date of the vehicle.

October 2019: Different in Ireland with the NCT, apparently, where the limit is dependant solely on the age of the car, not the engine. Stephen Elster wrote on the MG Enthusiasts Bulletin Board how his 1981-registered model had failed emissions with 1.3% CO i.e. well within the limit of 4.5% but 1627 HC where the limit is 1000 - a high HC indicating incomplete combustion. This wasn't an isolated instance as it only just scraped through last time, apparently. All the more frustrating as this is the last time it would have to pass emissions, being exempt next year. Some of it concerned another problem with a front damper, but it took nearly 130 posts over 3 weeks to get it resolved. A lot of the suggestions such as plug gaps and tinkering with the carb settings I just didn't feel would have that much effect, and he got nowhere with multiple tests including at garages elsewhere. It wasn't until he went back to basics and checked valve clearances which he discovered had been set to 0.15mm instead of 0.015" (by a so-called professional mechanic), i.e. about 6 thou instead of 15 thou, and discovered he had an intake leak from loose manifold nuts discovered by spraying carb cleaner round the inlet manifold. With both those fixed a retest came in at 1.95 CO and

557 HC. It's a shame we don't know which had the greatest effect - valve clearances or vacuum leak - but I do suspect the latter. He'd previously adjusted the carbs for 3.5 CO, which was probably rich at the carbs compensating for the vacuum leak 'downstream', and maybe not mixing properly for full combustion. So the moral of the story is to go back first principles checking all the basics, before you start throwing parts at it.

Checking prior to MOT: All engines are different and while some always pass emissions when the carbs have been adjusted to the lifting pins, others don't, and the V8 is a case in point. I always have to weaken the mixtures by at least a quarter-turn (both carbs by the same amount in the same direction remember) and put them back afterwards. Many years ago I bought a Gunson's Gastester, and like the curate's egg it has only been good in parts. It's reasonably accurate as far as checking and tweaking prior to the MOT if you have to pass the limit test. However I have found that it gives noticeably different readings if it is sitting on hot tarmac on a warm day compared to about bumper level on a stool or some-such, and also varies according to which way it is tilted! If that wasn't enough although you are supposed to set it to read 2% before the probe is inserted into the exhaust, after many years mine won't go that low even on the minimum. Nevertheless I do find that if it goes up by less than 2.5% between fresh air and the exhaust, it does pass the MOT.

I don't always use it, and I think at least once in the past I have not turned them back to 'normal' after the MOT. The upshot being that whilst in 2016 it was 3.56 CO and 272 HC, in 2017 it was 1.41 CO and 201 HC and in 2018 it was 0.2 CO yes nought point two and 190 HC, and the tester looked at me in astonishment. The amazing thing is that apart from warming up from cold in winter taking a bit longer at weaker mixtures, otherwise she has always run very well with no stumbling or anything else. Paradoxically though given the longer warm-up, she was running noticeably hotter on the gauge when left idling for the duration of the 2018 test. As it was after this test I readjusted to the lifting pins, winter warm-up is now noticeably better, and in future I'll be using the Gastester before and turning her back to 'normal' again afterwards.

Ethanol *added November 2009*

Ethanol is appearing in UK and EU fuels in various concentrations, leading to questions as to its suitability for MGBs.

August 2019: The ethanol industry has been kicking off and pressing the Government to introduce E10. The consultation referred to below was updated and the outcome published in February 2019, and the upshot of that is that **pump**

labelling laws will come into force in September 2019. How and when E10 itself will be introduced is still pending, and at the moment is being left up to suppliers. As the Government are proposing to require a continuation of E5 95 in stations that sell E10 95, suppliers may be unwilling to carry the costs of providing both, so may choose not to provide E10. Also because of the low rate of take-up of 97 and higher octanes, changing that to E10 will have little impact on meeting any increased renewables objectives, perhaps meaning 97/99 E10 is less likely to appear. We shall see.

August 2018: I wrote to the Renewable Transport Fuel Obligation government department asking about E10 - whether any was being sold in the UK, and whether there were any plans to sell it. The response was:

> "There are currently no firm plans to introduce E10 via a mandate, hence the current consultation to better understand some of the challenges. Fuel suppliers are permitted to supply it if they wish, but to date no supplier has taken the commercial decision to stock it."

The consultation (dated July 2018) referred to can be found here and contains links to three documents - a main PDF and two annexes which oddly are in ODT format. Not compatible with my computer (nearly as old as my cars ...) but other formats including PDF are available on request using the links given. The consultation includes proposals to retain E5 in some form ('protection grade') beyond 2018 for 'older' cars as well as classics not compatible with E10.

2015: From March 2013 retailers have been allowed to sell petrol containing up to 10% ethanol, replacing the previous E5. There had never been a requirement to label pumps that carried E5, and it was by no means clear whether pump labelling would be changed to indicate E10 or not. That was for 95 octane, 97 and higher octane was classified as 'petrol protection grade' which was limited to E5, but that requirement had been due to expire at the end of 2013. The Government confirmed it would continue until the end of 2016, EC proposals to extend it to 2018 were awaiting approval, and the Government as seeking the views of interested parties in this document dated October 2013. Also I had not seen any definitive statement from an authoritative source i.e. Governmental as to exactly what E5 and E10 actually meant in terms of ethanol content.

Eventually I asked the AA these two questions and had the following reply:

> "There has never been a requirement for E5 to be labelled as such - 'normal' petrol can contain up to 5% bio-ethanol without any labelling referring to bio content.
>
> "European standards now permit up to 10% bioethanol in petrol. Petrol containing between 5% and 10% must be labelled as E10.
>
> "Technically the assumption is that all vehicles are compatible with E5 while compatibility with E10 (5< >10) must be checked with the vehicle manufacturer.

> "Government's regulatory plans are laid out in this response to consultation on a proposed amendment to the motor fuel regulations 1999."

So the upshot is:

- E5 can contain up to 5% ethanol, and E10 anywhere from 5% to 10%.
- Only 95 octane can contain more than 5% ethanol.
- Pumps dispensing E10 must be labelled '95 E10', so potentially can be avoided.
- In answer to a written question in July 2015 the Government stated:
  > "The ethanol content of petrol supplied in the UK is a commercial matter for fuel suppliers, subject to the Motor Fuel (Composition and Content) Regulations 1999 which set the maximum permissible ethanol content of petrol at ten per cent, known as E10. The Regulations set no minimum ethanol content.
  > "E10 is not yet on sale in the UK. Petrol sold in the UK today typically contains up to five per cent ethanol, known as E5. The Motor Fuel (Composition and Content) (Amendment) Regulations 2013 ensure that E5 petrol will continue to remain available until the end of 2016, thereby providing a 'protection grade' of petrol for drivers of those vehicles which would be incompatible with petrol which has a higher ethanol content.
  > "Should E10 be rolled out by suppliers, we will carefully assess the compatibility of the UK vehicle fleet in determining whether to extend the regulatory requirement for E5 to remain available beyond 2016.
  > "This Government recognises the concerns of owners of some older vehicles that may not be compatible with E10. The Department is in regular contact with suppliers who in turn have been asked to write to us to give at least three months of notice if they were to plan the introduction of this fuel. As yet none have indicated they have any immediate plans to introduce E10.
- **Proposed** EC legislation would extend the availability of 'petrol protection grade' until the end of 2018, and the Government has said it will review whether UK legislation needs to be altered if the EC directive comes into force.
- Suppliers have indicated they have no plans to introduce E10, but it is a commercial decision and certain suppliers in certain areas could introduce it at any time. So if you habitually use 95, study that pump!

February 2015: More scare tactics. Moss claims:

> The key problem is that ethanol absorbs water from the atmosphere. In fact, fuel with 10 percent ethanol absorbs up to 50 times more water than standard gasoline. Older gas tanks found in many classic cars vent to the atmosphere, increasing the likelihood that moisture will be absorbed into the gas tank at a rapid pace.
>
> The end result of water in the fuel is phase separation. The fuel separates into two distinct layers: a thick layer of gasoline mixed with a little ethanol

> on top, and a thinner layer on the bottom consisting of water mixed with most of the ethanol. And it doesn't take much water for this to happen - phase separation occurs in a gallon of 10 percent ethanol blend with just 3.8 teaspoons of water.
>
> A gasoline/ethanol blend absorbs water until it triggers phase separation. The blend has a 90-day product life in a closed tank, but lasts just 30 to 45 days in a vented tank often found in classic cars. With 10 percent ethanol blends, owners are supposed to replace the fuel in vented tanks about once a month by driving or draining, taking into consideration the humidity in the atmosphere and temperatures.

However **all** tanks have to be vented to let air in as the fuel is used, or they won't let the fuel out. 'Older' cars have a non-vented tank and a vented filler cap, and the cap should contain a spring-loaded valve to prevent fuel running out in the event of a roll-over. This causes a small vacuum to be developed in the tank as fuel is used before the valve opens and starts letting air in, which is what causes the small 'gasp' when you remove the filler cap to refuel after running for a while. If the problem is going to be temperature changes causing air to be 'breathed' in and out by the tank, then the valve will stop the breathing under the temperature variations likely to be encountered during the 'close' season for classics. However later American-spec MGBs etc. with emissions controls have an unvented filler cap, but the tank is vented via a charcoal canister. This canister is open to atmosphere, with no valve, so will 'breathe' freely. The canister would have to absorb any and all moisture to prevent it getting to the fuel in the tank. But this USA EPA document says:

> Water vapor, however, dissolves in gasoline very slowly, even at very high humidity. For example, at a constant temperature of 100 degrees F and relative humidity of 100%, it would take well over 200 days to saturate one gallon of gasoline in an open gasoline can (assuming the only source of water is water vapor from the air). Water absorption from the air is far slower at lower temperatures and humidities. (At a temperature of 70 degrees and relative humidity of 70%, it would take over two years to saturate one gallon of conventional gasoline in the same gasoline can.)
>
> Water phase separation in any gasoline is most likely to occur when liquid water comes in contact with the fuel. (Water in the form of moisture in the air will generally not cause phase separation.) Water which is in solution with gasoline is not a problem in any engine, but as a separate phase it can prevent an engine from running or even cause damage. Since oxygenated gasolines, however, can hold more water than conventional gasoline, phase separation is less likely to occur with oxygenates present.

This all came about from a discussion on brimming the tank over winter, about which the EPA document says:

> "... gasoline should not be stored for long periods of time, especially during seasonal changes which usually have large temperature changes associated with them. ... If it is unavoidable to store gasoline for a long period of time,

> one should be sure that the tank (is) full to prevent condensation of water from the air ..."

But quantifies the risks:

> For example, assume a tank containing conventional gasoline contains only one gallon of fuel. Assume also that it is closed while the outside temperature is 100 degrees F with a relative humidity of 100 percent. If this tank is left sealed and the temperature drops to 40 degrees F, water will likely condense on the inside of the tank, and dissolve in the fuel. In order for enough water to condense from the air to cause gasoline-water phase separation, however, there must be approximately 200 gallons of air per gallon of fuel over this temperature drop (100 to 40 degrees). Since oxygenated fuels can hold even more water than conventional gasoline, it is even more unlikely that enough water will condense from the air to cause gasoline-water phase separation.

In other words phase separation is **less** likely in fuels containing ethanol than without! As far as absorbed water goes it says:

> Water in solution operates as no more than an inert diluent in the combustion process. Since water is a natural product of combustion, any water in solution is removed with the product water in the exhaust system. The only effect water in solution with gasoline can have on an engine is decreased fuel economy. For example, assuming a high water concentration of 0.5 volume percent, one would see a 0.5 percent decrease in fuel economy. This fuel economy decrease is too low for an engine operator to notice, since many other factors (such as ambient temperature changes, wind and road conditions, etc.) affect fuel economy to a much larger extent.

Hot start problems? *June 2014:* Some people are beginning to experience odd hot-starting problems and are wondering if ethanol is the cause. Vee had two bouts of this recently, near the end of the tank i.e. not a recent fill (Tesco 95), and the second time was barely warm. I checked the mixture balance and it was slightly off, but no more than it had been in the past without this problem, but since correcting the mixture it hasn't reoccurred, with the same tankful, so who knows?

August 2014: Two tankfuls (one Esso, one Tesco) caused no problems despite the hottest weather of the year, but a subsequent Tesco tank did on a pretty warm day. After repeated cranking I could smell petrol so I know it wasn't fuel starvation i.e. vapour lock. It could have been flooding due to fuel expansion, but the usual treatment of flooring the throttle had no effect (although that's usually done when it is cold flooded), and it restarted after about 10 minutes with the bonnet up. The coil was very hot, I wasn't sure about the spark, and subsequent testing showed the coil boost circuit on the ballasted 6v ignition system wasn't working - and never had been with this starter. Now fixed, only time will tell.

Then a link to an American news broadcast about the problems E15 was starting to cause in nearly new cars came my way, so I asked around about how long they had been using E10 and whether it had caused any problems, see here for the responses, which summarised indicate so far that apart from possibly lay-ups over winter - and none of those in cars, there have been no problems.

Who supplies what? *September 2016:* This TR-Register page contains information on ethanol in petrol including the following:

(This information was correct at the time of asking - Feb 2011)

BP	Ethanol is added at 5% to unleaded petrol at all sites across the UK. BP Ultimate (super unleaded petrol) does not have Ethanol added, except in the South West of England.
Esso	Ethanol is added at 5% to unleaded petrol at most sites in the UK. Esso Super Unleaded petrol does not contain Ethanol, except in the South West of England (Devon & Cornwall)
Shell	Shell has repeatedly refused to answer the question. It is therefore an assumption only, that all Shell petrol should be considered to contain 5% Ethanol.
Texaco	Ethanol is added at 5% to unleaded petrol. Texaco Super Unleaded petrol does not contain Ethanol.
Total	Ethanol is not added to any Total fuel (including standard unleaded petrol). Except in the North West and South East of England.

It includes a link to download a list of TOTAL E0 sites, which can also be found here, sorted by Postcode. Bear in mind that any or all of the information above could change at any time.

My own research came up with the following:

> Q: How much ethanol is in Tesco petrol? (19th question/answer)
>
> Petrol sold in the UK must conform to BS EN 288 British Standards. This allows up to 5% ethanol in petrol. Tesco fully complies with these standards with the ethanol content of our fuels varying from 0 - 4.8% depending on the location and supplier.

Also this Ethanil page which contains a league table compiled from users testing petrol they have purchased, using a testing kit available from Ethanil. Interestingly Shell V-Power 99 from Durham tested at 5%, whereas 95 in Hampshire and Cornwall tested at 3%, and Sainsbury's 97/98 in West Mids tested at 1%. Also interesting is that Morrison's 95 in Humberside tested at 5.25%, which if correct should have the pump labelled 'E10 85'.

History:

Update December 2013: Published October 2013 this Government Impact Assessment and Proposal to retain a 'petrol protection grade' i.e. Super Unleaded with a maximum 5% ethanol (E5) until the end of 2016. Currently the legal requirement for this expires at the end of 2013. Super Unleaded isn't available from all retailers. The document indicates that the limit rose from 5% to 10% without pump labelling during 2013 for 95 octane. Although the document does say that so far the rate of supply has been

small, it also says some suppliers have indicated they may start supplying E10 by the end of the year. But as pump by pump you won't know when 95 octane has changed from E5 to E10, it is probably advisable to stick to Super Unleaded from now on. Note that keeping Super Unleaded at E5 until the end of 2016 is only a **recommendation**, not confirmed.

*Update October 2012:*The FBHVC site was updated on 25th April 2012. **Permitted ethanol content in petrol will rise from 5% to 10% in 2013. i.e. unlabelled pumps will increasingly contain up to 10%.** The FBHVC have endorsed three products that protect against **corrosion** (although confusingly they are described as 'stability' products), although be aware this only covers corrosion of mild steel e.g. tanks and lines, they were not tested as regards damage of other materials in the fuel systems e.g. plastics and rubbers. They are:

- VSPe Power Plus, VSPe and EPS from Millers Oils; email: enquiries@millersoils.co.uk; website: www.millersoils.co.uk
- Ethomix from Frost A R T Ltd
- Ethanolmate from Flexolite

Update September 2011: Currently UK petrol can contain up to 5% ethanol without any additional labelling, anything more than 5% must be labelled "Not suitable for all vehicles: consult vehicle manufacturer before use" The Biofuel (Labelling) Regulations 2004. There is currently a proposal to increase the amount to 10% before labelling is required Targeted Consultation on Proposed Amendments to the Biofuel (Labelling) Regulations 2004. The FBHVC is on the case - see The Changing Nature of Fuels.

- E5 has a 5% concentration and is becoming more common in Europe. It's said to be compatible with most vehicles, including all MGs, although certain Alfas, Audis, Fords, Lotus, Mazda, Peugeot, Subaru, Suzuki, Toyota and all Daewoo are not.
- E10 with a 10% concentration is available in countries like Australia and America but there are a lot more incompatibilities, for example no MG or Rover models are compatible.
  The main problems of E10 for carburettor equipped engines are:
  - The vapour pressure of fuel with ethanol will be greater (if the base fuel is not chemically adjusted) and probability of vapour lock or hot restartability problems will be increased.
  - As a solvent, ethanol attacks both the metallic and rubber based fuels lines, and other fuel system components.
  - Ethanol also has an affinity to water that can result in corrosion of fuel tanks and fuel lines. Rust resulting from this corrosion can ultimately block the fuel supply rendering the engine inoperable. Water in the fuel system can also result in the engine hesitating and running roughly.

  In addition there are the following problems for injection engines:

- The use of ethanol blended petrol in fuel injection systems will result in early deterioration of components such as injector seals, delivery pipes, and fuel pump and regulator.
- Mechanical fuel injection systems and earlier electronic systems may not be able to fully compensate for the lean-out effect of ethanol blended petrol, resulting in hesitation or flat-spots during acceleration.
- Difficulty in starting and engine hesitation after cold start can also result.

◦ E85 with an 85% concentration of ethanol and only 15% petrol or gasoline is widely available in Sweden and becoming available in America, Europe and elsewhere. Only cars with specially designed engine management and fuel handling systems should use E85. These cars have stainless or plastic lined tanks and lines and no aluminium, magnesium or rubber parts. Ethanol is more combustible than regular fuel and so spark arrestors and other precautions have to be taken to prevent vehicle fires and explosions. E85 vehicles should not use regular fuels as the higher compression needed to get the best out of E85 will result in catastrophic detonation.

Given the problems listed for E10 I don't think I want to use even E5 in my cars. *Update May 2010:* I understand UK fuels can contain up to 5% without labelling on the pumps, and even Shell V-Power may now contain it. Car warranties may state only E5 can be used and nothing higher. E10 becoming more common in Europe, and forces in America are pushing for E20.

Update July 2011: Amal Carbs states:

> For fuel blends containing less than 5% ethanol the concentration is low enough not to cause any significant effect. For 5% to 10% blend then some changes are recommended, (albeit that the USA has been subjected to this concentration for sometime without any known problems). For above 10% the effects of ethanol are known to cause problems and the necessary modification that would be required would extend beyond those of just our product content in a vehicle.

That leaves a question-mark over 5% (i.e. does it cause no significant effect or are some changes recommended?), and from what I've read a lot of people in America wouldn't agree that 10% doesn't cause any problems.

Frost Restoration are selling Ethomix additive at £12 per bottle. The advert mentions nothing about protection against ethanol, it seems to be a fuel system cleaner more than anything, but modern fuels don't need additional detergents. The data sheet linked from that page does mention that it protects against ethanol-based acids and corrosion, however the FAQ page includes:

> **What materials should be changed or avoided (or regularly checked)?**

> Zinc and galvanised materials, Brass, Copper, Lead / tin coated steel. (Aluminium), Buna-N (seals), Neoprene (seals), Urethane rubber, Acrylonitrile-butadiene hoses, Polybutene terephthalate, Polyurethane, Nylon 66, Fibreglass-reinforced polyester and epoxy resins, Shellac, Cork.

References:

- http://www.fcai.com.au/publications/all/2006/6/3/can-my-vehicle-operate-on-ethanol-blend-petrol-
- http://en.wikipedia.org/wiki/E85

Fault Diagnosis *January 2018*

This probably all revolves around cutting-out or misfiring. Possibly failure to start, although that's only likely to be after work on the carbs that has emptied the float chambers. At any other time there will normally be enough fuel left in the float chambers to start the engine, even if it cuts out shortly afterwards if the pump isn't operating. The one exception could be a V8 in the heat of summer where heat soak after switch-off can boil all the fuel out of the float chambers. Unless the ignition is only switched off momentarily (English version!), you should always get a couple of clicks at least when turning it on, several if parked overnight, many if it was switched off hot or parked for many days. When turning on, always listen for the pump. If no clicks i.e. pump not operating at all then investigate the pump. One click each time you turn the ignition on and another when you turn it off indicates the points are stuck closed. Continual clicking means you are out of fuel, or there is a major air-leak on the tank side of the pump, or the one-way valve on the inlet side of the pump is stuck open. If this only happens when the tank still has plenty of fuel, as indicated by only being able to get a few gallons back in, then the pickup pipe inside the tank could be rotted through. Note the fuel gauge is not a guaranteed indication that fuel is still in the tank - or that you have run out, as the gauge and the sender can have their own calibration and fault issues.

For cutting-out and misfiring while under way, always look at the tach before doing anything i.e. while the momentum of the car is still spinning the engine. If the tach is jumping about or has dropped to zero while the engine is still spinning and the ignition is still on then it's an ignition LT problem.

If the tach is still registering the appropriate engine revs then try and get in a position where it is safe to turn off the ignition while the problem is apparent i.e. while the car is still rolling, and bring the car to a halt. Then, when things are quiet enough turn on the ignition while listening to the pump. If the pump makes no sound, and it won't restart, then check for a fuel delivery problem as follows: Carefully remove the delivery pipe from the front carb - being careful to catch any spurt of fuel in a cloth so it doesn't spray on the hot exhaust. If you get a spurt of fuel then the pump is working normally, so if it still won't start it's probably an HT problem, or possibly a failed condenser.

If the pump chatters away before slowing and stopping and when turning the key to crank the engine restarts, or if there was no spurt of fuel, then the problem is fuel starvation, either because the pump is intermittently cutting out or dead, or there is a blockage in the plumbing between pump and carbs. With an intermittent pump the cutting-out or misfiring is also likely to be intermittent, or you will find that sometimes when turning on the ignition there is no chattering and no start, but on another occasion there is both chattering and starting. If the pump always chatters, and it always restarts, then it is a delivery problem which should be confirmed by the delivery check here. As before if you find you are getting one click each time you turn the ignition on and one click when you turn it off again, then the points are stuck closed.

November 2019: in the last couple of years there have been complaints of rough running and cutting-out in hot weather, or failure to start a hot engine in hot weather, with people blaming ethanol for vapour-lock or vaporisation. These people should take a step back and look at the bigger picture: For a start you need to consider just how many people get this - a tiny number. Also that these cars have run in desert states from new without these problems, and America has had ethanol at double our level (and more) and weird brews for far longer than we have and don't report these problems.

Secondly I just don't see how you can get 'vapour-lock' with our fuel system - the pump pressurises the fuel, and if the float chamber needs fuel the float valve opens and the pump will push fuel forwards. If there is any air in the fuel that will simply be pushed out of the float chamber vent and the pump will keep pumping until the float chambers become full.

Thirdly because the pump is at the back pushing fuel forwards it is pressurising the fuel, which will make vapourisation less likely. Indeed fitting an electric pusher pump at the back in place of an engine-driven mechanical pump is a recognised method of solving vaporisation problems in America at least.

