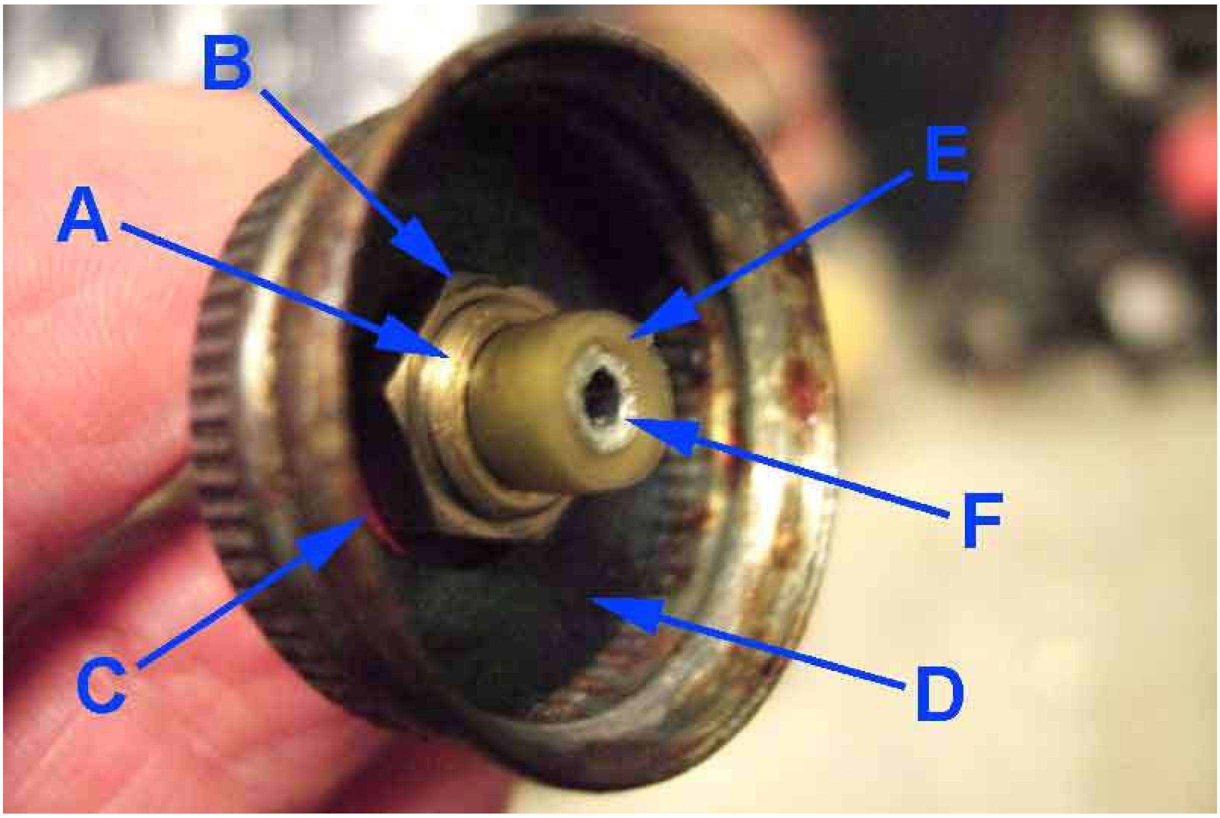
EeziBleed

The cap that fits onto the master cylinder. These are removed and fitted as required for your master, and it is very important that all parts of it seal correctly otherwise fluid will leak from it.



A - the brass fitting.
B - the brass nut that secures the fitting.
C - the red fibre washer (there is another one on top) that seals the fitting to the cap.
D - the rubber seal that seals the cap to the master cylinder.
E - the plastic tube from the EeziBleed reservoir.
F - the tapered alloy cylinder inside the end of the tube that wedges the tube into the brass fitting and forms the seal between tube and fitting.