The most likely cause - if it IS fuel and not ignition - is probably fuel expansion, possibly forcing the float valves open and raising the level in the float chambers and hence the jets, and that plus expansion of the fuel in the float chambers and jets possibly overflowing into the inlet manifold giving a overly rich mixture. So flooding, not fuel starvation.

Fuel Filter *Updated October 2015*

A clear plastic fuel filter (originally 603183) was fitted to all V8s, and 4-cylinder cars from various times according to year and market (probably with HIF and Zenith carbs), and there is frequent concern about how empty or full these filters should be. From observations of my own V8 (my 73 roadster doesn't have one) and from others it matters not how full it is. I have seen mine virtually empty, at other times virtually full, and it seems to make no difference whatever to the running of the car either way. So if your car is running well ignore an empty fuel filter. If it **isn't** running well then seeing the filter empty or very nearly so is **not** a diagnosis of fuel starvation. The only way to verify that is to remove a delivery

pipe from a carb and direct it into a container, turn on the ignition, and it should deliver **at least** one Imperial pint per minute (and in practice nearly two) in a continuous series of pulses with minimal bubbles.

V8 Filter:

However whilst the V8 did come to me with a filter there was no bulkhead clip for it and it was hanging in mid-air between the supply-pipe and the near-side carb. I did change it and the hoses on getting the car, from the original style where the outer casing is two identical halves bonded together in the middle, to what Halfords had available which has a cup-shaped body with a lid. Another difference between the two is that the original has short 5/16" ports both ends, which is fine for the supply pipe, but the carb port takes a 1/4" hose. How original it was I don't know - it's not shown in the parts catalogue - but there was a 5/16" to 1/4" reducer between the filter and the carb, to cope with this difference. The new filter (as most seem to now) had dual 1/4" and 5/16" ports both ends, so didn't need it, and in to the Misc Prts box the reducer went.

As the car is now 40 years old and on its third time round the clock I had decided to change the fuel pump hoses, as they were almost certainly original, and some people have been getting hot under the collar about ethanol and rubber. In the event they were in perfect condition, but that's another story.

As part of that job I had occasion to remove the filter hose from the carb, and noticed it had some internal longitudinal splitting at the cut end. I cut an inch or so off and opened it out but the splitting didn't extend under where the clamp had been, so I reckoned the rest was OK. However what I did notice was where the end of the carb port had been positioned in the hose there was some radial damage, and I wondered whether it had been caused by the unsupported filter flapping around for 20 years and nigh-on 100k. That started me looking at filter clips.

The original clip (BHH1212, confusingly on the fuel tank page of the Parts Catalogue) is symmetrical in that it mounts to the bulkhead behind the filter, and two ears are clamped together in front of the filter. However all the suppliers show this as having been superseded by clip 603185, which is a completely different P-shape, and is used for the crankcase breather filter on the back of the engine, albeit for the same filter. The mounting point on this clip is offset significantly to one side, which would put the filter itself to one side or the other by a significant amount, blocked on the one side by the heater, and on the other by the brake pipes that go to and from the servo. Much research later I found this capacitor clip, which looked identical in shape and style to the original, albeit at 40mm diameter which is slightly smaller than the filters which seem to be about 45mm. Cheap enough at £2, but by the time VAT and P&P had been added on it had risen to £6.43. Still, not much dearer than one of the wrong clips from the usual suspects.

It had to be opened up to fit round this filter, but by pinching the right-angle corners, flattening the sides a little and bending the clamping ears it has ended up a good fit, albeit with the ears slightly further apart than they were originally. But since there wasn't a clamping screw and nut supplied I've just had to ferret a longer one out of my tin of bits than I otherwise would have for an original clip.

Although there was no trace of muck in the filter while installed, there was a very small amount of sediment visible once I had removed it. Still, that is after nigh-on 100k, so very little.

With the hoses removed from the filter there is very clear cracking in the ends. OK, they are 20 years old, but bear in mind the 40 year-old pump hoses showed no cracking whatsoever. It does beg the question of how long 2015 hose is going to last.

A 2BA screw and lock washer secures it to the bulkhead, then the supply pipe has to be repositioned towards the bulkhead and the heater a bit to sit under the clip with the open end vertical, as it had been pointing forwards quite a bit for how the filter was previously fitted. I bought a length of 1/4" hose for between filter and carb, partly because the filter is now sitting further back so that needs to be longer, but also as a replacement anyway given the existing condition, and I still had some 5/16" left over from the pump hose replacement to fit between the supply pipe and filter. I cut the 5/16" with a small hacksaw as that was before the filter which would catch any bits, but the smaller 1/4" I was able to cut with a pair of tin snips and hopefully leave no bits.

A potential problem with these later filters with the dual size ports is of course that each port is now at least twice as long as the original, which means the unwanted 1/4" section on the supply side of the filter stops the filter going as low in the clip as it otherwise might. Not a problem in itself, but the outlet side of the filter has another double-length port pointing vertically upwards, that the hose has to fit onto then curve over and down under the closed bonnet. I cut the 1/4" section off the supply side of the filter, as again the filter would trap any bits left behind.

After that it was just a case of fitting a short length of new 5/16" hose onto the supply side of the filter with two Jubilee clips - the lower supply side one loose of course, and dropping the filter down through the clip and onto the supply pipe. Well, I say 'just', but getting the hose onto the pipe was easier said than done as its bore slightly smaller than the OD of the supply pipe, and there is very little room to grasp, twist and push. So I eased the supply pipe forwards and up until I had enough room to work the filter hose onto the supply pipe, then

opened up the clip so I could push the hose with its Jubilee clips back through between the clamping ears, then pushed the filter body down through the clip. The pipe moved back and fore quite easily, so sat happily in the clip, although not fully down at this point, and I fitted the clamp screw and nut. This only needs enough tightening to grip the filter body gently, you don't want to risk cracking it by overtightening. I'd already fitted the new 1/4" hose to the filter, as it was easier off the car to push it over the thickened section at the open end, the other end slid onto the carb port very easily, and I tightened all four Jubilee clips.

Now for a leak check. Turned on the ignition, got the initial rapid clicking as expected while it recharged the filter and hoses, then a steady click - click - click every couple of seconds or so - not so good. No visible leaks, so perhaps a carb float valve has got some debris in it. Even though I was careful to cut the hose that side of the filter with blades rather than saw, maybe there was something inside the new hose. Took the overflow hoses off and sure enough it was pulsing out of the near-side carb i.e. the first one to get fuel. So instigate ploy No.1 which is to remove the fuel pump fuse and run the engine until it empties the carbs and stops, then reconnect the fuse. Much chattering as it refilled the now empty carbs, hopefully flushing out any debris from the now wide-open float valves. The chattering slows and stops, then silence - no more clicking. It's perhaps something I shall have to keep an ear on for a while, turning on the ignition and listening to the pump before starting the engine, in case any more remains to cause a problem subsequently.

Finally I do order the 'correct' filter i.e. the one with two identical halves bonded together, but then realise that because of that central flange, and the longer dual ports, it isn't going to sit down in the clip as far as the filter I have now, which means the outlet hose is going to be that much closer to the bonnet. However despite the photo on the website showing the original style albeit with dual ports I get the later version i.e. the same as I fitted 20 years ago! But with the magic of Photoshop and doing a side-by-side comparison I see that with the central flange of the earlier style filter fitted below the clip, the ends of the shortened inlet port and the dual length outlet port end up in almost exactly the same places as each other. I can't track down a dual-size version of the original filter body, so will stick with the current style.

Fuel Hose *July 2015*

Hose replacement
HS carb hose supports

Moss Europe have Gates Barricade 'ethanol-proof' in 1/4" dia and 5/16" dia which are the two sizes needed on the MGB. If this are an easy fit to the ports you should be OK, but if it is a tight fit over ribbed ports then the inner layer is easily damaged and debris will block your carbs. The strange thing is that these 5 -layer hoses are cheaper than the standard 2-layer!

People are getting exercised about this and the perceived effects of ethanol, as well as on running and anything else to do with the fuel system. I'll say at the outset that - so far! - I've had no problems with fuel hoses on either car. Whilst the roadster has always run on higher octanes - Shell V-Power and its predecessors by choice - there is no evidence that they are ethanol free. The V8 has always been run on supermarket 95. I have changed carb and pump hoses on the roadster, but that was only for visible appearance reasons when I refurbed the carbs and fitted a new pump, and it was many years ago. And on the V8 whilst I have also replaced the carb-end hoses for visible appearance reasons, that was also many years ago, and the pump hoses are almost certainly original.

SAE J30 seems to detail the standards for fuel and oil hose, with R6 and R9 being the specific types relevant to us. R6 is the specification for 'low pressure' i.e. carb hose, and R9 for 'high pressure' i.e. injection hose. However after that confusion reigns.

This site claims SAE J30R9 is suitable for E85, and also quotes DIN 73379 TYPE 3 E. But if you search on that you get pages that say it is for E10 or E85 or 100% ethanol or 'not for bio fuel' although to be fair this last doesn't include '3E' in the description. This site claims R9 has a nitrile core, but the FBHVC (scroll down a bit) says Acrylonitrile hoses are not recommended.

Finally if this document is genuine, Table 1 together with Appendix A appears to be saying that R9 gives the lowest permeation of 15 g/m2/day with E15 whereas R6 with the same fuel gives 600 g/m2/day. R10 seems to be an 'in tank' hose so wise to avoid for external applications I'd say. Of course, whether a vendor's hose does actually conform to R9, and whether these tests have anything to do with longevity - permeation rates being a completely different issue to rupturing - is another matter.

This Fuel System Components and Aggressive Biofuel Environments by DuPont document states that Viton and Zytel-cored hoses meet 15-year life requirements as well as meeting pressure and permeation requirements, but then as the manufacturers of those materials in that time-honoured phrase, "Well they would say that, wouldn't they". This apparently independent organisation then says that although SAE J30R9 has a thin Viton inner layer (whereas one of the above sites claims theirs is nitrile), it still deteriorates, and says that motor manufacturers are switching to Teflon or PTFE-cored hoses for their superior performance. It also says that Teflon is a DuPont trade-name, but DuPont don't mention it on their page!

Nevertheless R9 is probably going to be better than R6, but then sourcing it becomes the issue. A pal did some investigation and came to the conclusion that Gates Barricade was probably the best option, however he was unable to source any in the UK even though Gates have a UK presence of some kind. He contacted a local supplier of fuel hose off the roll, apparently able to supply R9. On arrival it turned out to be a barn in a farmyard, and the hose had no markings of any kind on it.

Another pal went to a great deal of trouble to import some Barricade, but on fitting it he had no end of problems with rubber bits blocking his float valves and jets. Barricade is a 3-layer hose, with a very thin internal layer, and that was shredding as he pushed it onto his pipes and ports. And that was caused by the next issue - sizing differences between metric and imperial. There are plenty of suppliers of R9 by the metre on eBay, but I have only been able to find metric sizes - although occasionally they will show an Imperial measurement as well, although that is just a 'near equivalent'. The two sizes the MGB needs are 5/16" at the pump end, and 1/4" carb end, with a conversion from the larger to the smaller on cars with HIF carbs, done with a reducer, or a modern plastic filter that has a two-stage spigot on each end. The exact equivalent of 5/16" is 7.9375mm, so 8mm would be fine, but only 7.3mm or 9.3mm are typically available. The exact equivalent of 1/4" is 6.35mm, but again the available sizes are 5.5mm and 7.3mm. It's forcing on smaller hose that caused pal No. 2's problem. Holden lists Imperial sizes, but at £50 plus for a metre of each by the time you have added on P&P.

What about the usual MGB suppliers? They seem to have hose by the metre in imperial sizes - at a fraction of the price from Holden - and on enquiring with the MGOC they tell me they supply R6 - COHLINE type 2134, with a working pressure of 10 bar and E10 compliant. Moss also show Cohline 2134, but on ordering it I received Codan BS AU 108/2/L4/C4/R SAE 30 R6 WP 12 bar. However that was from going through the menus, if you search on 'fuel hose' you get Gates Barricade listed in both 1/4" and 5.16", and despite being 5-layer as opposed to 3-layer it's fractionally cheaper! However whereas the Codan is shown as 12 bar which is 174psi, the Gates is shown as 'only' 50psi. I doubt that will be an issue at the 3psi or so that our systems operate at.

Both suppliers also have sized lengths for each position, with banjos for the pump, but they are stainless braided as per the originals. The problem with that is given the question marks over hoses, maybe it's better to have plain rubber and be able to inspect it, rather than being original. A third pal has recently bought a V8, which although having just passed an MOT, developed a massive leak which turned out to be one of the fuel pump hoses having broken away from the pump banjo spigot. Given the number of units and metres the usual MG suppliers must get through, and the damage to their finances and reputations if they were shown to be supplying inadequate hose, I can't help feeling that R6 is going to be perfectly adequate for the MGB. And given the probably original pump hoses on the V8, I'll be replacing them, and with plain hose, rather than the braided originals.

Hose Replacement: *September 2015:*

The pump hoses on the V8 were 'old' when the car came to me 20 years ago, with the metal braiding crumbling away, but what I could see of the rubber gave me no qualms. I did replace the hoses at the carb end when I got the car as I wasn't happy with them. But since there are more and more complaints about fuel hoses lately, with ethanol being blamed for deterioration, I thought I had better do something about them. As mentioned above I had decided upon R6 unbraided to keep an eye on the external condition of the rubber.

The RB pump has two hoses, and the clamps were the flimsy 'metal strap with screw and nut' type. I didn't think I stood any chance of unscrewing them, so opted for cutting them off with a Junior hacksaw, for which despite the after-market anti-roll bar and everything else in the vicinity there was just enough space at the right angle to get at both and each only took a couple of minutes work.

I had run the tank down to not much more than a gallon to reduce siphoning problems, and had considered undoing the pipe to tank fitting joint to break the siphon. But with the high position of the pump on the RB, the join between the tank pipe and the hose is level with the top of the tank anyway, so easing the hose off the pipe let air in to break the siphon and only a few of drops came out. The pump hose to carb pipe was more of a problem as having reversed the car onto the ramps just minutes before there was still pressure in that line. But several sheets of newspaper scrunched up and held under the join as I eased the hose off caught most of that.

After that it was only a few minutes work to remove the earth wire and diaphragm-end vent tube from the pump body, then remove the metal cover in the boot, remove the 12v feed, and slacken the clamp round the large grommet and pump body, and the pump complete with hoses came out from under the car after less than an hours work. I had chosen to do it that way rather than undoing the banjo unions on the in-situ pump for two reasons - one was to avoid breaking yet another seal, and the other is that being able to grasp the pump body with one hand it was relatively easy to work the hoses of the banjo fittings with a pair of grips.

With both hoses off I measured them at 170mm, so cut two sections off the metre length I had bought. They needed a bit of a push onto the banjo ports which have a single rib, which may well have been enough to rupture the thin inner layer of Gates Barricade hose that Peter Ugle had had so many problems with. They were an easier fit onto the plain ends of the pipes. I probably spent as much time slackening the four new Jubilee clips right off before painting them with Waxoyl, part-tightening them, fitting, orientating for convenience then fully tightening as much as anything else, but even so had probably only spent a couple of hours so far.

I connected up the pump but before fully mounting it turned on the ignition to test the joints. As expected the pump chattered, but then kept chattering, and eventually I switched off. Pondered a bit, I was sure I had got the hoses the right way round but checked the roadster and a spare pump to make sure, and they

were. Then I wondered if, because I had refurbed this pump which originally failed on the roadster, and used it to replace the problematic Moprod pump that the car came to me with, I had got the one-way valves round the wrong way and the hoses had been the other way round ever since fitting. But checked some photos I had taken at the time, and they were correct. More pondering.

I had run the tank down, but there should be at least a gallon left, and I've never had a problem picking up with previous tank and pump changes. So I took the filler cap off and pressed the end of the filler pipe against my face round my mouth to form a seal, and blew. It pressurised, and released from the filler when I moved away. So I tried that again this time with the ignition on, chattered again, chattering rate increased slightly as I blew, but didn't stop. Switched off again and more pondering.

Suddenly it struck me. I'd driven the car onto the ramps immediately before I started, engine still cold, so the float chambers were full hence the float valves closed, and so the pump couldn't pump anything through, hence couldn't suck up any fuel! So I removed the delivery pipe from the carb (it spurted as I expected from fuel remaining in the line), directed it into a container, switched on, pump chattered momentarily, then slowed as it picked up fuel and started to pump it into my container. Phew! Whilst I was at it I decided to do a delivery check to find it delivered just over an Imperial pint in 30 secs which is correct.

One thing I had noticed (towards the end after I had pressurised the tank) was a little dampness on the end of the hose where it attached to the carb port, which wasn't something I had been aware of before, and looking at the end of the hose I could see three radial cracks. So I cut an inch or so off, which left a clean cut end, and refitted that. With that clamp tightened I disconnected the coil and did a leak check by turning on the ignition again and got three quick clicks, waited for over a minute and no more, so OK. Carefully checked the carb joint, and all four pump joints - all bone dry, so finished off fitting the pump grommet clamp and cover. All done in probably 2 1/2 hours.

After that I cut a section out of one of the pump hoses as well, split that and the carb piece lengthwise, and flattened them out by screwing the corners to a piece of wood. The 40 year-old original piece was perfect inside and out, not a trace of cracking anywhere, even on the inside after having been opened out. No reinforcement either. The 20 year-old piece was fine inside, the cracking at the cut end didn't extend under the clamp. However it does show some circumferential cracking where the end of the carb port had been, probably because the filter is suspended between a short piece of hose coming off the body pipe and a longer piece going to the carb, and has probably been waggling about under engine movement and its own weight. This was how it came to me, the filter should really be in a clip screwed to the bulkhead by the end of the heater. However that clip (BHH 1212) is no longer available, only the crankcase breather filter clip (603185) is, but that is a different shape, even though both filters are the same (603183). Something for another day, along with replacing the carb feed hose.

May 2016:

The day after the MOT I was looking at the cooling fan switching arrangements with the ignition on by engine not running, when I could smell fuel - again. This time it was from the overflow hose on the near-side carb, so that float valve was obviously leaking. But so was the hose, which was odd, as it didn't when I had a similar problem after changing the filter mounting and hoses last year. That hose has been showing external surface cracking for years - so much so I'm surprised it's not been mentioned at any of the MOTs, but as it doesn't normally carry fuel I had done nothing about it, perhaps unwisely. I'd installed it about 20 years ago as when the car came to me there were no hoses on the overflow ports at all. I took the near-side across to the off-side, joined the two with a metal 1/4" tee, and took a hose from there down past the starter. When I took the leaking hose off it was very hard and inflexible. No external writing, so perhaps it wasn't pukka fuel hose but just something I had lying around at the time. The off-side hose and the down-hose seem fine. This time I had the remainder of the length I had used to replace the hose from filter to carb i.e. pukka fuel hose, which hopefully will be OK.

Fuel Pumps *September 2008*

The fuel pump is powered from one of two unfused ignition circuits - until the 1977 model year with white wires from the ignition switch. On 1977 and later RHD models it was off the ignition relay which starts off brown/white at the relay output then changes to white where it connects to the rear harness, but on LHD models it remained from the ignition switch with white wires via an inertia cut-off switch. It is strongly recommended that the pump circuit be fused in the engine compartment - more info here.

Late North American spec cars had an inertia switch as standard that cut power to the fuel pump - part number C41220. You may be able to find one of those by Googling, but unless you are replacing a factory item and want to keep the car original you would be better off with one for a modern car (should be standard on anything with fuel injection) and either be new - or only a few years old if from a scrapper. If you Google 'car inertia switch' you should find loads. Regardless of

where you physically mount it the easiest place to connect it is in the same place as is recommended for a fuel pump fuse i.e. where the white wire in the rear harness joins the main harness in the mass of bullet connectors by the bulkhead on the off-side. Connect the two in series. Incidentally North American spec cars also had an inertia fuel valve in the fuel line to shut off the flow directly, but they have a reputation for leaking!

Types:

The MGB always used the SU reciprocating type of pump, although there were variations over the years. Clausager describes these as 'high pressure type', they may well have been 'high pressure' in SU terms but in general terms they are low pressure of the order of 2psi or thereabouts. Many aftermarket pumps deliver considerably more pressure than this, which overwhelms the float valves in the SU carbs, and pressure regulators need to be fitted. Originally AUA 150, minor changes to AUB 182, then AUF 301, AUF 303, and AUF 305. The AUF 305 had two breathers whereas the previous types only had one. The MGC used AUF 303 and the V8 305. All these pumps used capacitor spark quenching to protect the points, and can be fitted to either polarity of MGB. These pumps can be identified by the plastic cover over the points having a stepped end. They also originally had blue 'SU' tape wrapped round the join of the cover and the pump body, but this could have been replaced with other colours.

In January 1977 pump AZX 1307 was used which had diode-resistor quenching instead of capacitor. Clausager states that this was to prevent points 'buzzing' but he means 'burning' (it's either a mis-print or illegible in the source material he used). By this time all MGBs were negative earth of course, but the AZX 1307 is polarity sensitive and should not be fitted to positive earth cars without modification which involves reversing the diode-resistor connections, there are also positive earth versions. Other part-numbers for these diode-resistor protected pumps seem to be AZX1331 for negative earth and AZX1332 for positive. This type of pump has a cylindrical bulge in the end of the plastic cover, and the join is wrapped in black tape for negative earth pumps and red for positive. The diode is connected in series with a current-limiting resistor so that reverse connection will not cause damage (it will increase the current the pump takes by about an amp, though), so it's the resistor that is effectively performing the quenching function. There is already a 'swamp resistor' wired in parallel with the coil which reduced points burning even before capacitor quenching was fitted, but the diode-resistor is connected across the points rather than the coil. The diode-resistor may well reduce sparking at the points (there was none at all I could see on a pump I have just worked on) but over time they still seem to erode as much as my capacitor protected pump had when it finally stopped working from physical causes. In both cases I was able to reface the points with a sharpening stone, checked the clearances and the 'throw', and were working again and probably good for another 20 years or so.

Subsequently SU Burlen only listed AZX1307 and AZX1331, both of which are negative earth, with no apparent positive earth version! But this is because the diode-resistor has been replaced by a bi-directional metal-oxide varistor (MOV) which gives quenching in both directions i.e. with either polarity so can be fitted to either positive and negative cars. This device is a blue disc with two parallel wires with the same colour insulation, one wire off each side of the disc. However one web source also quotes the AZX1332 as dual polarity, so the situation is very confusing. At least one example of the AZX1331 had the box labelled 'dual polarity', but the information sheet inside the box still stated "All AZX pumps are polarity conscious" i.e. it hasn't been updated since the substitution of the MOV for the previous diode-resistor.

June 2014: The quenching device currently being supplied by SU Burlen is a transient voltage suppressor or TVS. Like the MOV this is bi-directional so not polarity-conscious, but is a black cylinder with a wire at each end, again with the same colour insulation on each. It connects the same as the MOV, more info on all types of quenching here.

There is always much talk about 'pointless' pumps in the MGB communities, i.e. electronics in the shape of a magnet and a Hall -effect transistor or reed switch in place of the points. There are SU versions with an 'EN' (electronic negative) after the earlier part number e.g. AZX1307EN or AZX1331EN, and 'EP' (electronic positive) e.g. AZX1308EP or AZX1332EP for positive. I have no idea what protection there is on these against reverse connection, there could be a diode in series with the 12v supply which would mean the pump would be protected and simply wouldn't work, or there could be no protection which means you could destroy the electronics. There is also a Moprod version of the SU (shown here), 'plug compatible' but plastic bodied and there have been reports of the bodies cracking if the unions are overtightened. The V8 came to me with one of these and although it worked fine for many thousands of miles, it then started 'short stroking' and causing fuel starvation. Even though the electrics end protrudes into the boot space on rubber bumper cars and I was able to open it up in-situ while the problem was happening one day, I couldn't see what was wrong and nothing I did resolved it, I just had to wait until it decided to start working properly again which it did for several days, then it would happen again. After two or three bouts of this I decided to junk it and replace it with my refurbished roadster points/capacitor pump, and the V8 has been fine ever since. Therefore I would **never** recommend a Moprod pump, and would never countenance fitting an SU electronic to any of my cars. Once the electronics start playing up you are

stuffed. With points, like ignition, you can usually sort them out by the roadside (like rapping the pump body with something) and get on your way. Points usually last 30k or more without attention, and usually give you warning rather than complete failure. It's true that they are difficult to access on chrome bumper cars, requiring pump removal, but access for cleaning or replacement is very easy on rubber bumper cars.

There are any number of after-market types, many of which require mangling of the mountings and/or connections to fit. Some of these make a loud chattering all the time regardless of engine requirements, and many output excess pressure that overwhelms the float valves and causes flooding unless a fuel regulator limited to about 2psi is fitted.

Mounting:
Chrome Bumper   Rubber Bumper   An Alternative Position in Chrome-bumper Cars

Chrome Bumper:

The pump is mounted by the right rear wheel under the car in a not terribly accessible position, particularly the points end in-situ which projects into part of the cage that holds the right-hand battery. It's not very easy to get at the points end either from below, or above if you remove the battery, the rubber bumper arrangement is much better. Having said that when my pump packed up on a run miles from home, and the only space available off the road was in a farm gateway on soft ground, I was able to change the pump with all four wheels still on the car and on the ground as I didn't trust working under the car with it jacked up on the soft ground. I was very lucky, I had an idea how the pump mounted having been interested enough to lie under the car when up on ramps simply looking up to see what was there. I was also lucky in that both unions came undone, and both nuts that attach the pump bracket to studs on the body shell, even the clamp nut and bolt came undone. But the biggest luck of all was that very little fuel ran out when I disconnected the unions. This a UK car with vented fuel filler cap, and the vent is spring-loaded to prevent fuel running-out if the car overturns. This allows a small negative pressure to develop in the tank after running for a while (I have always heard a slight 'gasp' when removing the cap to refuel whilst on a run) and that prevented fuel siphoning out of the tank, the pump being below the top of the fuel in most circumstances. A North American car with sealed filler cap and tank vented via the charcoal canister (or a faulty vented cap on other cars) would not allow such a vacuum to develop and so the supply hose would dribble unless the fuel level in the tank were very low. I was also carrying a new spare, which fitted right in and tightened up with no leaks, and the points weren't oxidised as I had previously tested the pump when I first had it (bought as a spare prior to a long run through France). While changing the pump I noticed the braided flexible hoses were pretty manky, and subsequently changed those in the garage. As the car hadn't been running before I started, and the seal provided by the vent in the cap isn't perfect, the small vacuum from previous running had dissipated, and I had fuel running out all the time I was changing the hoses!

The pump has 12v (white) and earth/ground (black) wires coming out of the rear harness, the 12v attaching to a spade on the electrics end, and the earth to a spade by the unions. The other end of the earth terminates with the reversing light and some number-plate light earths at a number-plate bolt.

Rubber Bumper:

As with the chrome bumper the pump is mounted near the right rear wheel. At first sight it is less accessible than on the chrome bumper as it is mounted quite a bit higher and the unions at least can only be accessed from immediately below, i.e. the car needs to be raised. However being this high it is above the top of the fuel tank, hence above fuel level, which means the unions can be worked on without fuel siphoning out of the tank. But the biggest advantage of the rubber bumper is that the points end protrudes into the boot, making cleaning/replacing/adjusting of these very much easier. A large purpose-moulded grommet (unfortunately NLA new) is pushed into a large hole in the front wall of the boot and the panel edge located in a groove in the grommet. The pump body is pushed into the grommet from under the car, and orientated so that the pump unions are pointing towards the middle of the car. A large worm-clip is fitted around the grommet clamping onto the pump body, which together with the panel edge in the groove of the grommet seals against water entry. Under the car an earth wire comes from the rear harness and attaches to a spade on the pump body near the unions, the other end of which terminates under a number-plate bolt as before. A steel braided fuel supply pipe from the tank connects to the lower pump union, and another feeding the carbs connects to the upper union.

In the boot the 12v supply wire is connected to the pump terminal. A metal box screws to the boot front wall to protect the pump and wiring from damage from heavy objects in the boot.

An Alternative Position in Chrome-bumper Cars by Peter Mayo: *Added November 2011:*
At the start of the long refurbishment of my 1970 GT one of my main objectives was to replace the two ageing 6 volt batteries with a single 12 volt system, this coupled with a new lightweight high torque starter motor would ensure better first time starting and a considerable saving in weight. Removing the old batteries and cleaning the metal frames I then cut and riveted aluminium sheet turning each holder into a box thus preventing the Ingress of water and road dirt, sprayed them both with grey primer and finished with colour match and drilled a new earth point. I looked at the now vacant offside battery box and realised that I could now fulfil a long held idea of re-locating the SU fuel pump from its awkward access under and forward of the offside rear wheel and install it in its new home. First job was to jack up the car and securely support it on axle stands, got to be safe when working under a car.

Removing the wheel to access the fuel tank fitting, I scraped away the dirt and underseal and cleaned the area, don't want to get bits in the fuel tank. When using a large pair of adjustables to

hold the rectangular block tank fitting and a spanner to undo the nut remember when pulling down on the spanner to push up with the adjustables to reduce the danger of stressing or fracturing the tank. I got the nut loose without any problem or fuel loss and moved the pipe to one side. I intended to wrap and seal the pipe to prevent any sparks when cutting the pipe but it wasn't necessary as the pipe didn't have a sealed olive end so a flexible fitted fine.

Mounting the pump on the floor of its new location I used the original cut out in the side of the (ex) battery box as access to route the flexible pipes from tank to pump and from pump to carburettors. The pipe from the carbs to the pump will need the end cutting as it has a fixed olive but it is not a problem and the flex pipe fits straight on after the cut.

When mounting the pump I found the best access was afforded by a diagonal installation, which allow you to get to the points if fitted, the electrics and the banjos.

With the air delivery bottle uppermost and the banjos 45 degrees apart with the banjo feed to the carburettors at the top.

One last job to cut and fit foam insulation to cut out and possible noise. If you have an electronic, no points pump so much the better, it will stay cleaner and access to the flex pipes and electrics are good. Job finished. Battery access panel and rear seat installed. Car started..........................

NO NOISE WHATSOEVER.

Pump Vents: *Added December 2009:*

Originally the fuel pump only had one vent - on the main body by the diaphragm. In Feb 68 at MGB 140611 and NGC 1062 a new fuel pump AUF305 replaced AUF301 which had an additional breather fitted to the end cover. In 1969 at car number 173850 Clausauger says "Longer fuel pump breather tube, of reduced diameter" but doesn't specify which. These vents are necessary to prevent the diaphragm pressurising the air space around the solenoid which would tend to restrict the movement of the diaphragm and hence pumping performance. On chrome bumper cars both (where provided) vents are connected by plastic tubing to Tee pieces (similar to screen washer Tees) in the boot - curiously the two tubes and Tees are of different sizes. The larger of the Tees sits in a hole on the shelf, the other thinner one is brought through a different hole and to a position further up to sit in a harness clip. Rubber bumper cars already have the electrical end of the pump inside the boot, so there is only one length of tubing brought into the boot from outside, this time though the vertical wall below the shelf, but again ending in a Tee sitting in the hole. In all cases the arms of the Tee are left open. Even though the electrics end of the rubber bumper pump is already in the boot mine still has a short length of tubing under the metal cover, presumably to stop any debris or moisture dropping into the vertical port.

The port in the plastic cap has a little ball in it, which tends to act as a one-way valve. The purpose of this isn't clear, ordinarily as the solenoid operates it would tend to suck air in the body vent and push it out of the cap vent and the one-way valve will allow this. When the solenoid releases ordinarily air would flow the other way, but with the valve closed air from the diaphragm side of the solenoid will be pulled past the solenoid into the cap end. The effect of this is that as the pump repeatedly operates air is pumped through the pump body from the body vent to the cap vent. As air can apparently flow past the solenoid as it releases, presumably it can also flow the other way when it operates, so in theory only the body vent is required to allow air to flow in and out as the diaphragm itself actually moves - presumably what happened in a one-vent pump. Why they went to two isn't known. One could hypothesise that the two-vent pump moves air through the body of the pump so cooling the solenoid and coil. But as the pump is only energised for less than a second once every two or three seconds at most in normal use, it's difficult to imagine the pump getting very warm anyway. Different when you have run out of fuel of course, as the pump then chatters away like billy-oh, and for maybe half a minute or more while the float chamber empty before the engine cuts out.

There is a view that on chrome bumper cars the cap vent can be left without any tubing as air only flows out of it and the valve **should** prevent anything getting in. But as Abingdon saw fit to provide a second length of tubing and Tee from this into the boot it seems perverse to remove it. Even sillier is another view that says you can block off the cap vent with caulk, on the basis that the early pumps didn't have it!

My pointless Moprod (same system as the SU but different packaging) has no identifiable ports at all, so either it vents differently, or maybe they didn't think compressing of the air inside the pump was an issue. It's true my pump started short-stroking, which was why I replaced it, but only after many tens of thousands of miles including very cold and very hot weather, so I don't think that was the cause.

Testing, Diagnosis and Adjustment: *Added December 2009:*

Electrical tests *November 2014*
Adjusting the diaphragm and points *June 2014*

If you have an SU pump then listening for clicking when turning on the ignition but before starting the engine is a perfectly valid test. Depending on how hot the engine was when last switched off it may click just a couple of times (cold) or for several seconds (hot). But if you turn the engine on within a few minutes of

turning it off it may not click at all especially when cold. Note that some after-market types chatter all the time, regardless of engine demand.

If it doesn't click at all after having left the ignition off for several hours or overnight then the pump or its electrical supply is probably faulty. If it clicks, then it should stop, and only make a single click once every 30 secs or longer. If it clicks more frequently than that then either the float valves are leaking and it will eventually overflow, which if you have a charcoal canister make take some time to appear on the ground, or the non-return valve in the pump inlet is leaking. If it continues to click rapidly then either you are out of fuel i.e. the fuel level is below the pickup strainer, the pickup pipe is perforated above the fuel line, or a float valve or the non-return valve mentioned above are stuck open. If rapid clicking stops and starts while the ignition is on but the engine isn't running that implies either very marginal fuel level or the non-return valve intermittently sticking. Note that some after-market types output excess pressure which will overwhelm the float valves and cause flooding unless a fuel regulator limited to 2psi is also installed.

If it clicks and stops as it should, then check delivery. Remove a fuel feed pipe from a carb (be aware it will spurt if the ignition has been on recently with SU and Moprod types), direct it into a container, and turn on the ignition. It should deliver **at least** one Imperial pint per minute, in practice closer to two, in a steady stream of pulses with minimal bubbles. Erratic pumping indicates pump or fuel level problems, lots of bubbles a leak on the tank side of the pump plumbing. Note that the delivery requirements apply to after-market types as well.

If all that is right then the only other thing running the engine is going to tell you is if there is a very intermittent problem with the pump or its electrical supply that only being operated for a long time may reveal.

Electrical Tests: *November 2014* SU Burlen state that these pumps take 1.5 amps at the minimum voltage of 9.5, which implies a solenoid resistance of 6.3 ohms. However when I measure the resistance between the two pump spades of mine I see about 2 ohms, which implies a current of 6 amps at 12v, and 7 amps at a running voltage of 14v. I then measured the current through the solenoid i.e. bypassing the points and at 12v saw 5.5 amps - so where do Burlen get their 1.5 amps from? If you power a pump on the bench, not pumping fuel i.e. chattering away, using either an analogue meter or a digital meter that will average the current, that's when you will see about 1.5 amps. In other words the current that Burlen quote is the average of the current flowing while the points are opening and closing, and they are open for longer than they are closed.

Adjusting the diaphragm and points: *June 2014* The Leyland Workshop Manual and Haynes info on points adjustment is pretty sketchy, more info here. But the info on diaphragm information is confusing at best if not downright incorrect, correct info is here. Note that there have been three different methods of spacing the diaphragm over the years, and SU Burlen have gone back to the original brass spacers after two different types of plastic spacer.

Update January 2010: This source details a problem with a nearly new Burlen pump. It seems to have been caused by a misalignment between the moving and fixed contacts such that only one contact pip of the two each side was being used. On the face of it one should work as well as two (in fact much earlier SU pumps did only have one pip each side) except that physical erosion from the rubbing action as the contacts are closed and opened would occur at double the rate. I don't know how good MOV (Metal Oxide Varistor) spark suppression is compared to diode (there seems to be no sparking with diode like there is with capacitor quenching) but if there **is** some sparking, and hence burning, maybe that is enough to cause a single contact to fail fairly rapidly. With two even if one burns and so no longer conducts, it will still be subject to the rubbing action while the other contact pair is still working, which would tend to wear any such burning off again. **NB:** Subsequently compared capacitor, diode and MOV on brake light relay circuits and whilst the varistor results in a slightly higher back-emf as the contacts open there is still no visible spark, unlike capacitor quenching.

Union Leaks:

Banjo union sealing changed from fibre washers to O-rings at some point, and it is important to get the correct seal for your pump body or you will get leaks. Looking carefully at the ports on the pump, the type that need a washer have the thread starting right from the face. But the type that need an O-ring have a recess before the thread starts.

The banjo has an orientation - the flat face goes towards the pump, regardless of whether a washer or an O-ring is fitted, and a washer fits into the recess that goes towards the bolt.

See also the following information:

- New SU Pumps with 'O' ring seals from Dave Dubois.
- An alternative approach from Herb Adler

Pump refurbs: In June 2014 I replaced the points and diaphragm and some other parts on a spare pump which seems to have been successful.

Then in early 2015 Michael Beswick refurbed one of his, but went further and dismantled the air bottle and smoothing chambers replacing the seals and diaphragm, and had considerable problems, as recounted here. He ended up having the body replaced, and from his experiences and going by comments in these SU Fuel Pump articles from Dave Dubois it does seem that current bodies are slightly different in a number of ways and some replacement parts do not fit old bodies very well.

North American Emissions Plumbing

From February 1964 all MGBs had a positive ventilation system drawing in fresh air from the oil filler cap or charcoal canister (not closed-circuit as Clausager states, which involves drawing air in from between the throttle butterfly and the air filter, passing it through the crankcase, then returning it to a port on the inlet manifold i.e. down-stream of the throttle butterfly), passing it through the crankcase to a PCV valve on the inlet manifold i.e. making sure oil fumes were burnt instead of being vented to the atmosphere, replacing the hit-and-miss draft tube and air cleaner hose on earlier cars. In 1968 an air-pump was added to North American models to reduce exhaust emissions. In 1969 the crankcase breathing system on all cars was changed from using the troublesome PCV valve on the inlet manifold to using breather ports on the twin SU carbs. In 1970 (California) and 1971 (rest of North America) emissions plumbing was added to prevent vapours from the float chambers and tank being discharged to the environment, being trapped in a charcoal canister, fresh air being drawn through this to purge it before being passed through the crankcase. In 1973 an anti run-on valve was added to North American cars to deal with problems caused by lower octane fuels and weaker mixtures, and in 1975 the single Zenith/Stromberg replaced the twin SUs, also North American cars only.

Click on the thumbnail for an enlarged schematic of the plumbing of twin SUs with emissions but without anti-runon valve. This version prevents fumes from any expansion of air or petrol in the tank or float chamber from entering the atmosphere. The system also scavenges the crankcase burning any oil fumes and preventing condensation as before.

Twin SUs with anti-runon valve. Otherwise as above, the additional of the valve ensures there is no Dieseling when the engine is switched off. The leaner mixtures and lower grade fuels associated with emissions controlled cars made Dieseling more likely.

A general overview of the engine compartment plumbing SU carbs.

As above but with Zenith carb replacing twin SUs.

Detail of how the emissions pipes connect to the Zenith.

A general overview of the engine compartment plumbing Zenith carb.

My thanks to Mark Childers and Lawrie Alexander for their help in producing this section.

Removing the emissions plumbing *(Added August 2010)* Many people remove the emissions stuff, but apart from the air pump and gulp valve there is little to be gained by removing the charcoal canister other than space in the engine compartment. If you do, there are a number of things you should do as part of the job:

- Crankcase ventilation - this comes via the charcoal canister to the port on the rocker cover, and must be retained. You could seal the restricted port on the rocker cover and fit an earlier breathing oil filler cap, but that wouldn't be obvious and a non-breathing one could be fitted subsequently which would kill the ventilation. Much better to fit a small filter to the rocker cover port, then it is obvious.
- Tank ventilation - again this must not be sealed, unless a ventilated petrol filler cap is fitted, or you will get fuel starvation. You could just leave the hose open in the engine compartment, but that would emit fumes as the tank was filled and the fuel expanded. Neither should you simply disconnect the breather pipes in the boot or that will fill with fumes. Probably the best solution is to fit a loop of hose to the tank breather port, going up into the space by the battery and back down again to about axle level.
- Carb float chamber ventilation - this must be left open to atmosphere otherwise the float valves will never rise to stop the pump, and fuel will be pumped straight into the inlet manifold and engine. Neither must the hoses simply be removed and the ports left open, as any fuel venting if (when?) the float valve fails can be poured straight onto a hot exhaust. Instead pipes or hoses must be fitted to take any leakage down past the exhaust to by the bottom of the crossmember by the front left-hand engine mount.
- Inlet manifold ports - none of these must be left open to atmosphere or it will cause a significant vacuum leak. If you are not happy plugging the port itself (which must be done in such a way that the 'plug' can't be sucked into the engine) then replace it with a blanking plug and sealing washer.

Octane Ratings

Briefly 'octane' is a number which indicates the grade or combustibility of petrol. As well as being ignited by a spark e.g. from a spark plug in an engine (which initiates a rapid but steady burn), fuel can also ignite if it is compressed enough which heats it up (which causes a sudden explosion). The octane number indicates how much a particular grade of fuel will resist this compressive explosion - the lower the number the more likely, the higher the number the less likely. A sudden explosion is very bad in a petrol combustion engine, it can cause serious damage to the engine (by contrast a Diesel engine is designed to cope

with the sudden explosion which happens when fuel is injected into the hot, compressed air in the cylinder). High compression petrol engines need a high octane fuel, but lower compression engines can run on a lower octane. Higher octane costs more to produce than lower octane and consequently is more expensive at the pumps, but generally delivers more performance when used in an engine that is designed to take advantage of it. Using high octane in an engine designed for low octane gives no performance benefits. However using a low octane fuel in a high compression engine will cause pre-ignition or detonation under load (similar to the sudden explosion referred to above) known as 'pinking' or 'pinging' from the sound it makes, which can damage the engine.

There are various way of measuring and specifying octane: The UK uses RON (Research Octane Number), there is also MON (Motor Octane Number) measured in a different way, and America uses a composite of these two (RON+MON)/2 which is known as PON (Pump Octane Number). Taking just one example 99 RON is 90.75 MON and 94.9 PON.

The MGB was designed to run on '4-star leaded' in the UK which equated at the time to 98 or 99 RON. Now leaded is no longer commonly available (for health reasons, although it still is from some UK specialist garages) unleaded at 95 RON is the universally available fuel in the UK with many (but not all) stations also stocking Super Unleaded at 97 RON. There is also Shell V-Power at 99 RON (replacing Optimax at 98 RON), and Greenergy from some Tesco outlets also at 99 RON. BP Ultimate 102 (102 RON) is available from some outlets but at about 2 to 3 times the price of 95 or 97 octane! Whilst the MGB will run on 95 RON the ignition typically has to be retarded by 3 degrees or so to control pinking, but this reduces the performance of the engine, increases running temperatures, and increases fuel consumption. Some eras of MGB engine seem to be very prone to pinking (my 73 is and I have noticed it on others of a similar vintage), probably due to features of the cylinder head design. Even when 4-star was still available I had problems with pinking if the timing was advanced even slightly from specification. By choice I have always used Optimax when available, have just started using V-Power, but can't say that the change from 98 to 99 has made it any less likely to 'pink'.

Further reading:

Probably all you would want to know about Octane from Thor Racing
'Fuel grading systems' from 'Mad Mole'
'Definition of octane rating' from Wikipedia
See also 'Unleaded' below.

Pump Fusing

Both my cars came to me with the white wire to the fuel pump damaged as a result of a short to earth in or near the pump. Another on a pal's barn-find, and one visible on a picture sent to me by another person ostensibly of where the overdrive wires connect between main and gearbox harnesses! You might be lucky and get away with just a slightly damaged but useable harness (Bee). Or you might have to run in a new wire to the pump (Vee), or you could lose the whole car to a fire. So fusing the pump would seem to be a good idea.

On most (if not all) models the fuel pump wire is in the rear harness that that runs under the floor and connects to the main harness in a mass of connectors by the fusebox on the RH inner wing. It is a simple matter to pull the white wire from the rear harness out of the bullet connector in the main harness, make up an in-line fuse with two short wires terminating in bullets, plug one wire into the existing bullet connector in the main harness, and with a new single bullet connector connect up to the pump wire in the rear harness.

Note that for North American cars with the gearlever manual switch the inertia switch feeds both the fuel pump and the overdrive. There is a double connector, possibly by the junction of the firewall and RH inner wing as before, where there is a white from the inertia switch, a white to the fuel pump, and a white/brown to the overdrive switch. To just fuse the fuel pump insert it in the white wire going to the pump. But while you are at it you could fuse both the fuel pump and the overdrive it you insert it in the white from the inertia switch. If the inertia switch has spade connectors you could insert it here (using male and female spades on the in-line fuse instead of bullets). Incidentally, if adding an inertia switch to car that didn't originally have one, this is the place to insert it - in series with the fuse.

Personally I would use a standard 17amp rated/35 amp blow fuse in the circuit simply because there are (or should be!) a couple of spares of that rating in the main fusebox. That rating may seem higher than required for the pump but the purpose of the fuse (like all in the MGB bar certain North American models) is to protect the wiring and that rating is fine. Information from SU Burlen is misleading when they say the pump takes 1.5 amps at 9.5v, so you may be tempted to fit a 2 amp fuse. The pump actually takes pulses of 7 amps at 14v, but only very briefly, it is only over time that these average out to about 1.5 to 2 amps that you would see on an analogue meter. If you fit a fuse of less than 7 amps then it is repeatedly being stressed, and may eventually fail when there is no fault.

This arrangement had an unexpected benefit out in my V8 one day when I had a major fuel overflow from one carb, and I really couldn't countenance driving home with fuel pouring out of the overflow. Then I had the idea of cross-connecting the overdrive and pump fuses so I could use the OD switch to turn the pump on and off! While driving along I'd turn it on for two or three seconds then turn it off again, then continue driving until I felt it start to splutter from fuel starvation, then turn the pump on again for a few seconds and so on.