Dual Brake Masters

Plumbing   Servo

1968 to 74 North American unboosted dual master 37H2780, two outputs to a separate manifold unit that contains the pressure failure switch:

Internals from Haynes:

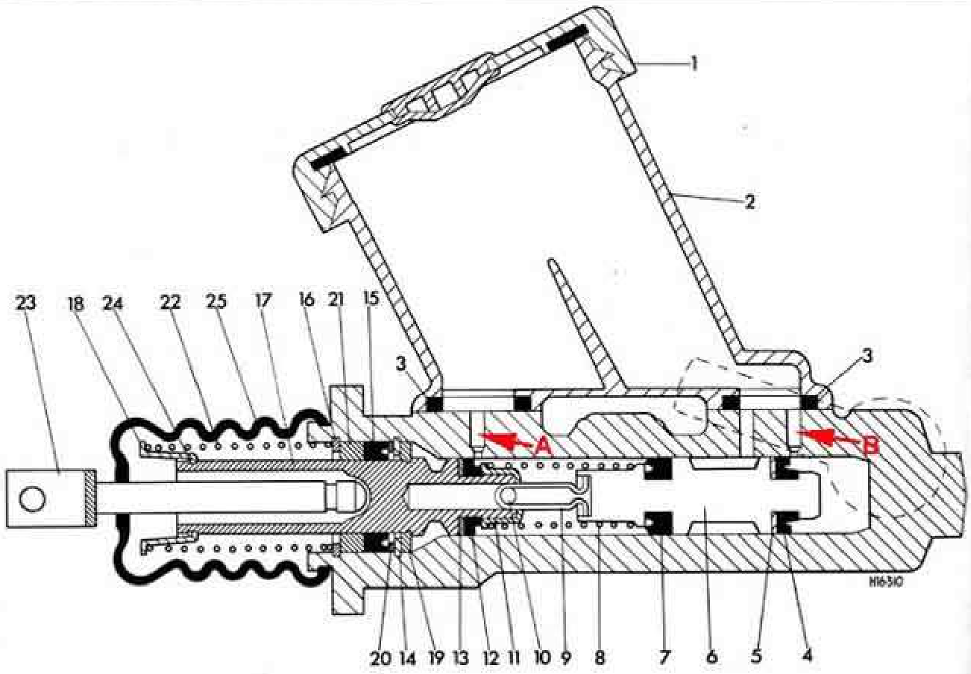
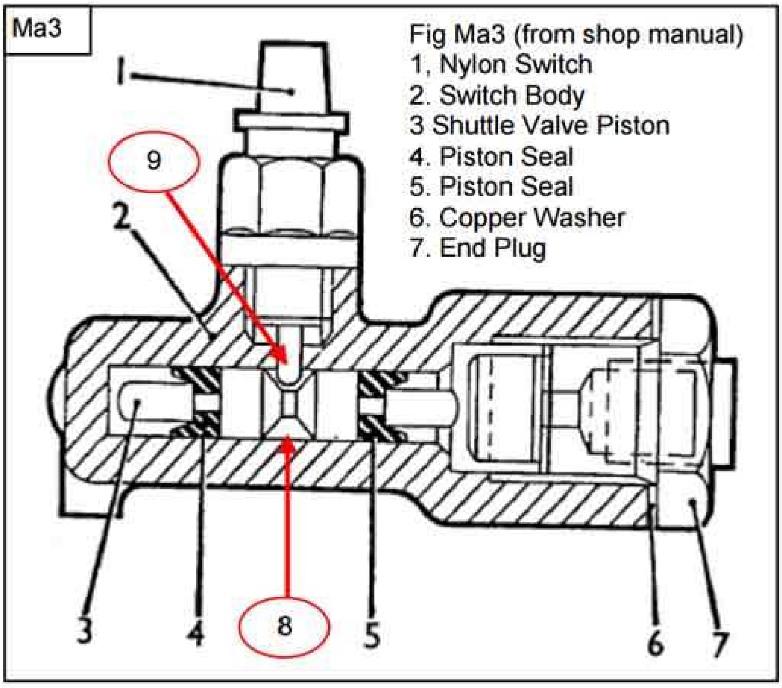


Fig. 9.12 Tandem brake master cylinder – sectional view (Sec 19)