Running-on

My attempts to control Running-on

The Problem

Running-on, or Dieseling, is characterised as a very rough shuddering and shaking when the ignition is turned off was a progressive issue during the production life of the MGB due to increasingly stringent emissions regulations. It seems to have been more of an issue in North America and the factory fitted an anti-runon valve for that market from 1973, the UK never had one as standard. It should be noted that North American cars can suffer from a completely different kind of running-on which is characterised by completely normal idling for several seconds, as if the ignition hadn't been turned off at all. This is caused by a fault (or faults) in the emissions systems on those cars, see below.

Running-on was always a bit of an issue on my 73 roadster, but liveable-with as long as the idle speed wasn't set too high. With the demise of 4-star Leaded I tried LRP (which doesn't give the protection against valve seat recession offered by 4-Star Leaded or Unleaded with a suitable additive) and Super Unleaded (same octane as 4-Star Leaded) with Castrol Valvemaster and neither of these seemed to offer any change in running-on, either better or worse. Standard Unleaded with Castrol Valvemaster Plus gave diabolical running on and pinking on hills and is unusable in my engine.

I decided to fit the MGOC anti-runon valve (note, the MGOC valve has been shown as 'not available' for some time at the time of writing. It was available from Moss Europe at one time, but very expensive at £58 (very? £140 from an RR and Bentley supplier!), there may be a much cheaper option). When testing it I was concerned that disconnecting the valve while the engine was running didn't stop the engine, even though I could hear the valve had opened and was dumping copious amounts of air into the manifold, although it did make the engine run faster and roughly. On the road with Super Unleaded and standard Castrol additive it might, just might, have reduced running-on a little, but it certainly didn't eliminate it.

However Super Unleaded is not always available, and with a weeks touring of the Scottish Highlands coming up I bought a bottle of Castrol Valvemaster Plus (valve seat recession protection plus octane booster). Sure enough, I couldn't find any Super Unleaded anywhere we stopped throughout Scotland, so switched to the Plus additive. Immediately the running-on was much, much worse and so was pinking on hills. "Fat lot of good that valve is", I thought, and not cheap at 50 quid. . My initial reaction was to demand my money back, but that would still leave me with the problem.

So whilst touring I pondered some alternatives: Now the North American system uses a 3-port valve as part of the emissions system and when it operates it applies manifold vacuum to the float chamber overflow, which has the effect of sucking the fuel out of the carb jets and instantly stops the engine - a pretty neat piece of lateral thinking, IMHO. Could I get hold of a North American valve? Could I use the MGOC valve to perform the same function as the NA valve? Would I have to rig up a second valve to close off the bottom of the overflow pipes in order to develop enough vacuum to suck the fuel out of the jets? Could I get away with some Gunson's Carbalancer-like ball-valve where the vacuum lifted the ball and blocked off the pipe? Would a fuel overflow do the same thing and negate the purpose of the overflow pipe? Could I pinch the bottom of the pipes a bit and develop enough vacuum that way, whilst still leaving enough of a hole for fuel to escape? Despite so many unknowns I thought it was worth a punt.

I rigged up the MGOC valve as described below. Once fully installed, and after a motorway thrash in warm weather followed by a crawl through some town traffic, I revved the engine to 2500rpm and switched off. You may have some idea what revving the engine above idle **at all** does for Dieseling in a car that suffers from it, let alone 2500 rpm, but in this case the engine just cut and ran down perfectly without a single cough of Dieseling. For the sake of a fivers-worth of bits and an afternoons work it works better than ever I could have hoped.

August 2001: (sigh) not as successful as I had first hoped. In fact if switched off at idle speed it still runs-on even though it does not if revved - presumably the higher vacuum when decelerating from 2k or so makes the difference. I have had a switch in the petrol pump lead for some time as a primitive immobiliser but have now moved it to the anti-runon valve circuit. Switching this off cause the engine to cut after a second or so, then I turn off the ignition. Makes for an even more effective immobiliser - the car apparently has spark and fuel and even if it starts it cuts out again a second later - most confusing!

November 2001: Shell have launched Optimax at a claimed 98 octane. My first try at half a tank and unboosted Valvemaster (mixed 50/50 with standard unleaded and boosted Valvemaster) immediately reduced running-on to its former level with 4-star leaded, possibly a bit less, my anti-runon valve is still connected as before. I note that the MGOC claim boosted Valvemaster raises octane by two points, which is more than Shell state, and others claiming to be in the know say it is not technically possible to raise it by more than one. MGOC also say that "Optimax is not an option". I query this and they revise it to "not an economical option". Well excuse me but anything that causes the amount of pinking and running-on I was getting with standard unleaded is no option at all.

July 2002: Determined to solve this I have been thinking of installing the North American anti-runon system. Bought the valve (which are available new from the MGOC, cheaper than their own option too) to see just what it

did. Since one of the problems with my current system is that fuel is sucked out of the carb overflows and dumped straight in the inlet manifold, which is why the engine continues to run after a fashion if I activate the valve with the ignition still on and also still Diesels, so I may need the charcoal canister or equivalent as well to stop the fuel getting to the manifold. But then I would need to rearrange the engine breathing so the canister can be purged during normal running which would mean butchering the rocker cover. Where do I stop? Then I suddenly realised that the North American system has a restrictor in the pipe on top of the rocker cover, whereas I'm using full manifold vacuum. Fashion a simple hose clamp as a restrictor as described below and 'lo and behold' it seems to work.

The Solution

I drilled holes near the tops of the overflow pipes and soldered a short length of copper tubing to each to make a T then linked these with two short lengths of 6mm hose and a T-piece, and piped this to the inlet of the MGOC valve. Ran the engine, disconnected the valve but left the ignition on - and the engine instantly died - and this was with the bottom of the overflow pipes open to the atmosphere and not restricted in any way! This intrigued me as to just how little suction was necessary to stop the engine so I removed the hose from the valve and just sucked on it with my Mk1 mouth. I was amazed to find just how little suction I had to apply to stop the engine. It must be sucking the fuel out of the jets since the UK overflow pipes are open to atmosphere so cannot be affecting any other part of the carbs. There also seems to be no chance of sucking fuel up into the new pipes due to the very small volume of fuel in the jets - the level in the float chambers rises by this amount and thereafter you can hear and feel air coming down the jets and bubbling up through the float chamber (could be different if the float valve is stuck open e.g. with grit, though, and is full and overflowing).

More ingenuity required to obtain/fabricate a set of reducers to get down from the 1" or so of the MGOC valve inlet to the 6mm of my new T-piece. The hoses that go between the overflow pipes sit neatly out of sight under the carb flange between air cleaners and the U-brackets they bolt up to, and the hose to the valve comes up from the T-piece, between the carbs, then round the back of the rear carb to the MGOC valve which is screwed to the bulkhead between the heater and the remote servo (LHS of bulkhead).

Amazingly, too much vacuum is developed even with the bottoms of the overflow pipes open to the atmosphere and some fuel is sucked through the valve and dumped into the inlet manifold, which allows the engine to continue to run albeit roughly so I fashion a hose clamp to control the vacuum. I can tighten the clamp so the hose is fully restricted and it disables the anti-runon valve altogether, or I can loosen it so the engine continues to run after the valve is opened. But there is a position in between the two where it cuts out cleanly.

A couple of things to watch out for are to check the outside diameter of your intended hoses fits in the space between air-cleaner and U-brackets without being pinched. Also I found it easy to route the hose to the valve such that it doesn't interfere with either throttle or choke linkages, or reduce access to jets, clamps and adjustment screws by a significant amount.

Several months and thousands of miles down the road there may have been a slight cough on one or two occasions, but other than that it has stopped as clean as a whistle under many different conditions.

An alternative solution *August 2010*

Sometime after installing the above (which incidentally is still working perfectly and has needed no further alterations or adjustments) someone mentioned plumbing the MGOC valve straight into the inlet manifold may be a better solution to being teed into the servo hose, as perhaps it is the restriction of the one-way servo valve that is limiting its effectiveness. I've been pondering this for some time, and wondering how I could mount the valve direct to the inlet manifold.

Recently I happened to notice that the PCV valve used on earlier engines used a short length of hose to attach it to an adapter screwed into the manifold - previously I had thought the valve screwed in directly. The adapters have a large bore, no one-way valve like the servo adapter, and my inlet manifold has a large blanking plug at the front end ... are they the same size? Going against the edict "If it isn't broken don't fix it", and having found the original filter off the end of the valve which wasn't needed in Solution 1 ("If you haven't found a use for something yet you haven't kept it long enough") I splash out six quid or so on adapter 12H1405 and sealing washer. Lo and Behold it screws straight into the manifold in place of the large blanking plug. However it has about twice the thread of the blanking plug, and extends down into the inlet manifold, so I remove nearly half, maybe not necessary but I didn't want to restrict the flow of vacuum. The port for the hose is quite a bit bigger than that on the valve, and I would either need to get larger diameter hose to fit that and then pad out the valve port to fit the hose, or ... do something else.

I have some copper pipe that fits really snugly into passage through the adapter, and is a reasonable fit to the valve hose. So I cut off the adapter port, press the copper pipe all the way through the adapter, cut that to the same length as the

original port, and solder it in place for sealing as much as anything else. I tap a centre punch into the open end of the copper pipe, which swages it out a little into a flange to make a snugger fit into the hose. The hose is cut to literally just long enough to push onto the adapter and the valve, i.e. the ends of the two are practically touching. The valve is a tight fit into the hose so doesn't need a clamp, and I have a spring clip which just goes over the hose to clamp it onto the adapter port.

The original 12v wire reaches to the new location, so I just have to extend the earth wire back to the tapping where the valve mounted previously. While trying to remove the valve and it's short length of hose from the Tee in the servo hose I break the spigot off, which is a bummer ("If it isn't broke ...") for if I have to put the valve back in that position again, I'll have to get another tee. In the meantime a bolt with some tape around the threads is a push fit into what's left of the spigot, and more tape round the outside makes a seal against a vacuum leak. Turn the ignition on and off a couple of times to check the electrical connectivity (the valve clicks on and off), and fire it up. Engine starts and runs normally, so probably no vacuum leaks. First test is to turn the valve off with the ignition still on, obviously masses of air rushing into the inlet manifold, and whilst the engine still runs (unlike in solution 1 above) it does so very badly and much worse than it did as originally, so hopefully more effective. A run round the lanes on the first warm and sunny day for a couple of weeks reveals no problems, and switching off no Dieseling. However I'll have to use the car a lot more before I can declare it as effective as solution 1 above, but if it is then it is an easier option for others to try than Solution 1 - The Plumber's Nightmare. *September 2010:* After several short, medium and long runs there is no sign of running-on, so plumbing in directly to the inlet manifold is definitely an option. However it still allows the engine to be started with choke, and run albeit with a weak mixture despite the open port into the inlet manifold, whereas my original solution also acts as a very effective immobiliser, so I will be returning it to that version - when I have replaced the plastic Tee I broke when disconnecting it from the servo hose!

Yet another alternative *November 2010*

Herb Adler wrote to me from Australia about his need for an anti-runon valve to prevent his engine trying to exit the car while the bonnet was still closed, his solution can be found here. He obtained a couple of vacuum solenoids from a scrapyard (for a sight less than the aftermarket valve that I have). However they operate 'the other way round' to the aftermarket valves in that they are normally closed, and have to be powered to open the valve on engine switch-off to apply vacuum to the carbs. Easy enough to use a relay controlled by the ignition with a normally closed contact, but that leaves the solenoid powered all the time the car is unattended which is not good. The factory overcomes this by feeding an earth to the valve from a normally-open oil pressure switch (**not** the same as the normally closed oil pressure warning light switches), so once the engine stops and oil pressure bleeds away the valve releases again. You can retro-fit this of course, but there may be another way. Or two.

Option 1 is for cars with an Accessories position on the ignition switch (1968 (UK) or 1969 (North America) onwards) and uses a relay with a normally closed contact (i.e. it has 87a terminal as well as an 87), operated and released with the ignition. Turning the ignition switch from Run to Accessories will release the relay, and it's normally closed contact will now connect power from the Accessories circuit to the solenoid to open the valve and apply vacuum to the carbs. Turning the ignition switch from Accessories to Off will release the solenoid again. In this case once the ignition switch has been turned fully off both relay and solenoid will be released, so you will have to remember to pause in the Accessories position while the engine comes to a halt. Cars from 71 to 74 have a fused Accessories circuit (green/pink) feeding the heater fan, wipers and electric washers so this can be used to feed the relay contact. Outside those years your own fuse off the white/green would be advisable.

There are a couple of other options that make use of the fact that while the engine is running, and the alternator (or dynamo) is charging, there is 12v on the indicator wire from the alternator or dynamo control box to the ignition warning light, which disappears when the engine has come to a halt. It's theoretically possible to use this via a relay to operate the solenoid when the ignition is first turned off with a running engine, then when the engine stops and the alternator stops charging the solenoid will release again. However on alternators this involves connection to the electronic voltage regulator and I'm not sure how that will be able to stand up to the additional load of the relay or solenoid or the fact that both are inductive and can generate a pulse of high-voltage back-emf which could damage the regulator. Because of that I'm unwilling to give details of how it could be done. However this method could be used safely if you are prepared to delve into electronics a bit deeper and either use an isolation circuit between the indicator wire and the relay or solenoid, or indeed devise a timer circuit to avoid connection to the indicator wire altogether.

Non-Dieseling (normal running) runon in North American cars

This type of running-on is not the shuddering, Dieseling kind but completely normal running as if the ignition had not been turned off at all. If the ignition warning light isn't working either, then check here first. Believe it or not this is caused by a failure in the anti-runon valve or emissions plumbing, in conjunction with a design defect in the wiring of the ignition relay. When Abingdon provided the relay on North American cars they did it in such a way that the relay remains operated when the ignition is switched off, which maintains power to the ignition. But the anti-runon system is so good at stopping the engine no-one realised at the time. The problem was caused by (sensibly) moving all the heavy electrical loads to the relay contacts, but they left the ignition warning light connected to the

white which goes to the relay winding. When the ignition is turned off current flows from the alternator still charging through the warning light and the relay, which is enough to keep the relay operated. No-one realised this at the time because the anti-runon system cuts the supply of fuel through the carb instantly stopping combustion. So it is lack of fuel that stops these engines, not lack of sparks. If the valve fails to operate, or any of the emissions hoses develop air leaks or certain of them get blocked, or you have removed the emissions plumbing, the engine will continue to run normally with the ignition switched off. The easiest fix is to split the white/brown wires at the fusebox, find out which feeds the coil and connect that to the **white** on the ignition relay. This will power the ignition from the ignition switch, so it can be turned off to stop the engine.

March 2019:

In response to a person complaining of this problem with his 1977, and my explanation based on the above, Kelvin Dodd of Moss US wrote to say Glenn Lenhard of Glenn's MG Repair says that the problem only occurred on 1977 models, for 1978 on the ignition coil feed was moved from the ignition relay back to the ignition switch (as per RHD above). However none of the Workshop Manual or Advance Autowire diagrams I have seen show this change for these models (in fact Advance Autowire don't even show the ignition relay for 1977 models from Bentley). Kelvin Dodd of Moss Motors has kindly sent me a picture of their 1979 MGB LE with only 30 miles on the clock, and definitely unmolested. This (attached) clearly shows that instead of three white/brown wires on the fusebox and a white and a white/brown on the ignition relay as in 1977, the white/brown for the ignition coil has been moved from the fusebox to the white at the ignition relay leaving just two white/browns at the fusebox.

Note: If any of the plumbing leading from the charcoal canister to the fuel tank gets blocked the engine will tend to stall from fuel starvation after a short period of running. This is because these systems have a sealed petrol filler cap and the only way fuel can be replaced by air as the fuel level drops is by drawing air via the canister. If this path is blocked a vacuum builds in the tank that eventually overcomes the pumps ability to deliver fuel to the carbs.

When the ignition relay was fitted to UK cars the wiring problem was discovered immediately because these cars don't have the anti-runon valve and emissions plumbing, so cutting the ignition is the only way of stopping these engines. The problem was fixed on these cars by moving the ignition warning light wire from the relay winding to the contact, and normal operation was resumed. However for some reason they also moved the coil feed, heated rear window, indicators and heater fan from the relay output to the relay input i.e. back to the ignition switch circuit, which as well as stopping the problem rather destroys the reason for installing the relay in the first place! Either change would have done the trick, why they did both I don't know, but moving the warning light on its own would have made far more sense. *Update August 2010:* Apparently the original fix **was** to move just the warning light wire, but subsequently there had been problems with the ignition relays sticking on, which left all the ignition circuits running, flattening the battery, and was obviously a fire risk. So the factory moved the ignition, heater fan, indicators, GT heated rear window and tach back to the ignition switch, but powered via a separate in-line fuse. This still left the washers, wipers, brake lights, reversing lights, fuel and temp gauges, handbrake warning and seat-belt warning circuits powered in the event of the relay sticking on, and some of those at least would still be draining the battery, but it does remove the worst circuits I suppose. However since those 'worst' circuits are also the ones that take the most current, it rather removes the need for a relay in the first place! *end of update*.

The North American anti-runon valve

Valve Schematic 

From 1973-on North American spec cars had an anti-runon valve factory-fitted. The ignition switch has a special contact that is closed when the ignition is off and open when the ignition is on. This contact has a slate (grey) wire feeding 12v to an in-line fuse. The other side of the fuse has a slate/pink wire going to one side of the valve, and the other side of the valve has a slate/yellow wire going to an oil pressure switch which supplies the earth for the valve. Note this is a special switch with a normally **open** contact that **closes** with oil pressure, it is not the more common type used to warn of low oil pressure that has a normally closed contact to light an oil pressure warning lamp. If you install the wrong switch the engine probably won't even start. With the engine running and the ignition on there is no 12v supply to the valve but there is oil pressure so there is an earth going to the valve. As the ignition is switched off 12v is sent to the valve, and as the engine is still running and there is still oil pressure, the oil pressure switch is still supplying an earth to the valve. So the valve operates and cuts off the supply of fuel by applying manifold vacuum to the vent ports of the carb(s) which sucks the fuel out of the jets instantly stopping combustion. When the engine stops and the oil pressure dies away the oil-pressure switch opens, removing the earth from the valve which releases. You may hear a click a couple of seconds after switch-off. So when the car is being driven the valve has an earth but not 12v, and when the car is parked it has 12v but not an earth. When you first start cranking it has neither 12v nor an earth, only during switch-off does it have both 12v and earth. But the valve will only do its job if the emissions plumbing is complete and has no blockages or leaks (see above). The valve can be tested as follows: With the ignition switch off, remove the wire from the oil pressure switch and briefly tap it on and off a good earth. You should hear the valve click as it operates and releases. If it does not, check the in-line fuse, 12v supply from the ignition switch, and continuity of the wiring and valve. *(Corrected 25th August 2003 thanks Patrick Callan of*

Connecticut.) If the valve is clicking OK, then either there is an internal mechanical defect, or there is a leak or blockage in one of the emissions hoses or charcoal canister. If you remove the emissions kit (although there is little benefit in removing anything other than the air-pump and gulp valve, except freeing up some space in the engine compartment) and encounter this running-on problem, and have an ignition relay, then you will need to correct a wiring design error as described here.

NEW Stromberg Carbs

Just a little on these following experiences working on a pal's TR4, even though they are not the same as the single Stromberg/Zenith used on later North American MGBs.

After a failure on the road and reports of weak spark I suspected the condenser. That was fine, but spark wasn't consistent, or as strong as expected. Eventually by juggling coil and distributor caps (which caused it's own frustration as the leads exit 90 degrees round when fitted compared to the original, and I replaced one for one ...) it would fire but ran very roughly indeed and would neither idle nor rev, then wouldn't even do that. Front plugs were soaked and rear just damp, so I started looking at the front carb. I lifted up the piston while cranking - to see fuel flooding up from the jet, but not on the rear carb. That has to be flooding e.g. from a faulty float valve, but nothing going on the ground. I then realised there is no vent/overflow as on SU carbs as the float chamber is below the jet, so it can use the jet to vent when filling the float chamber. HIF carbs have a similar arrangement of float chamber under the jet, but still have a dedicated vent/overflow. The added complication was an engine-driven fuel pump instead of electric, so no clicking to alert one either. Along the way I discovered the 'choke' is indeed a choke and not solely an enrichment device as on SU, as it consists of a flap in the throat that rises to lift the piston somewhat to allow more fuel in, as well as block off that part of the throat to reduce airflow. Very simple in comparison to both the HS with it's multiplicity of parts and the HIF with it's internal valve and O-rings.

Removed the carb and float cover, blew out the valve, and that would close with just the weight of the float with carb inverted which seemed fine. Unfortunately with the cover removed some half a dozen jet components fell out, so much peering at small drawings to see how they went back. Back on still no firing, and no spark again. By this time we were back on the original coil, so do some DC tests, to find the points dirty so low current through the coil, but more importantly the coil HT winding was now open-circuit on an ohmmeter. Back to a (tested!) spare coil, and points cleaned, it now runs albeit roughly, but that is down to having upset the mixture setting. Hopefully just a case of setting up from scratch, which I left to said pal as I ran out of time.

That done, still not running. Back to first principles with static timing and static mixture which is the same as SU i.e. wind the jet fully up, then down two full turns. Starts and runs better than any other time, but after a few moments bogs down and dies, then nothing. Back to checking spark, two leads sparking, one only as the key is released, and the other not at all. Measure those two leads and they are open-circuit, which turns out to be the silicone core just floating around in the plug cap and not trapped under the crimp as they should be. Fit my 25D cap, leads and rotor. All four sparking but still no start, and one plug on each carb soaked. While cranking the engine with plugs out No.2 is puffing out a white cloud on every compression, which turns out be fuel - the front carb is flooding again! So onto the computer to source float valves as well as new leads (and cap and rotor just in case) - not easy. As well as parts for the TR4 not being as widely available as MG, there seem to be a plethora of float valves depending on model, and most online sources don't have a clear parts breakdown. Moss Europe do ... but the standard float valve is NCA! So it's back to pre-history and ringing round. Continues.

SU Carbs

Done properly, and not fiddled with afterwards, SUs will keep their tune for many thousands of miles. A superb quote that I have seen attributed to Lawrie Alexander of British Sportscar Centre is that "90% of the problems with SUs are due to Lucas electrics" i.e. the ignition system. Before setting-up the carbs it is essential that the valve clearances, plug gaps, points gap/dwell and timing including operation of the centrifugal and vacuum advance mechanisms are correct and any defects causing erratic or rough running are fixed.

The MGB was originally provided with HS2 carbs for all markets, the rear having a vacuum advance port. In August 1971 with the then new 18V engine all export markets changed to HIF carbs - 18V584Z for North America, 18V581/582/583Y for other export markets. North American engines now had the vacuum source on the inlet manifold, other markets still from a port underneath the rear carb. UK or 'home market' cars stayed with HSs on

18V581/582/583F engines, then in November 1973 they switched to HIFs on 18V779/780F engines again with a port under the rear carb, and non-North American export models had the same engines and carbs. With the change to rubber bumpers UK and non-North American export the vacuum source moved to the inlet manifold. In December 1974 North America changed to a single Stromberg/Zenith carburettor on 18V797/798 engines until the end of production. Other export markets continued with HIFs and the same engines as the UK until the 1977 model year at which point all LHD cars were to North American spec - and only roadsters as North American GTs ceased production in December 1974. There were several additional carb spec changes during production.

Theory:

I'm not going into the theory of carburetion in general, just the specifics of the SU, but the job of the carburettor is to feed a mixture of air and atomised fuel into the engine, in appropriate quantities and volumes for the conditions, so as to achieve good combustion and so best performance and economy. These conditions vary according to how fast the driver wants go, whether the engine is hot or cold, accelerating or steady speed etc. Too much fuel in the air (or too little air for the fuel) - a rich mixture - will result in sluggish performance, fouled plugs, poor economy, and in extreme cases can wash the oil off the cylinder walls causing rapid engine wear. Too little fuel in the air (or too much air for the fuel) - a weak mixture - will cause hesitant running and miss-firing, poor performance, overheating, and paradoxically poor economy just like a rich mixture.

The SU carb is brilliantly simple in its design, with very little to go wrong. However the later HIF (which stands for 'Horizontal Integral Float', by the way) is a bit more complex than the earlier HS, which I *think* stands for 'Horizontal Side float'. Why not HSF then? Who knows? The 'Horizontal' in both cases refers to the direction of air flow into the engine, as opposed to the 'down-draft', or 'semi down-draught' you might see applied to some other designs of carb. Visual identification is simple - on the HIF the float chamber is contained within the main body of the carb and actually surrounds the bottom of the jet whereas on the HS the float chamber is to one side of the main body of the carb and has an external pipe connecting it to the jet. Whilst technically the HIF is an improvement over the HS, for a number of reasons there is no good reason to convert to HIFs if you already have HSs, and if you are converting to SUs from Zenith/Stromberg or an aftermarket conversion and have the choice of HSs or HIFs then HSs would be marginally preferable for their simplicity. The diagrams below are of an HS unless otherwise indicated, click on a thumbnail for a full-size image in a different window.

Put simply the SU carb consists of a butterfly valve on the engine side of the carb connected to the throttle pedal and this controls the volume of air being pulled through the carb and into the combustion chambers. However there is another independent 'valve' in the air passage, and this is the large piston which is on the air-cleaner side of the butterfly. The piston is relatively free to rise and fall depending on how much the butterfly is open or closed as will be seen later. Attached to the bottom of the piston is a tapered needle projecting downwards into the open end of a tube (the jet) containing liquid fuel, the height of which is controlled by a float and valve in the float chamber (not shown). With the butterfly mostly closed i.e. at idle the piston will be at the lower end of its travel so it is blocking most of the air passage through the carb. Also the widest part of the needle is in the jet so blocking most of its opening, and therefore little fuel is being mixed with the air, but the ratio of air to fuel (given correct adjustment of the carb) will be correct. With the butterfly fully open the piston will be fully raised allowing the maximum amount of air to flow through the carb, the needle will have its narrowest portion in the end of the jet, so unblocking most of its opening, and the maximum amount of fuel is being mixed with the air, but again the ratio of air to fuel will be correct. Generally this state of affairs will be obtained for any throttle butterfly opening, and hence any vertical position of the piston in the air passage and the needle in the jet. If you look through the carb it is not the same diameter all the way through. Across the top of the jet there is a raised portion the width of the carb - the bridge. This restricts the diameter of the carb throat at that point, which has the effect of speeding the airflow over it and hence over the top of the jet (Bernoulli's Principle). This lowers the air pressure above the jet which is what causes fuel to be drawn up into the airflow to produce the mixture. So as well as the thickness of the needle in the jet controlling how much fuel is drawn up, the speed of the air flowing past the jet is also having the same effect. In steady state conditions although the **volume** of air increases as the butterfly opens and the piston rises, the **speed** of the air across the top of the jet remains much the same. However as the piston rises the narrowing needle allows more fuel to be drawn up from the jet even though the speed of the airflow is much the same. Later on we will see what happens when the speed of the airflow increases for the same needle position in one case, and the size of the jet orifice is increased for a constant volume and speed of airflow in another case.

So how does opening the butterfly cause the piston to rise, and the needle with it? With the engine at idle the butterfly is mostly closed and the piston is mostly lowered. But far from 'idling' in the usual sense of the term i.e. doing nothing, the engine is acting like a large vacuum pump due to the action of the pistons in the cylinders. On the engine side of the butterfly i.e. in the inlet manifold there will be quite a large vacuum, which is measured in inches of mercury (in. Hg.), and can be up to 18 or 20 in. Hg. However between the butterfly and the piston there will only be a few in. Hg., and on the air cleaner side of the piston the air will be virtually at atmospheric pressure i.e. 0 in. Hg. Now consider the instant the driver opens the throttle a significant amount, say to accelerate away from traffic lights. The butterfly opens, but with the piston still mostly closed the large vacuum that existed on the engine side of the butterfly is now present between the butterfly and the piston. The piston has

a couple of holes on the butterfly side near its base with passages to the space above the piston and its large skirt, so the vacuum is applied above the skirt. Although there is a gap between the edge of the skirt and the inside face of the piston cover it is a very small gap, so virtually none of the vacuum 'leaks' away. Now below the piston skirt there is a passage way to the two breather holes in the air filter flange, so the whole of the bottom of the skirt is at atmospheric pressure. Vacuum above, atmospheric below, causes the piston to rise. This increases the air flow into the engine and raises the needle out of the jet, which increases the fuel flow into the engine, so more mixture in the cylinders, a bigger bang when the plugs fire, and the engine accelerates the car.

So how does the piston know how far to rise? As the piston rises it 'unblocks' the flow of air into the space between the butterfly and the piston, which reduces the vacuum there and above the piston. This reduces the difference in air pressure above and below the piston, which reduces the force causing it to rise. The piston will continue to rise, and continue to reduce the vacuum above the piston, until it reaches the point where the air pressure both sides of the piston and skirt are largely equal again. It will stabilise at a point where the vacuum between the butterfly and piston, and hence above the piston, are more or less at the same level it was before accelerating. It is this feature that causes this type of carburettor to be called a 'constant depression' or 'constant vacuum' carburettor i.e. no matter how big the throttle opening is under steady state conditions the vacuum between butterfly and piston will always be much the same. If you manually raise the piston further than it wants to go, the vacuum between the piston and the butterfly and above the skirt reduces, and when released the piston will fall back to its previous level. Similarly if the piston is manually pushed down the vacuum between piston and butterfly and above the skirt increases trying to pull it back up again, and when released the piston will rise back to its former level, and the amount of vacuum between butterfly and piston will be maintained.

That is generally the case, but in practise there is a physically large but quite weak coil spring between the top of the piston and the outer cover pressing down on the piston and so restricting its rise somewhat. This is another feature to ensure the correct balance of air to fuel across the range of throttle opening, and means that a progressively larger vacuum is required the higher the piston rises. However the difference in vacuum between idle and full throttle piston heights is relatively small compared to the up to 20 in. Hg or so available in the inlet manifold. The spring strength, carb throat diameter, needle shape and jet size are all chosen to give the correct mixture across the operating range of the carb in any particular application. For a larger or smaller engine, single or multiple carbs, with or without supercharger, etc. the carb throat size, needle shape, jet size, spring strength etc. will all be chosen to give the correct results for that application. You can't just bolt on a bigger carb without doing anything else and expect your car to go faster, indeed it will probably perform worse. Likewise if you make changes to engine capacity, breathing, valve timing etc. you probably won't get the best out of them unless you change the carb parameters as well. What changes to make under what circumstances is a huge subject.

That is basically it. However whenever the throttle is suddenly opened the volume of air passing through the carb is able to increase faster than the volume of fuel can increase coming out of the jet. This has the effect of weakening the mixture, which causes the engine stumble when accelerating. To counteract this on top of the large piston there is a cylinder filled with oil - the damper cylinder. Attached to the outer cover there is a small damper piston sitting in this oil. As the large piston tries to rise the damper cylinder also rises, and because the damper piston is fixed this has the effect of forcing the damper piston further into the cylinder. As the lower end of the cylinder is sealed, and oil is not compressible, the only way the large piston can rise is for oil to be forced past the damper piston. The dimensions of both damper cylinder and damper piston are carefully set to that the oil flows past at a known rate, and hence controls the rise of the large piston. This damps or slows down the rise of the large piston, so that for a short time (a couple of seconds or so) the increased vacuum between butterfly and large piston causes the air flow across the top of the jet to increase in speed, which sucks more fuel out of the jet relative to the **volume** of air that is flowing even though the needle hasn't yet moved, so enriching the mixture to avoid the stumble. But when the throttle butterfly is closed there is no such need to control the movement of the large piston, so the damper piston is designed to be ineffective when the large piston is falling, so it falls immediately.

Another occasion when the ratio of air to fuel has to be altered from the norm is on starting from cold. When everything is cold the fuel doesn't atomise as well and so doesn't combust as well inside the engine, so again you get the effects of a weak mixture and indeed the engine may not start at all. To counteract this we have a choke. Well, it is called a choke but that is a hangover from earlier carbs where the air flow through the carb throat was manually restricted or 'choked' as a way of enriching the mixture. In both types of SU carb it is done by increasing the amount of fuel for a given amount of air (rather than reducing the amount of air for a given amount of fuel as in the other design of carb) and so is an enrichment device rather than a choke. But no matter, 'choke' is the generic term, so that is what we shall use. The HS and HIF types differ in how they enrich. The HS has a very simple mechanism for lowering the jet relative to the needle, so increasing the size of the outlet, which allows a given speed of air passing over the end of the jet to draw out a greater quantity of fuel, so enriching the mixture. In the HIF there is a separate valve which opens and adds more fuel to the air stream via separate passages in the carb body. Both types allow the amount of enrichment to be continuously varied i.e. they are not a simple on/off switch. As mentioned before a mixture that is too rich causes a number of problems so you should endeavour to have the minimum amount of enrichment for smooth running. In practice every car is different and you will have to learn how much yours

needs under various conditions. As well as varying from car to car it also various according to the ambient temperature and how long the engine has been switched off. Even though the temperature gauge may show fully cold if the engine has only been off for a couple of hours, as opposed to overnight, it may restart with no choke or only minimal choke, you will have to learn. For example my roadster needs full choke to start from fully cold then immediately pushed in about half-way, then gradually pushed in further as the engine warms up. By contrast the V8 needs full choke to start and for the first few seconds, then gradually pushing back in as the engine warms. Also it is better to drive off immediately after starting and not let the engine warm through idling, unless you have to defrost windows etc.

Another feature of the choke control on the MGB is that when correctly adjusted the first 1/4" of movement actually only increases the idle speed - the fast idle - and doesn't enrich the mixture. This is very useful if you are scraping frost, once it will idle at that amount of choke, even though you may have to add more choke once you drive off. In both carbs the choke control turns a cam which is sitting under the fast idle adjustment screw. As the choke is pulled the cam is turned and it gradually lifts the screw, which opens the butterfly a little more than the normal idle setting. Again the amount of choke to fast-idle is a matter of balance - too much fast idle will cause the engine to race before you have enriched the mixture sufficiently for slow running, which makes for difficult slow running in traffic. Insufficient fast idle may cause the engine to tend to stall even though the mixture is enriched, so you apply more choke until the idle speed is suitable, by which time the engine is over-choked causing the aforementioned problems of plug fouling and oil dilution.

Ports and Vent/Overflow Pipes: There is often confusion about which hose goes on which port of SUs. If you get the inlet and vent hoses reversed for example, the carb will flood petrol out of one of the ports and/or the jet.

HS carbs:

HS carbs are a mirror image of each other (except for the jets which are NOT handed), each with its own fuel inlet and vent/overflow ports. The main fuel feed pipe has a T-piece which feeds the rear carb from a side tapping, the straight-through tapping feeding the front carb. From October 1969 and the 18GG/GH/GJ/GK engines the carbs also had a crankcase ventilation port which removed the need for a separate PCV valve. These are joined together by a Y-piece and connected to the front tappet chest cover port. Click on the thumbnails to see which port is which but basically the fuel inlet ports point straight across the car to the rocker cover, and the vent/overflow ports are the same size pointing straight across the car in the opposite direction i.e. to the left-hand wing. The ventilation ports are larger and point diagonally upwards, towards the front of the car on the front carb and the rear of the car on the rear carb.

The vent/overflow ports are connected with a short length of rubber hose to two individual steel pipes which carry any overflow safely down past the exhaust. Bee came to me with them just dangling, so I looked closely at a concourse winner of the same year (and colour!) which had them retained by one of the rear engine mount to chassis bracket bolts, so that is how I fixed Bee's. However this means that as the engine rocks the carb end of the pipes moves up and down, but the clipped part stays still, which stresses the short piece of rubber hose connecting them to the carbs. Subsequent research has shown that these run side-by-side behind the engine mount, and are attached with a clip to a bracket (AHH7382 was NLA). This bracket mounted to the side of the block, but could only be used if there was a mechanical oil pump blanking plate with two studs. It couldn't have been used if there was only a single stud in an unpierced moulding as is shown in some places for 3-bearing engines. In any event it positions the pipes quite close to the exhaust manifold - much nearer than it needs to be if just a P-clip is used on one of the block studs and the pipes reshaped slightly. Used until the introduction of the 18V engine in 1971 for export cars, and until November 1973 for UK cars i.e. until the change to HIF carbs. With the bracket NLA I eventually changed Bee to use the engine restraint bracket (also missing when she came to me) which has a convenient hole for a bolt and P-clip to hold the pipes which moves with the engine.

HIF carbs:

HIF carbs are **mostly** a mirror image of each other, but this time both the floats and the jets are handed, and the fuel feed arrangements are different. The jets are colour-coded black and white according to which carb they go in, and I *think* the black one goes in the front carb. The right-angled pick-up pipe should more-or-less face the butterfly, and the adjuster mechanism engages with a tab on the body of the jet. It might be possible to install the wrong jet with the pick-up pipe facing the other way, but it may also be the case that the cover plate then won't fit correctly. Note that although the manuals and SU Burlen's web site show the jet bearing having a washer above it, a phone call to Burlen elicited the information that later versions did not have it! The fuel feed pipe connects to the front (4-cylinder) or left-hand (V8) carb only, which as well as feeding the float valve in that carb goes straight through the carb body to an 'outlet' port on the other side. A short (very short in the case of the V8) length of rubber hose goes straight across from that port on the front/left-hand carb to a mirror-image inlet port on the rear/right-hand carb. There is a matching outlet drilling on the other side of the rear/right-hand carb, presumably for triple carb setups, but it is plugged on MGB carbs. The crankcase ventilation ports are connected individually via a flame/oil traps to the associated rocker cover. Click on the thumbnails for details of which port is which, but basically the fuel inlet and outlet ports are at the back of the carbs pointing straight across the car, with the inlet on the left-hand carb

immediately above its mixture screw, and the blanked-off outlet port of the right-hand carb the same. The vent/overflow ports are immediately in front of those, also pointing straight across the car, and the same size as the fuel inlet/outlet ports. The crankcase ventilation ports are in front of those, are larger, and pointing diagonally upwards as well as across the car. On 4-cylinder chrome bumper cars the vent/overflow ports and crankcase ventilation ports are plumbed similar to HS carbs, but the former are held by a retaining clip bolted to a stud on the engine restraint bracket. On 4-cylinder rubber bumper cars the pipes are clipped to one of the studs for the mechanical fuel pump blanking plate on the block. The V8 has hoses from the vent/overflow ports going being the carbs to a T-piece behind the right-hand carb, then a single down-pipe clipped to a bolt on the bell-housing.

Flange gaskets *March 2017*

The inlet manifold gaskets are straightforward but on the air-filter side care must be taken to get things installed the right way up. The air-filter flange has breather holes that maintain the underside of the piston at atmospheric pressure, so when inlet manifold vacuum is applied above the piston it can rise correctly to deliver the correct mixture. Originally the gaskets were 'handed' in that they must be the right way up or they block the breather holes. Later gaskets have two sets of holes so that they can go either way up. However 4-cylinder air-cleaner bases have the same breather and fixing holes as the earlier gasket, so even with the non-handed gasket the base must be fitted to the engine the right way up. V8 HIFs are different again in that there are no less than nine holes in the carb flange. The gaskets must be installed the right way up to leave the breather and fixing holes clear, which blocks all the other holes.

V8 - which carb feeds which cylinder? *May 2015*

The V8 firing order is 1 8 4 3 6 5 7 2, with cylinders 1 3 5 7 on the near-side bank, and 2 4 6 8 on the off-side. Each carb feeds two cylinders on each side - the outer cylinders on one side and the inner cylinders on the other. The port arrangement is basically two 'Y'-shaped manifolds, one on top of the other, clearly seen externally on the casting. However only by removing the adapter between carbs and manifold can you see which carb feeds the upper 'Y' and which the lower. The question came up on the MG Enthusiasts forum and I copied and pasted the text from a V8 Forum post that stated the near-side carb feeds 1 4 6 7 and the off-side 2 3 5 8. However someone else said that was wrong and it was the other way round. So I independently asked two people with very extensive V8 experience, who both came back saying it was indeed the other way round, i.e. the V8 Forum was wrong. One said he thought it was that way, and the other saying that's how the original Rover manifold is, where the carbs sat on top. Allen Reeling said he had blown compressed air through a spare, and it is definitely as the V8 Forum says.

But pictures trump descriptions, so the next time I had my inlet manifold off I fed wires through from the carb ports to each cylinder port, and it is as the V8 Register said i.e. the near-side carb feeds cylinders 1 4 6 7, and the off-side 2 3 5 8. Or to put it another way, each carb feeds the outer cylinders on its adjacent bank, and the inner cylinders on the opposite bank.

Floats and Valves

One of the biggest benefits of the HS carb over the HIF is that the floats and valves are so easy to access on the HS compared to the HIF, which really need to be removed from the car. The bottom cover on the HIF is also submerged in fuel, and any weakness in the seal can cause significant seepage, enough to drain the float chamber while parked. The HS float chamber lid does have a gasket, but it is above the level of the fuel, so really only protects against seepage if the fuel is sloshing about inside, or if the float chamber should flood due to a faulty valve or float as the overflow port is above the join between chamber and lid.

See here for a bench test of a float chamber.

Floats
Valves

Floats:
Float Height

All HS carbs used the same float for both front and rear carbs - originally AUD9904, currently it seems to be WZX1300.

North American 4-cylinder HIF carbs used AUD3571 in the front carb and AUD3570 in the rear, currently WZX1510 and WZX1509 respectively.

UK HIF and V8 carbs used CUD2774 in the front/left carb (as viewed from the driving seat) and CUD2773 in the rear/right, however these also seem to use WZX1510 and WZX1509 respectively now.

There are also 'StayUp' float kits for all versions which have a closed cell construction and Burlen claim they are unsinkable. However on one forum someone had one sink, returned it to Burlen, who said it must have been damaged during handling ... which surely makes it no different to any other float ... apart from being nearly twice as expensive!

Originally HS floats had a metal tab that could be bent to adjust the height, but in the 1970s all-plastic floats were introduced that were non-adjustable. If these were found to

give an incorrect float height washers could be used under the valve, but this only works in one direction i.e. if the fuel level was too high washers would reduce it, but if too low and there were no washers you were stuck. However I found my plastic floats - with no washers on the valves - to be almost exactly in the middle of the tolerance range for height adjustment. Subsequently white HIF floats at least seem to have gained adjustable metal tabs, and black 'StayUp' floats do as well.

If the float cracks it can take in fuel, which makes it heavier, so the level of fuel in the float chamber and hence the jet has to rise higher than it should before it shuts off the fuel flow. This can give rise to mixture imbalance between the carbs and eventually overflowing. If you have repeated overflowing always check the float for fuel by shaking before automatically changing the float valve.

With the lid (HS) or bottom cover (HIF) removed, on HS carbs grip the thicker end of the float hinge pin with a pair of pliers and withdraw to release the float. On HIFs unscrew the hinge pin. On HIFs it is wise to replace the cover seal, they harden in use.

Float height: This is given quite a close tolerance in the workshop manuals if not a single value, but according to SU Burlen typically for the HS carbs on MGB it is 3 to 5mm with the adjustable float and steel needle, or 1.5 to 5mm for the 'fixed' nylon float and Delrin needle, and for HIFs 0.5 to 1.5mm. If having problems with a car or carbs new to you or that have had work performed on them and it could be fuel related, check this height. Easy on HS's - just remove the lids, invert, and slide a bar or drill between the lowest part of the float and the machined edge of the lid. HIFs will have to be removed and the whole carb inverted, a straight-edge laid across the centre of the float chamber at right-angles to the pivot i.e. crossing the centre of the 'U' of the float, and estimate (measuring being tricky without wire gauges) the vertical gap between the nearest part of the float and the straight-edge. Note that an excessive gap could be due to an incorrect or faulty valve holding the float too high or too low, and if the float is way too high it could contribute to fuel starvation at high speeds by restricting how far the valve can open hence low fuel level in the jet.

Valves: With the float removed the inner of the float valve should fall out. This has a conical point at one end, and a spring-loaded pin at the other. The outer can be unscrewed with a 11/32" socket.

Original float valve inners were steel tipped against a brass seat. The tip of the inner eventually develops a wear ridge, and this can cause seepage when the valve should be closed, and eventual overflow. Someone in America developed an alternative - Grose Jets (jets?) which used a ball valve, and were said to be superior. They may well have been, but then a Viton tipped valve was developed by SU that was equally as good. Subsequently the Grose products were produced by a different company, and people started finding those became worse than the original SU items, let alone the Viton-tipped versions. Outers for Viton-tipped seem to have a conical seat, i.e. different to the earlier flat seat. This is probably Viton is a resilient material, and the sharp edge of the original seats would almost certainly cause a ridge to be developed in the Viton in short order. It makes one wonder if a conical seat for the original steel-tipped inners would have delayed the development of a wear ridge, if not prevented it altogether.

Three different part numbers were used at various times:

18G (HS carbs) used AUD9096
UK 18V HS carbs used AUD9095
US 18V HIF carbs used CUD2795
UK 18V HIF used AUD9095 i.e. the same as the 18V HS carb
V8 (HIF) used CUD 2795 i.e. the same as the USA HIF! These have a larger hole in the outer than my UK 18V HSs, but the V8 inners seem to be compatible with the UK 18V HS outers.

Replacements can be confusing to identify. SU Burlen lists 'standard' (HS?) kits as:

Viton Tip 0.070" Spring Loaded VZX 1100
Viton Tip 0.096" Spring Loaded VZX 1101
Viton Tip 0.096" (presumably not spring-loaded) WZX 1102

From what I can tell 4-cylinder MGBs use the smaller 0.070" spring-loaded type, VZX 1100. HIF kits are:

Steel 0.096" Spring Loaded VZX 1095
"Delrin" .070" Small bore VZX 1099
Viton 0.096" Spring Loaded WZX 1096
Viton 0.070" (presumably not spring-loaded) WZX 1097

Interestingly Googling both V and W versions of these HIF numbers usually shows them with a small filter before the valve.

The above VZX numbers replace WZX equivalents, so if searching on part number you may need to try both.

My V8 uses the larger bore i.e. 0.096, spring-loaded. And whilst originally they were steel tipped it's probably best to get the Viton-tipped now, i.e. WZX 1096. However neither the old or the replacements had filters. As that is the only spring-loaded Viton-tipped, it's probably best to get those for 4-cylinder HIFs as well.

Seepage and Overflow: Small particles can cause slight flooding, getting trapped as the valves would never normally be fully open. Sometimes these can be washed out by disconnecting the fuel pump, running the engine to empty the carbs, then reconnecting the fuel pump. The resulting rush of fuel through the now wide-open valves can dislodge particles. These may not be a problem in HS carbs as the needle to jet clearance is large, and there is room for them to lie in the bottom of the float chamber. They can be more

of an issue in HIFs as there are more orifices to get blocked, and they will lie directly under the jet.

Many years ago I started getting overflow from the right carb in the V8. The above trick did not help, so I changed the float valve, but still had the problem. It was only then I discovered the float had fuel in it, impossible to see in the brown float. I tried putting it in hot water to discover the source of the leak, but that, pressure and shaking did not give any indication of where it might be, so replacement was the only option.

More recently I have been taking some voltage measurements for a pal, with the ignition on but the engine not started for several minutes at a time over a few days. During these time the fuel pump was giving a very occasional tick, as expected, anything less frequent than once every 30 secs, i.e. more than 30 secs between clicks, is not indicative of a problem. A couple of times I thought I got a whiff of fuel, but couldn't track it down or even be sure I had smelt it, even though the garage doors were both closed. Then one time I turned off the ignition, but could still hear an occasional 'tick'. After a short search I tracked it down to a carb overflow hose, dripping onto a sheet of paper. Had that not been there I probably wouldn't have heard it. Looked like the rear carb, and with the overflow hose removed from that carb it was damp, but the front wasn't. Removed the lid and float from it to extract the inner, to find a very definite ridge in the tip. I've lost track of when I had these carbs rebuilt, but it was many years ago. As luck would have it I had just found the unused new V8 float valve from all those years ago when helping another pal with a float valve problem - this time blockage with debris. I could see that the V8 HIF outer had a bigger hole through the middle compared to the roadster HS outer, but didn't fancy using that in case it caused an imbalance. The inners seem identical, so I fitted the new V8 inner to the original roadster outer, refitted the float, lid and supply hoses, and switched on. Left it a minute or more and no sign of any seepage with a piece of blue paper towel (which makes a very good indicator of fluids by going dark) under the overflow port, so refitted the overflows and air cleaners. Turned the ignition on again and after the initial couple of clicks waited ... and waited ... and waited, and eventually after two minutes with no click gave up and declared it 'fixed'. Temporarily perhaps, I've ordered a pair of Viton-tipped, and shall replace both when one or other shows any problems. This was a tiny seepage, much less than would be used at idle let alone running, and does show that if your pump is clicking more often than you think it should, it could take several minutes before anything will come out of the overflow. Even longer on North American spec with charcoal canister where it has to go right across the engine compartment and through the canister and anti-runon valve before it appears on the ground.

The opposite problem can occur where large lumps of debris can block the valve rather then wedging it open, as in this example from Peter Ugle. The debris is thought to be from the inside of a Gates Barricade hose where it had been pushed onto a very tight port, with rough edges scraping part of the hose inner away.

But 300 miles later with new lengths of hose exactly the same thing had happened again, and peering inside the inner liner had been rucked up. Peter slit a length of unused hose and found that even scraping with a finger-nail delaminated it. So it looks like it needs a clearance to be slid on without damage, and even then I can imagine that clamping it up onto the ridges of a filter would chop bits off it. Gates Barricade binned, more conventional hose substituted!

May 2016: Just before Vee's MOT I discovered a leak from where the supply hose replaced just a few months ago attached to the near-side carb, fixed by tightening the clip although it didn't move very much. The day after the MOT while looking at something else I discovered the overflow hose was leaking on the same carb. Obviously the float valve wasn't seating properly (a hang-over from the filter change last year?) and timing the ticks from the fuel pump they were about every 15 seconds. They shouldn't occur more frequently than once every 30 secs, otherwise a problem with a float valve or pump inlet non-return valve is indicated. The first trick is to run the engine with the fuel pump fuse disconnected to drain the carbs, then when the engine has stopped reconnect the fuse in the hope that the now wide-open float valve and high-rate of fuel flow flushes out any debris that might be there. After that clicks were more than 30 secs apart, although less than the 60 secs plus after I had changed the pump hoses. So not leaking now, but that still left the overflow hose to deal with. A few days later after a run - and when cool - I gave up waiting after 2 minutes without a click, but I'll lay a couple in for stock anyway.

Dampers

Oil-level *December 2011*

Some confusion over this, and the manuals don't help. HS drawings show the oil level being **below** the top of the oil reservoir, whereas HIF drawings in the same manuals show it **above**. I have seen a claim that it has to be above so the outside of the reservoir is lubricated where it moves up and down again

against the cover, but if HSs didn't need it why do HIFs? If you **do** try to keep it above, then you will be continually topping-up, and some people do say they have to keep topping-up. I have maintained my HIFs below, the same as my HSs, for around 90k with no ill-effects so far. All I do is unscrew the plastic cap, lift it up, and press it down again. If I can feel the resistance of the oil before the plastic cap reaches the cover, then I have enough, and the distance before tells me how much 'reserve' I have left. I don't have to top up from one year's end to the next. The oil only needs to reach the **bottom** of the damper piston in the oil reservoir to do its job, not the top, so to maintain it much above that is overkill.

March 2013: Just having discovered HIFs (and maybe some HSs) have ball-bearing assemblies between the piston and cover, I did wonder whether the higher level would initially drain down and lubricate the bearings, then stabilise, and only be topped-up again at the next service. As long as you only check at the recommended service intervals you will be fine, but if you keep checking weekly then you probably will have to keep topping-up. But as part of my research into the bearings I came across these historic SU technical documents on the SU Burlen site.

The HS document clearly shows the oil level below (a long way below) the top of the hollow rod, and the text states "... pour oil into the hollow piston rod to within about 1/2" from the top of the rod ..." (the text is a bit fragmented, you have to jump from the second line in section 4 to below the drawings in the second column).

The HIF document, Tuning - General page section 4 has three sub-sections depending on whether the suction chamber is 'standard' (i.e. no ball-bearings), has 'early' ball-bearings and the damper retaining clip, or 'later' ball-bearings. Not that it matters, because the two drawings and all three descriptions show the oil level is **below** the top of the hollow piston rod! So I go back to my Leyland Workshop Manual and Haynes to double-check what they say ... and start to wonder if I should have left well alone!

- Workshop Manual, section D, HS carbs: Has a drawing clearly showing the oil level about 1/2" below the top of the hollow rod. I can't see anything in the text about damper oil level, and the only reference to lubrication is that if sticking occurs, "the whole assembly should be cleaned carefully and the piston rod lubricated with a spot of thin oil".
- Workshop Manual, section D, HIF carbs: The drawing shows the oil level to be **above** the top of the hollow rod, and the text says to "Top up with new engine oil (preferably S.A.E. 20) until the level is 1/2 in. (13mm) above the top of each hollow piston rod".
- Workshop Manual, engine emission control supplement, Section 4 - carburetters (sic), HS carbs (single carb and dual): In four places the drawings appear to show the oil level **above** the top of the hollow rod, and the text states "Top up the piston damper with the recommended engine oil until the level is 1/2-in. above the top of the hollow piston

rod. **NOTE.** - On dust-proofed carburetters (sic), identified by a transverse hole drilled in the neck of the suction chambers and no vent hole in the damper cap, the oil level must be 1/2-in. **below** the top of the hollow piston rod". However the drawing shows a drilled cap, but the oil level below, which contradicts the text.

- Workshop Manual, engine emission control supplement, Section 4-D - HIF carburetters (sic): The drawing clearly shows the oil level above the top of the hollow rod, and the text confirms that. You can't see whether the damper cap has a hole or not, but the cover has the angled rib at the neck which indicates the internal drilling, which replaced the hole in the cap. On HS carbs this would mean the oil level should be below, and not as shown and stated.
- Haynes, HS carbs, section 17 (vehicles not fitted with emission control equipment): The drawing clearly shows the oil level below the top of the hollow rod, but the text (sub-section 7, Maintenance) states "... top up the hollow piston rod until the oil level is 1/2 in (12.5mm) **above** the top of the rod." i.e. a direct contradiction.
- Haynes, HS carbs, section 23 (emission control equipped vehicles): No drawings, but the text states "Top up the piston damper to 1/2 in (12.7mm) above the top of the hollow piston rod. (On dust-proofed carburettors with no vent in the cap, 1/2 in. below the top of the piston rod)."
- Haynes, HIF carbs: There are no drawings of oil level and nothing in the text covering oil level.

The upshot? The Workshop Manual and Haynes do largely seem to agree with each other, in that **the text** indicates HS carbs with a hole in the damper cap have it above and those without below, whereas HIF carbs have it above regardless. However they are not without their contradictions and both disagree with the SU documents which show and state that it is always below for both carbs. If you do decide to top it up to above, then don't expect it to remain there for very long. Only put it to that level at each recommended service interval, allowing it to drop below the top of the hollow rod (but still be high enough to perform the damping action) in between services.

There is currently a long thread on a BBS about plugs oiling, and oil pooling on top of pistons, and after many posts the person who started it all said he has just noticed that there is oil in the throat of the carbs while they have been sitting on the bench, and wondering whether it could be from the carb damper, saying he did top up the dampers recently. At the moment we don't know to what level he filled them, and if they are HSs or HIFs, but there is another possible cause of **complete** draining of the oil from an HIF, rather than just what is above the top of the reservoir. And that is that while the reservoir on HSs seems to be blind-drilled, that on HIFs seems to be through-drilled, then plugged. If the plug is faulty or gets dislodged somehow, then that carb could drain completely.

Breather *November 2013*

As the piston rises and falls inside the suction chamber the damper oil chamber also rises and falls. Unless there is some way of equalising the pressure the rise of the piston will increase air pressure above the damper, which will progressively resist further rising of the piston. Originally there was a breather hole in the damper cap, which allowed the space above the damper to be kept at atmospheric pressure. However in dusty environments this would draw dust into the carb on each fall of the piston, which when mixed with the oil makes a very effective grinding paste as well as clogging up the works and progressively restricting the free rise and fall of the piston.

Subsequently a web was moulded into the side of the piston cover, which was drilled into the suction chamber above the main piston skirt. These carbs had a non-drilled damper cap and were termed 'dustproofed'. This internal drilling results in suction chamber vacuum being placed above the damper as well as above the piston. This is not a problem if the spring and other components take account of the probable increased 'lift'. Incidentally SU Burlen state in their description of a damper cap that "... some are externally vented (hole in the top) and some are internally vented (angled hole in the Suction Chamber) these are termed dustproof and non-dustproof respectively." Surely they have the terminology the wrong way round - the externally vented being non-dustproof and the internally vented being dustproof?

However the situation is very confused regarding webs or no webs, drilled or not drilled, and vented cap or not vented cap. My 73 roadster has the webs, but they are not drilled. They also have vented damper caps, so probably are correct. But the V8 has no webs, no drilling, and non-vented caps - so how is the space above the damper vented? They also have the ball -bearing arrangement between the piston cover and the outside of the damper oil chamber, instead of the plain and very close-fitting earlier arrangement. So perhaps the ball-bearing arrangement has a larger clearance that supplies sufficient venting. This will also result in piston lift vacuum being above the damper as well as above the piston.

Another thought is that if a vented cap is fitted to carbs with one of these internal venting arrangements, that would introduce an air-leak into the suction chamber, which could limit its rise as the throttle is opened, and definitely upset the mixture.

Ball-bearing suction chamber *March 2013*

I've only ever claimed to be 'still learning', and this is a case in point. I got involved in a discussion about the Moss supercharger for the MGB when someone mentioned "needle rollers on the piston slide" of the HIF44 carb in that system. Whilst I could imagine ball bearings between the piston and cover to reduce friction and the chances of sticking, I couldn't see how needle rollers would do that, nor does the SU have a 'slide' like some other designs of carb do. I started Googling the HIF44, found no reference to 'needle roller' but did find one reference to 'a ball bearing' but no explanation. Again, it would have to be a minimum of three balls around the circumference to keep the piston centralised, and there would have to be a minimum of two sets to stop the piston tilting. So then I Googled 'SU ball bearing' and started to find more references.

Whereas originally the hollow rod of the piston slid in the cover directly, metal to metal, at some point SU started fitting two ball bearing assemblies, each containing six balls, to reduce friction and sticking as part of their emission reduction developments (see "Ball Bearing Suction Chamber Assembly" here). No clear indication of when, but it has to be in the late 60s/early 70s, and whilst it was definitely applied to the HIF it could also have been in late HSs as well. Originally the balls might have been loose as the V8 Register published a note about the risk, and Geoff Allen also mentioned it in a talk on the development of the V8. Later the balls were held in a plastic sleeve which retained them when the cover and piston were separated, this SU technical article does talk about two types of ball bearing assembly in the section on damper oil level. I have had my V8 HIF covers off and pistons out a number of times and never even noticed them, let alone had ball bearing dropping out, so wondered if I even had them. I found a picture of the cover on the Rimmer site which clearly shows the sleeve and lower balls, and whilst not wishing to remove my covers just for this I did remove the damper cap and peering inside can see the top of the same plastic sleeve between the piston and the cover. This does seem to indicate that mine have the later arrangement, but the same SU document describes that the early arrangement has retaining clips so the damper can only be lifted, not fully removed, whereas the later arrangement does not have the clip and the damper can be completely removed. And mine have the retaining clip! So maybe I've just been lucky not to lose my balls ...

I then started wondering whether this explained why the manuals show the HS damper oil level as being below the top of the hollow rod, whereas the HIF shows it above. I.e. at each service interval you fill it above, the excess runs down to lubricate the bearings, then you top it up again at the next service interval. It could also explain why there are periodic complaints about the HIF 'losing all its oil' if people are trying to **maintain** the oil level above the top of the hollow rod all the time, and not just at the service interval. But more of this in Damper Oil Level.

Retaining clips *March 2013*

These only seem to have been fitted to HIF carbs, and only for a period. Originally the piston and cover assembly was much like the HS in that the hollow rod of the piston slid in the cylinder inside the cover. Then as part of emissions reduction two ball-bearing assemblies were fitted between the two, to reduce sliding friction and hysteresis. It is

these that have the retaining clip, which means the damper can only be raised and tilted to one side for topping-up, not completely removed. Subsequently there was a version without the clip, although whether this used a different ball bearing assembly or just did away with the clip, isn't known. The only purpose I can see is to avoid mixing up pistons and dampers, which could result in different rise-times during acceleration for each piston. This SU Technical document (4 Check the piston damper oil level) emphasises that the bearing retainer is not to be displaced from the piston rod, but I accidentally pulled mine out many years ago and it didn't seem to make any difference to anything. Nevertheless after reading this I decided to re-fit it. There are two ways to do this, and if you have the 4-cylinder this is probably the easiest way: Remove the air cleaner, unscrew the damper cap, lift the piston as high as you can with a finger-tip, and hopefully that will lift the top of the hollow rod far enough for you to press the clip back in again. On the V8 it's a bit of a fiddle to remove the air-box then grope around the back of the carbs to lift the piston, reaching across the engine to reinsert the clip, so it's probably easier to remove the cover and piston from the carb body. Then unscrew the damper cap, lift the piston up inside the cover compressing the spring, until the top of the hollow rod has been raised high enough to reinsert the clip. Despite refitting it came out again the next time I went to top-up, so I left it out, and again it doesn't seem to have made any difference.

Jet Height *Added June 2012:*

Some recommend getting the starting point for setting-up from a depth gauge. Personally I've never seen the need when you are going to use the lifting pins and engine note for the final setting, it is only a starting point, and it means removing the cover and piston and putting them somewhere safe, as well as poking things down inside onto the jet. But Miles Bannister recently commented that when checking his he found them at different heights, and when setting them to the same height the car ran noticeably better. My first thought was that using the lifting pin to determine final settings is 'dynamic' based on what the engine is actually doing and not a theoretical measurement, much like dynamic timing is preferable to static, which again is only a starting point. Carbs like anything else have a tolerance in component manufacture, which may well result in very small differences in settings between carbs **for an identical mixture**, and that would be preferable to a theoretical jet height. But ever interested I decided to check Bee and Vee.

I found Bees at .0445" for the front and .0440" for the rear. Now on the one hand this is pleasingly close, just 1/12th of a flat different based on .0064" of movement per flat, but on the other hand it is significantly less than the .060" mentioned by various people as being 'correct' for the 4-cylinder, which should mean they are weak. Nevertheless Bee has always run really well, no flat spots, choke fully home within a mile or so in winter, so no need to change.

Vee was quite different at .106" for the right carb and .070 for the left. Now unusually this year Halfords had adjusted the carbs to pass emissions only a couple of weeks previously, normally I pre-adjust them up a quarter turn or so then back down afterwards, but this year I obviously didn't do it enough. So I have no idea how the Halfords mechanic adjusted them i.e. one, both, same direction or different. I did have a quick fiddle on my return using the lifting pins, and thought I had got them right, but perhaps not. The difference put one jet noticeably above the jet bearing and the other noticeably below. Wondering if the bearing height is going to be the same as a theoretically adjusted jet I measured both the bearings and found the right at .0735" and the left at .080, so perhaps not. Now one person who recommends .060" for HSs says .085" for the same size HIFs, but the V8 has 1.75" HIFs rather than the 1.5" as used on the 4-cylinder. So I did the same as Miles and split the difference, setting them both to .088. Weather too poor to take her out to try, and check the lifting pins when fully warm, hopefully tomorrow. (March 2013: I don't know whether I ever did this or forgot about it with so much poor weather and not being able to take her out, all I can say is that she is running as fine as ever at the moment).

Return Springs and linkages:

There has been a lot of discussion recently as to how many return springs were fitted to the SU carbs, and in particular whether the choke has one. The Parts Catalogue up to September 1976 for car numbers 101 to 332032 lists one 'Spring-cable return' in the list of parts for the choke and two 'Spring-return' in the list of parts for the throttle i.e. three springs in total. For car number 332033 on it lists one 'Spring-choke return' and two 'Spring-throttle return' i.e. again three springs in total. The September 76 on Parts catalogue for non-North American cars lists **three** 'Spring-throttle return' and one 'Spring-choke return' i.e. **four** in total. The fourth spring on the throttle cable itself was only added for the 77 model year and on, maybe there had been complaints of sticking throttles. In all cases Part Number AEC 2075 is quoted, and they are in addition to the return springs fitted over the actual carb spindles.

For completeness both Catalogues show one 'Spring-throttle return' with the Zenith carb, the 76-on catalogue also lists one 'Spring-throttle return' with the **pedal** parts but the earlier Catalogue doesn't.

Mine (HSs) originally had four springs the fourth one being on the throttle cable. But this is hooked over the pin of the cable clamp and not inserted into a specific mounting point, as is the case for the other three springs. The attachment points on the heat shield may give some clue the Parts Catalogue for up to September 76 shows it with three tags sticking out with holes in (confirmed by various owners) which also goes to support three springs, but my 73 UK roadster with 48G Gold Seal engine heat shield only has one tag, and four holes on the bottom edge making five potential

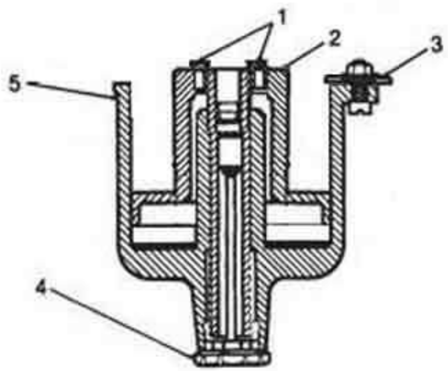
attachment points in all! However two of them are not holes but slots, so it is possible these have been added later with a hacksaw rather than a drill, which could reduce the original holes to three. But having said that, the slots are actually more logical places to attach the two throttle springs as they have a better alignment. The Parts Catalogue for September 76 on shows four tags, although whilst three are of the same size and look in about the right positions for springs on the linkages the fourth is larger and right off the rear so maybe for something else entirely. My throttle has always tended to be a bit jerky on small movements, lubricating the old cable and even replacing with a complete new inner and outer making no difference. I have temporarily disconnected the fourth spring and on a short drive it does seem to be smoother. The pedal return pressure doesn't seem to have been lightened to any significant degree, so hopefully there will be no increased risk of sticking. Time will tell.

However on a friends UK 78 (HIF) whilst there are holes on the choke quadrants and the throttle lever for 3 springs I can't see anywhere to hook a spring on either of the throttle cams. Neither is there a hole in the choke lever for a spring. There is only one hole either side in the flange on the heat-shield, assuming these are for the choke springs that leaves nowhere for throttle cam springs. However there are two holes and one tab with a hole in the centre, which suggests two of those could be for the throttle and choke levers as on HSs, leaving the two outer holes for throttle cam springs again as on the HSs, but as I say nowhere obvious on the cams to attach them. Confusing.

Drop-test: *April 2019*

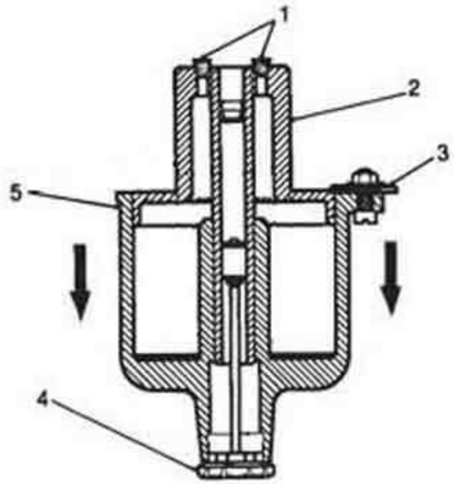
This checks the clearance between the piston skirt and the inside of the piston cover, and is normally only needed if no other reason can be found for running problems. The clearance can be too small meaning the piston sticks either going up or down, or could be too large meaning it doesn't rise far enough as the throttle is opened. The former can be caused by dirt or crud on the skirt or the inside of the cover, but if there are otherwise clean witness marks on both or either there is a problem with the size. There is no equivalent evidence for too large a clearance - unless you are in a position to observe piston height under large throttle openings and load e.g. on a rolling-road, only the drop-test. Pistons and covers are originally supplied as a matched pair, but over the course of time and owners parts could have been replaced incorrectly, or damaged, and particularly covers swapped between pistons if both have been removed at the same time and not kept apart.

The drop-test measures how long the cover takes to fall from the piston, while holding both inverted, and is performed as follows:



- Remove the cover (5) leaving the damper (4) in place (see Note).
- Remove the spring and put to one side.
- Remove the piston (2) and invert to drain the oil.
- Block the two holes (1) in the base of the piston (butterfly side) with Blu-tak or similar.
- Invert the cover and put the piston inside to lie in what is now the bottom (residual oil may result in some damping as it goes in).
- Attach a large washer (3) to one of the fixing tabs of the cover with a screw and nut, this will stop the cover in the correct position for timing.
- With cover and piston inverted hold

the piston in one hand and the cover in the other. With the piston fully in the cover you are ready to start timing.



- While holding the piston let the cover go and time how long the cover takes to fall to where it is stopped by the washer reaching the piston skirt.

The SU Burlen pages for both HS and HIF say: "For carburetters 38.0 mm (1.5 in) to 47.6 mm (1 7/8 in) bore, the time taken should be 5 to 7 seconds.". Other sources give slightly different timings, but I'd rather go by the SU information

Note: There seem to be different views about leaving the dampers in place, some remove them but SU Burlen specifically says to fit it, with its washer where provided. If you find one of yours takes too long to drop, then try the test again on both carbs but this time with the damper removed. If the two are now very close (albeit dropping faster) then the damper on the slow one is at fault - maybe the shaft is bent, or the (damper) piston not free on its spindle. However that would also be revealed by removing the air cleaners and lifting each piston fully up against damper pressure, then releasing, where both should drop sharply and at the same rate. That check should have been done way before you get into the drop-test.

Vacuum Port: *June 2017*

Information from various sources indicates that all MGBs up to the 18GK engine in 1971 had HS carbs, the rear carb having a vacuum port on the upper surface of the throat between the piston body and the manifold flange, see the first two pictures here.

North American 18GK engines in 1971, despite still having HS carbs according to Clausager, then seem to have the distributor connected to a port on the inlet manifold. They had AUD 465 HS carbs, but whether these carbs still had the port but it was capped, or whether there was no port, isn't known.

With the first 18V engines for the 1972 model year all export models gained HIF carbs. North-American models had different carbs to other export markets and did not have the vacuum port, other export markets may have had HIFs with the port, but it's not known whether it was used for vacuum advance.

UK didn't get HIFs until November 1973, and these have the vacuum port on the rear carb as before, but now on the bottom as the butterfly opens the other way. Clausager shows a 1975 with a vacuum connection to the top of the front carb, which would be wrong for an HIF on an MGB. The same picture shows a manifold port capped off, so the carb vacuum is almost certainly a user modification. Some people have spoken of drilling the body to add a port to change from manifold vacuum to carb vacuum, even though it makes no difference under normal driving conditions, and in this case has been done incorrectly. Sources indicate that all rubber bumper models used manifold vacuum.

With the exception of Japan all export models were to North American spec from the start of the 77 model year. Having said that Japanese models from 1977 were based on North American spec hence LHD, despite being an RHD country.

V8s always had HIFs with a vacuum port below the throat of the near-side carb.

Whether the port is above or below the throat depends on which way the butterfly pivots as it opens. If the top of the butterfly moves towards the carb, then the port will be at the top, to be presented to manifold vacuum as soon as possible, and this is how it is on HS carbs. If the bottom moves towards the carb then the port will be on the bottom, and this is how it is on HIFs. How the accelerator cable acts on the throttle spindle indicates which way the butterfly moves. On HSs the cable lifts a lever on the manifold side of the spindle, showing that the top of the butterflies will move away from the inlet manifold, and the vacuum port is at the top. But on HIFs the cable lifts the lever on the air-cleaner side of the spindle, showing the bottom of the butterflies moves away from the inlet manifold, so a vacuum port would need to be on the bottom. The V8 pulls a lever that is above the spindle away from the carbs, so again the bottom of the butterflies moves away from the inlet manifold, and hence the vacuum port is on the bottom. The parts catalogue indicates the change from the cable pulling up the inlet

manifold side, to pulling up the carb side, occurred at chassis number 332033 in the UK and 25800 elsewhere, which coincides with the change from HS to HIF in each case, indicating that all HIFs - if they had a vacuum port - would have had it underneath. Clausager also shows a 'post-76' car with the vacuum pipe going to the inlet manifold on p67, and on p80 he says the final carbs on UK cars 'possibly for the 77 model year' have much shorter necks to the bellhousings of the suction chambers, but the carbs on p66 and p67 seem to be identical.

Certainly the V8 suffers from fuel trickling down from the port into the vacuum capsule and rotting the vacuum advance diaphragm. 4-cylinder cars may not as the pipe always has to rise to go over the rocker cover. After two V8 failures of the very expensive capsule I fabricated a small separation chamber which I mounted above the carb port, so fuel trickles back to the carb.

Setting-up:

Note that in the UK MGBs first registered before 1st August 1975 the emissions test simply comprises a visual inspection for excessive smoke. Cars first registered on or after 1st August 1975 will fail if they emit more than 4.5% CO or more 1200ppm hydrocarbons. ~~But note that if it can be shown the car is fitted with an earlier engine it only has to pass the visual test.~~ As of May 2018 the rules have changed.

The basic requirement for good twin SU set-up is that the carbs should be matched - and that means matching springs, needles, jets, air flow and mixture. Springs, needles and jets should always be replaced in pairs. If you have modified the 'breathing' in any way - air cleaners, carbs, combustion chambers, exhaust - you may benefit from a different needle to standard. For example K&N filters may need a richer needle, see SU Needles. While the earlier metal floats can be adjusted to give the same fuel height in the float bowl, it looks like the later plastic ones cannot easily be, except by placing washers between the needle valve and the housing if the fuel level is too high. The float height on HSs is supposed to be such that, with the float chamber lid held upside down, the float should just rest on a 1/8" to 3/16" round bar placed across the middle of the lid parallel to the hinge pin.

Solid needles on HS carbs must be installed with the shoulder near the top flush with the bottom face of the piston.

Swinging needles on HIF carbs must be installed with the bottom of the needle carrier, flush with the recess in the piston.

With the earlier solid needles in HS carbs the jet must be centred so that the piston drops smartly and freely onto the bridge with a metallic click. This test should be done with the jet screwed up to be flush with the bridge, if it drops cleanly here then it will definitely do it when the jet is lowered to its normal running position. If it binds with the jet raised the jet needs to be recentered.

Tip: A float valve can sometimes stick in the closed position, particularly if the car is not used for some time. Running the engine will empty that float chamber which will cause poor idle and running. Rapping the top of the (HS) float chamber with the handle of a screwdriver can often free the valve.

Tip: The opposite effect is dirt in the float valve that stops it closing when the float chamber is full and it overflows. Disconnect the fuel pump and run the engine until the float chambers empty and the engine stops. Reconnect the fuel pump and the resulting rush of fuel into the float chambers will usually clear the dirt away. If it happens again immediately either the float could be punctured and full of fuel so it doesn't float, or the valve could be worn. If it happens frequently change the in-line filter (if fitted) or investigate the causes of dirty fuel e.g. internally corroded fuel tank. Check the float height after replacing the float valve, or float.

Tip: Many HIFs, and possibly some HSs, have a 'poppet valve' in the butterfly which opens under conditions of high manifold vacuum i.e. the overrun. This was an emissions measure which simulates opening the throttle slightly until the manifold vacuum drops closer to its normal value at idle. This valve can stick open and cause a high idle, sometimes only during certain circumstances e.g. warming up and be OK the rest of the time. One of my V8 carbs was doing this so I soldered them shut, which needs minimal dismantling to perform. Some recommend replacing the butterfly with the solid item, which has the same effect plus removes a small obstruction from the throat of the carb, but needs much more dismantling and it can be fiddly to get the new butterfly to seat properly in the throat, which leads me onto my next tip.

Tip: A high idle that cannot be brought down to normal by use of the fast idle screws is **not** being caused by a vacuum leak. A vacuum leak only lets in air, whereas the engine needs fuel to run. Therefore, if the engine is still running when the idle screws are backed right off, there is some other problem causing one or both butterflies to be partially open. This could be one or more of the following:

- Maladjusted fast idle screws holding the butterfly open, see below for correct adjustment.
- No slack in the throttle cable i.e. the throttle pedal stop is causing the cable to hold the butterflies open. There should be 20 thou free play between the finger on the throttle interconnecting spindle and the choke spindle.
- Maladjusted throttle interconnecting clamps and spindle - one carb fully closed is holding the other one slightly open. Go through the full set-up sequence below.
- Butterfly poppet not seating - solder it closed or fit a plain butterfly.

- Butterfly not seating properly - check the carb throat seat is clean and reseat the butterfly.

I repeat: With both idle screws fully backed off both butterflies should be fully closed, and this is more than enough to cause the engine to stall.

The main adjustments - the detailed info relates to the HS but the principles apply equally to the HIF:

- Remove the air filters, slacken the throttle and choke bar clamps, two on each bar, and back off the fast idle screws that bear on the choke cams.
- Screw each jet up (nut under the carb on HS, screw on the side of the body for HIF) until it is flush with the bridge (**NOT** as high as it will go), then screw it down two full turns to give the basic start-point for the mixture.
- Start and run the engine up to temperature, adjust the idle screws to give a reasonable idle speed.
- Using a tube to listen to the hiss in each intake, or by using a balance meter such as Gunson's, independently adjust each idle speed screw so you get the same hiss or meter indication in both carbs while still retaining a reasonable idle speed.
- On each carb in turn adjust the jet height to give the correct mixture for your spec. This is checked with the piston lifting pin which, when lifted 1/32", should cause the engine speed to momentarily increase then settle back down. NB: John Twist shows lifting the piston by turning a small screwdriver in the carb throat under the piston. Perhaps easier to judge than lifting with the pin, but it needs the air cleaners to be removed - although it's not easy adjusting the HS jet nuts with them in place (without a spanner ...). If the speed stays up the mixture is too rich, if the engine speed immediately falls the mixture is too weak. Each carb should be adjusted independently so that it gives the correct, and more importantly the same, results. After adjusting each carb the other should be rechecked as they are interdependent. NB: Emissions controlled cars have various CO readings, but this method should not be used until the carbs are balanced for air flow and mixture, and then only by adjusting both carbs by the same amount in the same direction. *Updated June 2012:* If you have had to adjust one carb noticeably more than the other from the starting point, that indicates there is a problem on one of the carbs, probably the one you had to adjust more. See here for more info on jet height.
- Recheck the air balance again, adjusting idle screws independently as before if required.
- The throttle spindle clamps should be set such that there is a small amount of free play in the throttle cable and interconnecting spindle before the butterflies start to open. There is a lever on the throttle spindle that rests on the underside (HS, above on HIF) of the choke spindle when the throttle is closed. Insert a .012" feeler gauge between the lever and the choke spindle, lightly press down on the part of the

clamp that engages with the throttle cam and tighten each nut. Check afterwards to ensure that the slight play described above exists, and also that there is about 1/32" end-float on the interconnecting spindle.

- Run the engine at 1500 rpm and check that the air balance is still correct. If it is not the throttle spindle clamp(s) will have to be readjusted. Persevere with this, it is important to get both air balance and clearances right - and more important to get them balanced off-idle than at idle for obvious reasons. If you find this difficult to set your throttle spindles/bushes may be worn i.e. can be waggled up and down or from side to side.
- Adjust the idle screws **by the same amount and in the same direction** to obtain the required idle speed.
- The throttle pedal should reach the stop on the floor just as the butterflies reach fully open - the butterflies and cable should not act as the throttle stop. Adjust this with the cable clamp on the throttle spindle. Take up any free play in the throttle pedal with the bolt located near the pedal hinge, but not so much that it moves the throttle spindle off its stop (the underside of the choke spindle).

- The choke operates in two phases - opening the throttle slightly first (fast-idle), then enriching the mixture. Make sure the choke cable is routed such that it has a clear run when the choke knob is out, otherwise stiff operation can result.
- Adjust the choke interconnecting spindle clamp screws at the carbs such that both jets start to move at the same time as the choke is operated i.e. after the fast idle movement has taken place. See here for how the chrome bumper 4-cylinder choke cable attaches at the carb end, it is unusual in that it has a fixed inner and moving outer. There can be quite a lot of movement of the choke spindle lever and fast idle cams before the jets start to move, so set the choke knob at about 1/2" out, then with the cable inner clamp screw slackened pull the inner through the clamp to move the choke lever (for the HIF top-down choke cable lift the choke lever up while keeping the cable under tension) until the jets are just about to move, and tighten the clamp screw. NB: John Twist covers this briefly on the MGA but just says to pre-load the cable somewhat. Unless you pre-set the control first you will be guessing how much cable needs to be pulled through the lever clamp to give half an inch of fast-idle before enrichment starts.
- Adjust the choke cable lever on the interconnecting shaft so that when the choke knob is about 2/3rds out the lever makes an angle of about 90 degrees with the cable, again to avoid stiff operation. You will probably have to go through a couple of iterations of adjustment of the choke lever and the trunnion to get both the angle of the lever and the fast-idle distance of the choke knob satisfactory. Pictures
- Independently adjust the fast idle screws such that as the choke is operated both throttle butterflies start to open at the same time, and gives the correct fast idle speed (e.g. 1000rpm when the engine is hot)

when the choke knob is in its maximum 'fast idle' position i.e. just before enrichment starts. Check the air-flow is balanced. Pictures

- Check the oil-level in the piston damper. The most sensible way to do this is to unscrew the damper cap lift it up, and press it down again. If you feel the resistance of the oil before the damper cap reaches the dashpot cover you have enough oil. If you try and maintain the oil level at the recommended top-up position of 1/2" above the top of the hollow rod you will be forever topping up which will wear out the damper cap threads and the damper cap will shoot up out of the dashpot cover under hard acceleration. The correct top-up oil is engine oil of whatever grade is correct for your local climatic conditions, e.g. 20W/50 for temperate climates. When you do have to top it up there is no point in filling it to above the top of the hollow rod as any oil above this point is rapidly drawn into the engine, hence the frequent topping-up if you try and maintain it at this level. However see Damper Oil Level

Herb Adler describes using a Colortune. I never got on with them on single-carb engines, so for years never contemplated it for the MGB where you either have to buy two or keep swapping them between pairs of cylinders. Herb describes how it is easy to tell between rich and not rich, less so between just right and slightly either side. Eventually he bought a second one, and even more eventually I first bought one then a second on eBay. I still don't see the colour change any clearer the idle rev change going from slightly weak to slightly rich and back again, which is the coarse adjustment. The only thing I did find is that with one carb a bit weaker than the other there is a visible difference in the richness when blipping the throttle.

Important: Once the carbs are correctly set up only ever make further adjustments to both carbs by the same amount and in the same direction. Once you start adjusting the carbs independently you will have to go through the above set up to get them balanced again.

As periodical conformation of the mixture you can check the plug colour. These from the roadster all look pretty good to me, perhaps the back pair are just a smidgen richer. I decided to weaken that carb a tad, and given that it's awkward to turn the HS nuts with the air cleaners on I made a box-spanner, which worked a treat.

July 2014

HS carbs are usually adjusted with the air cleaners off, as they restrict access to the adjusting nuts. However if you just want to make a small change to the mixture it's a bit of a palaver to take them off and replace them for something that only takes a second or two. There is a pukka SU spanner, but it's flat, albeit heavily cranked, so I can't really see it being much easier with one of those. So I decided to make a 'box' spanner to do the job, and found an offcut of some 15mm square tubing that I reckoned would suit. I have a spanner which is the correct size for the adjusting nuts, so used that to find a bolt with the same-sized head, to use as a mandrel to form a hex in one end of the square tubing. I used a steel wedge to open out the sides of the square section until I could start to get the head of the bolt in, then hammered it in, and used hammer and vice to make a hex end that was a good fit to the bolt head. The jet has a plastic part below the adjusting nut that carries the enrichment lever that pulls the jet down when the choke is pulled, so I cut one flat off the hex, and for a little way down the tubing, to clear that. Then below the five remaining sides of the hex I cut the edges back half a flat further, to give some 'swing' room to turn the nut one flat at a time. The square section at the lower end gives quite a good grip to turn the nuts - but they shouldn't be stiff anyway, and it works a treat. But if you wanted to you could fit a short tommy-bar through the lower end, or maybe even the handle of a stubby screwdriver, to give a better grip.

Heat Shield:

Originally a thin sheet-steel plate with two blocks of asbestos on the back to shield the carb float chambers from exhaust manifold radiation. Asbestos not such a good idea, and current replacements have two pieces of woven material silvered on one side. Can't say I'm impressed with the thickness, time will tell if it's adequate. Bee's has always been pretty manky and I knew almost half of the rear block was missing, so as part of the head conversion to unleaded I decided to treat her to a new one. Spring holes and tabs a bit different to the original - but at least the original ones are present, plus two more tabs in that area. One large tab near the right-hand edge not there, but then it wasn't used so doesn't matter. The new one has two off-set holes near the top edge, for what I can't imagine.

November 2018:

Even though the silvered cloth on the back of the new shield is rather thin compared to the old asbestos - I did wonder if it would be thick enough, despite some very hot weather in the summer this year I had no problems starting or running as usual. Unlike some with summer running problems who seem to think that vaporisation or vapour lock is 'common' and down to the fuel. I'd love to get my hands on one of these.

Air filters:

4-cylinder cars have a gasket between the air-filter box and the carb flange. All the ones I have seen have been handed in that they must be fitted to the right way up so as the auxiliary holes in the two flanges are clear (holes

uppermost), and not blocked which apparently affect carb operation. This is frequently mentioned as a likely cause of carb problems. While doing the clutch change on a friend's 78 I found these gaskets, which have holes in both upper and lower positions, and so cannot be fitted the wrong way round. However! You still have to fit the base-plate for the air-cleaner the right way round or the holes will be blocked whichever gasket you use or how you install it! It wasn't obvious from the running of the car that they were blocked, but Keith's car failed it's emissions test this year having passed just a year earlier, done very little mileage since, no changes other than a new choke cable (which **was** fully releasing the choke) even during the clutch change apart from having the air-filters removed. When I went to setup the carbs for air-balance and mixture I found the filter bases upside down, hence the auxiliary ports were blocked. In the end the balance and mixture were just about spot-on, only the balance under choke was out, which wouldn't have affected the emissions test anyway, so I can only assume I put the filters on the wrong carbs hence the bases upside down, and that was enough to affect the reading. Putting the air-filters the right way round (and hence fitting the bases the right-way round) and a precautionary weakening of the mixture by just 1/8th turn to show 3.8% on my Gastester passed the retest at almost the same figure.

Originally the air-filter cans were clearly handed and as long as you kept them, the bases, bolts and gaskets together as two assemblies you are unlikely to get them on the wrong carbs. But at some point they seem to have been modified so the cans are identical, so if you keep them together but mixed up and fit them to the wrong carbs you **will** get the bases upside down. The Parts Catalogue shows different part numbers for the front and rear cans for all years, but you can definitely fit the later ones on the wrong carbs and it isn't immediately obvious. Originally common to all markets they changed for the 72 model year (from straight intakes to curved?) to three different sets for UK, North America, and the rest of the world (export cars changed to HIF the previous year so it wasn't to do with that). UK changed to use the 'rest of the world' set in November 73 with the 18V 779/780 engines and all twin carb engines had those to the end.

Tank *Added August 2009*

Originally ARH176 wedge-shaped with flat top, curved bottom and rounded off front and rear, with separate end-plates, 10 Imperial gallons capacity, attached to the body with longitudinal straps under the tank, and with a sender attached by six screws. In March 65 at chassis number 56743 it was replaced with NRP2 a bowl-like pressing with separate top of increased capacity of 12.7 Imperial gallons, attached to the boot floor with a series of studs and bolts and nuts around the top edge flange, and the sender attached with a locking ring. Both types had separate fuel outlet and sender ports on the right-hand side, a vented fuel filler cap (until Oct 69 for North America), and a drain plug until Jan 74. However my 73 roadster came to me with a tank without a drain plug when it was about 15 years old, and was an 'old' tank as it rusted through shortly after.

The outlet pipe exits quite high up the side of the tank and internally goes across to the middle as well as down. If this pipe corrodes through then the pump will suck air when the fuel level drops below that point, which will result in fuel starvation if not total failure to run as if the tank was empty, but you will only be able to get a few gallons in before it is visibly full at the filler. This renders the tank scrap if prior to August 1976, but from then on there was a combined pickup pipe and gauge sender so it can be replaced. Well, I say scrap, but you may be able to seal off the original fuel outlet on the side and fit a later combined sender and pickup. It depends on how any internal baffling on the earlier tank interferes with the disposition of the later sender.

It's often asked whether tanks were internally baffled to prevent fuel sloshing about or not. With my 73 and 75 cars even through the fuel gauge is very slow-acting it doesn't take much of a curve for the gauge to rise on left-handers and fall on right-handers (modern cars are not immune, my 2004 ZS varies on slight inclines as well as curves!). On the earlier Jaeger 'fast-acting' gauges this would have meant the needle swinging from side to side all the time, and is something I remember from my Mini days in the 60s. Certainly on the 'cut-away' GT at Gaydon the tank **is** baffled, as can be seen here, into three compartments, although the interconnecting holes seem to be much larger than would be required to allow unrestricted tank filling. It can also be seen that the pick-up has a cylindrical strainer about in the centre of the tank, which will reduce the chances of fuel starvation in bends with low fuel levels. The strainer is a vertical cylinder a couple of inches tall, so as soon as the fuel level drops below the **top** it will start sucking in air and spluttering to a halt will shortly follow as the carb float chambers empty as well, with the pump chattering away ten to the dozen in the meantime. This cut-away was produced for the 1969 Turin motor show, so presumably factory tanks were still baffled at that point, i.e. long after slow-acting gauges had been provided. Many people claim their tanks aren't baffled, but this only has any value if one can be sure that they are original tanks, and who can be that anything from 30-40 years later? I had to change the roadster tank early on in my ownership, but by that time I hadn't really got started on esoteric questions such as this so I didn't look in either old or new tanks, nor on the two occasions I've had to replace senders on each car!

From Oct 69 cars for North America had tanks with an internal 'capacity restriction' device to prevent overflowing and a breather port at the top by the fuel filler. This breather was connected via a separation chamber to a charcoal canister in the engine compartment and a non-vented fuel filler cap to prevent the escape of fumes. With UK tanks if you brim the tank with 'cold' fuel, on a hot day it will expand and overflow. The capacity restriction device in North American tanks is an internal chamber with a hole at the bottom and a narrow pipe at the top connected to the breather port. This means that the chamber only

fills very slowly - much slower than the fill-rate from a pump. After brimming an empty tank at the pump the internal chamber will still be virtually full of air. Over a period of time the level in the chamber rises to become the same as in the main part of the tank, which lowers the level in the main part, and so prevents expansion overflow. The internal chamber reduces the effective capacity of the tank from 12 Imperial gallons to 10 Imperial gallons, however that is if it is brimmed from empty. If the tank was still half full the internal chamber will also be half full, so brimming now will end up with 11 gallons in the tank rather than 10, and if brimming when 3/4 full you will end up with 11 1/2 gallons, and so on. If you were being perverse you could repeatedly brim the tank while using very little if any, get more and more in, and completely fill it. But perhaps by that time the bulk of the fuel will have already expanded, so the small amount of expansion for subsequent top-ups would still not overflow, unless you were really persistent.

With a non-vented fuel filler cap any expansion that does occur expels air (and petrol vapours) from the breather port, through the separation tank and into the charcoal filter which traps the fumes. These fumes are subsequently drawn off and burnt via the crankcase breather system. The breather port also allows air into the tank to replace fuel as it is used.

From 1975 North American cars had exhaust catalysts and so were restricted to unleaded fuel, which necessitated a reduced diameter filler pipe with different filler cap to suit, and an 'UNLEADED ONLY' label adjacent, and on the fuel gauge.

In August 76 all cars had a modified tank with combined sender and fuel feed port. In late 77 California required a modified filler tube and connection, which was soon commonised on all cars.

August 2010: A couple of issues recently.

Someone in the USA reported that their new tank takes several minutes of trickling the fuel to get the last gallon or so in, reiterated this month by Morris Wadds. This is not the effect of the anti-overfill device inside American tanks but the filler tube extending down into the tank an inch or more, which is effectively (unless you are very patient) reducing the capacity still more. The effect of this extended filler tube is to trap a significant amount of air at the top of the tank, whereas you should be able to fill to the top (which the American anti-overfill device would slowly reduce after filling). It's only because it was an American tank with the sealed filler cap and the expansion vent going to the charcoal cylinder that they **were** able to trickle this last gallon in, UK tanks wouldn't be able to. This is a known problem with Canadian-manufactured tanks, which Moss in the US at least are selling. Moss are looking into it (ho ho), but they may also be available supplied by other vendors. When buying a new tank compare the internal length of the filler tube with its external length to the top of the tank, and if the former is more than 1/4" longer than the latter then reject it. If you already have one, or are desperate, then you may be able to overcome the problem by cutting two slots up from the bottom of the filler tube inside the tank

but stopping short of where it is welded to the top surface of the tank and bending the resulting tab into the tank to allow trapped air to escape while filling to the top of the tank. This will however create swarf inside the tank, which should be swilled out as far as possible.

The second issue relates to cleaning and sealing the inside of the tank, for example to stop rust particles affecting the pump and carbs and further rusting perforating the tank. Sounds like a good idea, but there have been a couple of instances where this has blocked the pickup. One chap recently then spent a lot of time disconnecting the pipe from the tank outlet to poke a wire down but he couldn't get it round the angle of the outlet connector. He then drilled through the side of the connector in an attempt to get a wire down the pipe, but it went so far and stopped without clearing the blockage. He then cut the connector off the tank in an attempt to get the pickup tube and strainer out of the tank to clear it, but failed in that as well as the strainer is retained by a strap on the bottom of the tank as can be seen above. After all that time and effort he had to shell out for a new tank, when the old one would have been perfectly serviceable for years! Even if it didn't block the pickup the sealant could block the bleed vent of the anti-overfill chamber which will cause completely filled tanks to overflow on heat expansion, but because of the sealed filler cap this expansion will go through the vent to the charcoal canister and leak onto the ground. And if that vent has been blocked by the sealant, then it will escape via the pump overwhelming the carb float valves and flooding them. Even without heat expansion with the external vent blocked there will be no route for air to replace fuel as it is used, and you will suffer fuel starvation. Note that the 77 and later tanks with the combined sender and pickup can have this removed for sealing, but you could still end up with a blocked bleed vent in the anti-overfill chamber and a blocked external vent. You could continually blow air through the external vent to keep it clear while the sealant hardens, but there is no way of keeping the bleed vent in the anti-overfill chamber clear. UK 77 and later tanks can be sealed with impunity, once the sender and pickup have been removed, although again earlier tanks might get away with blowing air through the **pickup** tube until the sealant has hardened.

December 2015: Another problem.
David Jackson has had problems with a new Heritage tank (strap-hung) as fitted to a 1964 car. His car uses the early Smiths stabilised gauge system with a sender screwed to the tank, which was only used for a few months. This sender float arm moves differently to the Jaeger and later locking-ring senders, and for some reason does not have the full travel that it should, so the gauge does not read correctly. The upshot is that he has had to fit the earlier sender for the undamped Jaeger gauges, but that operates on a completely different principle, more details here.

Throttle Cable and Pedal

Cable Adjustment
Throttle pedals

Just intending to put Bee back in the remote garage and bring Vee back to the house, I was suddenly reminded that I had been intending to look at the throttle cable for a while - like 15 years - as it was a bit sticky and jerky especially in the lower gears, so much so I've always slipped the clutch for small pedal movements in low gears/low speeds. Got the inner out to find a broken outer strand - ah ha! Thinking one wouldn't make much difference I started peeling it off only to discover the cable kinked a couple of inches from the pedal end to reveal another broken outer strand plus one or two inner strands. Oh well, have to replace it now and in fact it is a wonder it hasn't broken already, but had to put it back to get the car back in the garage, up the slope of the drive. By now I had found that the pedal end of the outer had become dislodged, because although it was wedged in the guide, the flanges had been broken off the guide so it, and hence the cable, was floating about in the cavity in the inner wing. As the inner was damaged where it passed through the body it could well have been caused by the broken guide, so now I need one of those as well. But how to get the bits of the broken flange out which were still screwed to the body inside the cavity? I removed the pedal cover which gave me just enough room to get a Pozidrive bit and a selection of 1/2" and 1/4" socket extensions and a UJ to undo the screws, which fortunately were under a layer of old grease or Waxoyl and not corroded. The cable should be easy to source but what about the guide? And if and when I do find one it's going to be fun getting the screws started without cross-threading them.

Got both cable and guide very quickly from Sussex Classics, plus new screws for the pedal box as I had three odd ones (they supplied five but there are only four holes), and bottom and cover seals for good measure as I intended to repaint the cover. The guide had a bit of flashing in the cable and screw holes but a moments work with a needle file soon removed that. With the pedal box cover removed again I found I could start the guide screws by hand (slim hands wedged behind the pedal support frame and in the access hole for the 'trumpet'), much easier than I had anticipated. I had screwed them up from the inside of the cabin first to make sure the threads were good and clear. Once started I used the same combination of bit, extensions and UJ to tighten them. Lubricated the new cable by gripping the outer gently in the bench vice, then fed the inner in slowly while I daubed Copper Grease on it, dragging it in to the outer. Once fully in worked the inner back and fore to distribute it, then removed the inner hanging it up to keep it clean. Fitted the outer into the guide, then with clean newspaper over the carpets and seats to avoid getting grease on them and picking up dirt, fed the free end of the inner up through the throttle pedal slot and through the hole in the firewall shelf, the guide, and into the outer.

Clamped the free end into the carb linkage. Needed a couple of goes to get the travel right so the pedal hit the stop bracket on the toeboard just as the butterflies hit their stops, then adjusted the pedal back-stop to remove excess play, but still leave the 12 thou clearance between the finger on the throttle interconnecting spindle and the choke spindle. Much smoother now, no jerking.

Stripped and repainted the cover with two coats of Hammerite Smooth, then stuck on the self-adhesive upper seal. Replaced the bottom seal, which was fun. In the end I chose to remove the pedals, then slacken the four bolts holding the pedal frame to the horizontal part of the firewall. I left the two upper bolts to the vertical part, but had enough play to lever the frame upwards gently while I removed the old seal with a flat blade, and slid the new seal into place. Note that it is handed left and right as well as back and fore. Retightened the four bolts, ensuring that the holes in the seal for the cover lined up with those in the firewall, and refitted the pedals, greasing the pivots and clevis pins with copper grease.

Three of the cover screws are easy to fit, but the fourth is in the very narrow gap between the cover and the edge of the wing. I chose to put the screw in the cover, then carefully move the cover into position but raised up a bit so it didn't push the screw out, then got it started using a screwdriver bit handle, 1/4" extension, and appropriate bit. Fitted the other three screws loosely, then tightened all four down. Job done.

Update August 2005: Having done a few hundred miles now the cable seems nearly as sticky and jerky as before. Oh well, at least I know it is sound. Subsequently I removed the 3rd spring from the throttle cable which has improved things.

Cable adjustment:

Two aspects - leaving some free-play in the cable so the butterflies are held open at idle by the idle screws and not the cable, and having enough pedal travel to fully open the butterflies. If the butterflies are left hanging on the cable you can get different idle speeds at different times as the throttle cable expands and contracts in varying temperatures. If the pedal can't fully open the butterflies you are obviously missing out on some performance.

On HS carbs there should be 12 thou free-play between the finger on the throttle interconnecting shaft and the underside of the choke interconnecting shaft. This is set by positioning the cable in the clamp at the carb end. Pedal travel is set by a combination of the positioning of the inner in the cable clamp, and the pedal back-stop inside the cabin. To replace the cable the inner has to be removed, the outer replaced, then the inner threaded up from the cabin and through the outer to the carbs.

4-cylinder HIFs are different in that they have a moulded nipple each end of the inner, and the outer has a threaded adjuster where it attaches to the bracket at the carb end to set free-play. There is also the pedal back-stop adjustment as with HSs for full travel.

The two nipples are a bit puzzling - one assumes the pedal end is small enough to pass through the hole in the body, but can it also pass through the hole in the guide plate beside the pedal box? If so - as there is no slot in the guide plate - the nipple must be smaller that the outside diameter of the cable outer, or the outer wouldn't be restrained by either the guide (or the body) when the pedal pulled on the inner. The bracket at the carb end is slotted to facilitate cable replacement there.

V8 HIFs are different again as there is a moulded nipple at the carb end, plain with a screw clamp at the pedal end giving adjustment, as well as a threaded adjuster on the outer at the carb end, both adjusting free-play! And again the pedal back-stop adjustment for full travel.

Unleaded

For the FBHVC list of approved additives click here.

Bayford Thrust still seem to be supplying 4-star leaded but only to a handful of stations. There used to be a web site which seems to have gone, asking Bayford (2012) elicited this list. Note that Bayford claims that genuine leaded 4-star has an octane rating of 99.7 significantly better than LRP, Premium Unleaded with octane boost, or most Super Unleadeds. Tesco 99 and Shell V-Power come closest.

For Tesco Momentum 99 octane click here (was Greenergy).

For a brief explanation of octane ratings and how they vary from country to country click here.

Update May 2010

The FBHVC reported in January of this year that Shell V-Power may now contain ethanol. It's not entirely clear whether it does or not, since the actual wording was *"Shell ... has begun blending ethanol into some Unleaded grades, including Shell V-Power ..."* i.e. is V-Power included in the grades it **is** adding ethanol to? Or is it that V-Power is merely one of its unleaded grades, only some of which contain Ethanol, which may or may not include V-Power? At any rate it is going to 5% or less, which isn't required to be stated on pumps, and is **supposed** to be compatible with classic car fuel systems. More here.

Spotted a typical media scare story in Classic Car Weekly today - "TOXIC FUEL DANGER", long on hyperbole, short on facts, about Ethanol and how classic cars are going to require expensive modifications or blow up!

Update March 2009

Just found this The Lead-Free Petrol Question first published in the journal of the Morgan Threewheeler Club in 1998, reproduced online by the MG T-ABC club in 2001. A long and interesting article on the origins of lead in petrol, the myth of tin pellets and Spitfires in WWII Russia, up to the loss of leaded petrol in the UK.

Update Autumn 2006

Sainsbury in Solihull (at least) has signs showing '4 star' in red and including the four stars that used to be applied to 4-star leaded. However when one gets to the pump and you read the small print it isn't 4-star leaded at all but nothing more than the old Lead Replacement Petrol. Quite why Sainsbury have just started stocking this when most other outlets dropped it some time ago is a mystery. Take care, whilst it does contain an anti-wear additive, like LRP it is only going to be half the ideal quantity. And mixing this with petrol containing other additives can cause valve sticking and consequent burning. Advertising LRP in this way is misleading and annoying in my opinion as they are using the same signage as other small independent outlets that **do** have the proper 4-star leaded. As 'proper' 4-star leaded is significantly more expensive than this LRP one could easily be sucked into thinking it was a cheaper but equivalent option. It isn't - caveat Emptor! **Summer 2007** - All the LRP pumps and 4* signage have vanished completely.

Update Summer 2006.

BP Ultimate 102 available at a few outlets, claimed to be 102 octane, but at about £2.50 per litre! Some confusion over 'ordinary' BP Ultimate, it is only a claimed 97 octane i.e. the same as most Super Unleaded, and not the 99 of Shell V-power which has replaced Optimax (98).

Update March 2006.

You may have heard of Tesco doing a trial of 99 octane super unleaded in some filling stations in the southeast in the Autumn of last year. The news release (deleted) gives more details and incidentally confirms that BP's Ultimate and Esso's Energy Supreme are only the same as 'ordinary' Super Unleaded at 97 octane. Many had assumed that because of the publicity they would have been 98 like Shell's Optimax even though you would never find a statement of the octane in any of their publicity. As well as being 99 octane Tesco's also contains 5% Bio Ethanol which reduces $CO2$ emissions, and claims to be cheaper than Optimax. See also this list of Tesco Momentum 99 locations.

Update November 2003.

Rumours of LRP being withdrawn at the end of 2003 in my local paper.

Update May 2000.

The British Motor Museum approves Superblend Zero Lead 2000.

Update April 2000.

Part III of "The Lead-Free Petrol Question" from The M.G. Car Club.

There are rumours that the petrol companies have doubled the dosage of anti-wear compounds in LRP (as a reaction to the bad press it has received?) but that it still falls short of what is considered to be an adequate for high-speed/heavy-load use.

Part II of "The Lead-Free Petrol Question" from The M.G. Car Club.

Update February 2000.

This month's Classic Motor Monthly reports that Super Unleaded has had its Octane rating reduced by one point from 98 to 97 in accordance with an EU Directive, thus making it the same Octane rating as the old Leaded 4-Star. It further reports that LRP is now being produced from Super Unleaded plus anti-wear additives.

As the level of additive in LRP is known to be about half the ideal level, and not of the ideal chemical, it adds weight to the Automobile Association's recommendation that the best protection and running performance is obtained by adding an un-boosted additive to Super Unleaded.

Super Unleaded is already the subject of a 'health tax' because of its higher levels of reputedly cancer-causing Benzene and aromatics, so it remains to be seen how long ***it*** will remain available. After that, Premium Unleaded will probably be banned because it is flammable, then maybe the anti-car lobby will finally be happy.

PS. Don't even ***think*** about using water as a fuel, people have been known to drown in it.

Part I of "The Lead-Free Petrol Question" from The M.G. Car Club.

Update January 2000.

The FBHVC have updated their information to include two new products from Car Plan - 4-lead and 4-star - currently being advertised on TV by Stirling Moss. The AA lists (in Technical Information leaflet TIC 20 06/99) a product called V-Guard along with the original four approved products but the FBHVC does not indicate approval for this product. The same AA leaflet also says that running Premium (i.e. standard) Unleaded with the timing retarded can still cause problems, that octane boosted additives can give unpredictable results with different brands of Premium Unleaded, and recommends that an unboosted additive is used with Super Unleaded (98 octane) if you want at least the same octane as four-star leaded (97 octane).

AA Technical Information leaflet TIC 29 10/1999 on LRP states that LRP is 97 octane i.e. the same as four-star leaded indicates that it will not protect for sustained motorway or heavy load use, but says that 'most of the larger oil companies' will be using Potassium as the additive i.e. brands can be mixed according to availability, unlike additives which means if you use an additive and go to unfamiliar territory you may well have to carry sufficient supplies with you.

Update October 1999.

LRP is beginning to take the place of leaded, but be warned, it is dispensed from red pumps and called 'four-star'. How can you tell which is which? There is no British Standard for LRP, so the pump will not have a BS number e.g. 'BS 4040', but should have the letters 'LRP' contained within each star instead. However, some stations are leaving the 'BS 4040' stickers on the pump body even though they have 'LRP' on the pump nozzle. So be warned!

Also petrol stations seem not to be selling any of the FBHVC endorsed additives (unsurprisingly, since it would compete with their own LRP), so anyone wishing to use these will have to locate them elsewhere, and they don't seem widely available.

Millers contains an octane-booster, and Castrol sells an octane-boosted version as well as un unboosted version. The others may need you to retard your engine's timing. The Castrol ad in the MGOC magazine is interesting in that it purports to show comparative wear for 4-star leaded, each of the additive compounds, and straight unleaded as follows (my figures extrapolated from its graph):

Additive	Mean	Max
Lead	100	100
Phosphorus (Castrol Valvemaster)	111	100
Manganese (Millers VSP)	222	129
Potassium (SuperBlend Zero Lead 2000)	333	200
Sodium (Red Line Lead Substitute)	556	471
No Additive	1889	1243

Needless to say, the Castrol product uses Phosphorus.

LRP from the major petrol companies is said to have the same octane rating as 4-star leaded so engines using these should not need adjusting, although the MGOC say that users are experiencing pinking and lumpy idling. However, the story is that they contain less of the additives than the recommended dosing levels, and so probably offer less protection. Since the FBHVC recommends against overdosing and mixing of additives, also mixing of additives with LRP, presumably mixing of different LRPs should be avoided as well. Although with the lower dosing levels of LRP, possibly the mixing of these is less of an issue.

Of the major petrol companies, Shell LRP uses Potassium.

April 1999.

Mainly for UK owners with the impending loss of leaded fuel. There are many web sites out there discussing the history, risks, additives, engineering changes and 'memory effect' of leaded fuel. Some sources say "All pre-1989 models: Fit higher-spec seats and valves, plus new guides". This is incorrect, certainly as far as V8s are concerned, which can run unleaded as standard.

This MG BBS News item contains some information, but for the 'full monty' read Part 1 and Part 2 of Roger Parker's articles originally published in the MG Owners Club magazine, and now on the MG BBS.

The text of an article published in the Electronic Telegraph relating to the first four products 'approved' by FBHVC/MIRA in the UK as petrol Lead Replacement additives.

Zenith Choke - Making a Blanking Plate for MGB Rubber Bumper Cylinder Heads when removing the automatic choke by Les Bengtson

There are several reasons why one may wish to blank off the water choke take-off on the cylinder heads of cars equipped with the Zenith Stromberg carburettor. The first is when a different carburettor is fitted. Both the Weber DGAV and the SU HS-4s are commonly adapted for use with the MGB engine. The SU HIF-44 and Weber DCOE are also encountered at a significantly lower rate. None of these uses a water choke and the connection must be sealed if the cooling system is to be kept from leaking.

A second reason is the removal of the trouble prone water choke and it replacement with a manual choke on the Zenith Stromberg. A number of people, based on the research of Barry Kindig, have begun to find that the Z-S carb is really a fairly good one, offering acceptable performance and economy (plus being part of the original pollution control equipment). The primary problem with the carb is the water choke system. They have found that replacing the water choke with a manual choke is far less expensive than converting to a different carburettor.

A third reason for wishing to plug the water choke take off is that one has replaced a cracked cylinder head on an earlier model engine with one from a later model car. All of these reasons are valid. Unfortunately, most of the solutions are not.

The standard solution to the problem of closing off the water choke take off on the cylinder head is to leave the existing hose in place and plug it. Sometimes, the hose is shortened and allowed to hang down behind the rear of the engine. It is less visible then, but is still a problem, perhaps a very expensive one, waiting to happen. The insertion of a bolt, or in some cases a spark plug, into the hose, especially when a hose clamp is used to secure it in place, is a useful method of plugging a hose on a temporary basis. It seals the end of the hose and does not allow the coolant, under 10-15 pounds of pressure, to leak out. But, how often do people replace this hose? We know that the radiator and heater hoses should be inspected regularly. We know that they should be replaced every two years as a preventive measure. But, how many people remember to replace the hose left over from the water choke? This is a great potential for a cooling system failure, with a possibility of engine damage. So, if the plugging of the line is only a short term solution, what is the long term solution?

When I was faced with this problem, on my daughter, Theresa's, car, I decided to make a blanking plate to replace the hose connection on the head. The hose connection is a piece of steel with a tube, bent at about a 90 degree angle, attached. It is held on the cylinder head with two ¼" studs. A paper gasket ensures that there is a good seal between the cylinder head and the hose connector. It seemed to me that the easiest way to block off the hole in the cylinder head was to make a blanking plate out of scrap steel and use the original studs and nuts to hold it in place. I did this, and it has worked well for over a year.

To make a blanking plate, you need the old hose connector off the cylinder head. This will serve as a pattern for the new blanking plate. The blanking plate is made from scrap steel that is about 1/8" thick (from .125" to about .180" will work). The first step is to coat the scrap steel with some form of "layout" covering. The clean steel can be colored with a magic marker, layout blue or given a quick coat of paint. Next, the hose connector is placed on top of the scrap steel and the outline of the hose connector is marked. This can either be scribed, using a sharp steel scribe, or drawn with a pencil or a Sharpie marker. Then, you cut the piece out.

The easiest way to cut the piece out is to use a hacksaw to remove most of the superfluous metal. Cut as close to the lines as possible without cutting into the lines themselves. You then are left with a rough blank. It is in the general shape of the hose connector, but oversized and lacks the mounting holes. The next step is to bring the outside shape to the proper dimensions.

To shape the outside of the blanking plate requires either a grinder, a belt or disk sander or a file. (Which ever method you use, wear safety glasses. Steel bits in the eyes are very uncomfortable and very expensive to correct. I speak from personal experience when I say you do not want to find out how painful it can be.) Grind, sand or file the blanking plate until you have just remove the scribed/drawn lines. This represents the true size of the original hose connector. When you are finished, you will have an oval-diamond shaped piece that duplicates the original almost exactly. It should be a close duplication, but need not be exact. Comparing the two as you go along will help to make your first attempt a successful one. Now you have your blanking plate and only need to make the holes for the securing studs to have a completed blank.

The original hose connector is then laid over the new blanking plate and a pencil or scribe is used to outline the holes for the studs. Remove the old hose connector and draw cross hairs on the blanking plate to locate the center of the circles you have just made. I did this by eye and it worked out fine. The holes in the original hose connector measured .283" while the studs are ¼" (.250") so there is considerable tolerance built into the original piece. I my case, I used a somewhat smaller hole of .261", using a letter G drill. You can also use a 9/32" drill (.281") which will duplicate the original holes. Before drilling, you should center punch the centers of the holes or use a #2 center drill to start the hole. If you center punch use a 1/8" drill to drill a pilot hole. If you use the center drill, run it down until the major part of the drill bit makes a hole for the larger drill to guide on. Then, drill the holes to final size. If you are lucky, they will be an exact fit on the cylinder head studs. If not, determine where the hole needs to be enlarged and use a round or oval needle file to file the hole to an exact fit.

With the blanking plate now fitting on the cylinder head, all that remains is a gasket. You can either buy a gasket for the hose connector or make one. All auto parts stores will have sheets or rolls of gasket material. Get the paper kind. Then, lay your new blanking plate on top of a small section of the gasket material and draw around it with a sharp pencil. Also, draw in the stud holes. Use an Exacto knife or a pocket knife with a sharp blade to cut out the stud holes. I find that pressing straight down with the knife in a series of overlapping cuts is the best way to do this. Then, use a pair of scissors to cut around the outline of the blanking plate. You now have a complete blanking plate and a gasket that can be fitted to the cylinder head. At this stage, I prefer to paint the blanking plate.

There are two reasons for painting the blanking plate. First, is to match the engine color (black). Second is so that the underside, where it is contact with the coolant, cannot rust. You can use regular engine paint for this purpose. Having trained as a gunsmith, I am aware of some better coatings--ones that will resist heat and chemicals better than paint. I used a coating called Gun-Kote because I had it available and it matched the engine color. Brownell's, Inc. also sells a "baking lacquer" which does the same thing and is less expensive. Both are sprayed on, allowed to dry thoroughly and then baked in an oven to harden. Any of these methods should work fine.

After the part has received its finish, I wire brush the studs to remove built up rust and crud. If the cylinder head is off the car, I use a wire brush in either a drill or a die grinder. If the cylinder head remains on the car, I use a wire brush by hand. Then, a thin coat of gasket cement (non-hardening) is applied to the cylinder head and the underside of the blanking plate. The gasket is fitted over the studs, the blanking plate is installed and the lock washers and nuts fitted. I use the blue Loc -tite on the studs to prevent loosening. The engine is then run up to operating temperature and the new blanking plate checked for leaks. There should be none if the surfaces were clean before installation. At this point, you can forget about the modification until the next time head work is required. It should hold up indefinitely and you will no longer have that nagging worry about a burst hose. The average time involve is about one hour and the cost less than a dollar. Quite a bargain for the piece of mind provided.

ADDENDUM

Since this piece was written I have had the opportunity to remove the water choke take off studs from an 18V cylinder head. The studs are 0.770" long and are threaded ¼"-28 on both ends. The shorter threaded end, ¼" in length goes into the block. The studs go directly into the water passages and, if removed, should be re-installed using some form of sealer such as Loc-tite or gasket cement. The original nuts are plain nuts with lock washers. It should be possible to use a standard nylock nut. Providing extra security. It would also be perfectly possible to replace the studs with two ¼"-28 grade 5 machine bolts of 3/8" to ½" length and use lock washers between the underside of the bolt head and the blanking plate. This would make a slightly better looking installation. Before re-installing the studs or using the bolts, run a ¼"-28 UNF taper tap into the holes to clean them up and ensure the threads are clean.

See here for rebuild and set-up info for the Zenith carb **with** water choke, and here for a picture of one with a manual choke. Note this picture came from a Calgary, Canada ad for rebuilt Zenith carbs and may not be the same model as for an MGB.