1 Filler cap
2 Reservoir
3 Reservoir seals
4 Second main cup
5 Piston washer
6 Secondary piston
7 Separating cup
8 Separating spring
9 Piston link
10 Link pin
11 Pin retainer
12 Main cup
13 Piston washer
14 Circlip
15 Seal cup
16 Circlip
17 Primary piston
18 Spring retainer
19 Stop washer
20 Washer
21 Guide bearing
22 Return spring
23 Pushrod
24 Spirolox ring
25 Rubber boot

The remote pressure failure switch assembly 13H5905: ([Somerford Mini]())

Internals from [Moss Motors]():

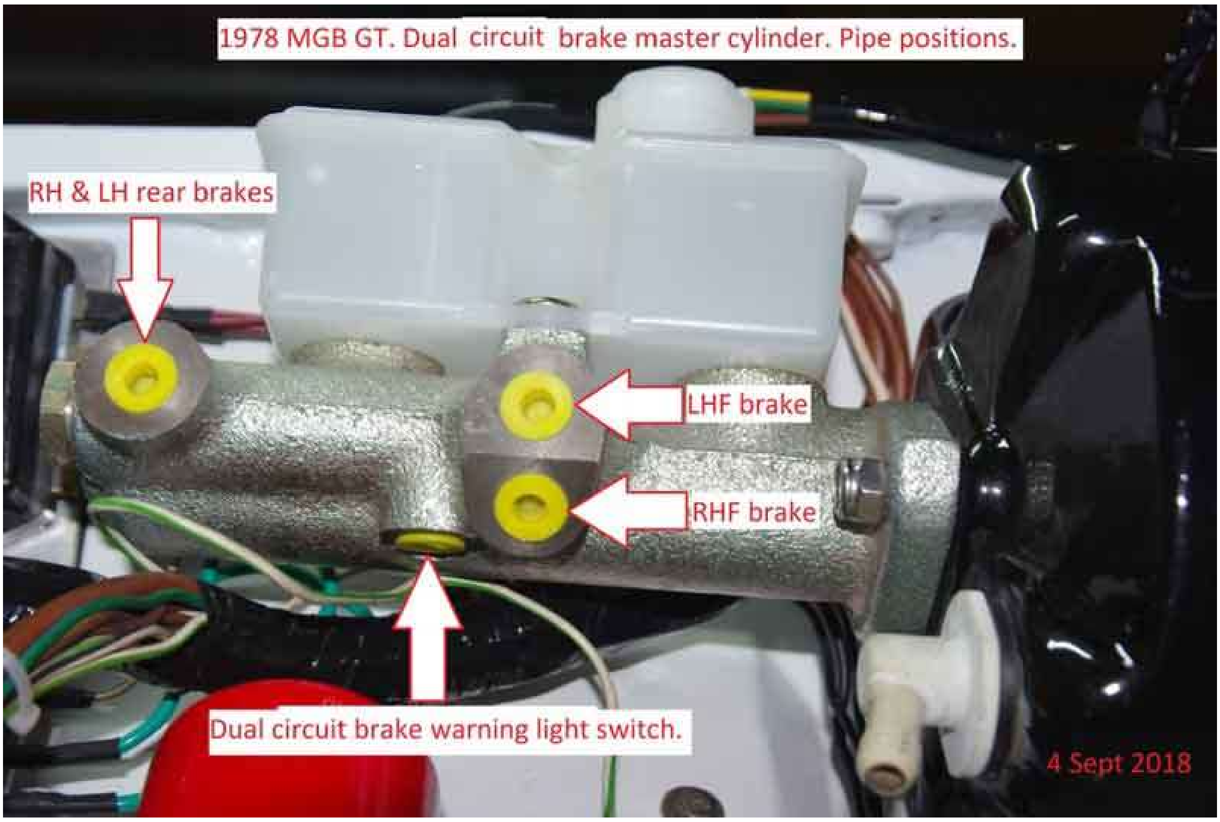


1974-on North America and 1977-on RHD dual brake master with integral servo:

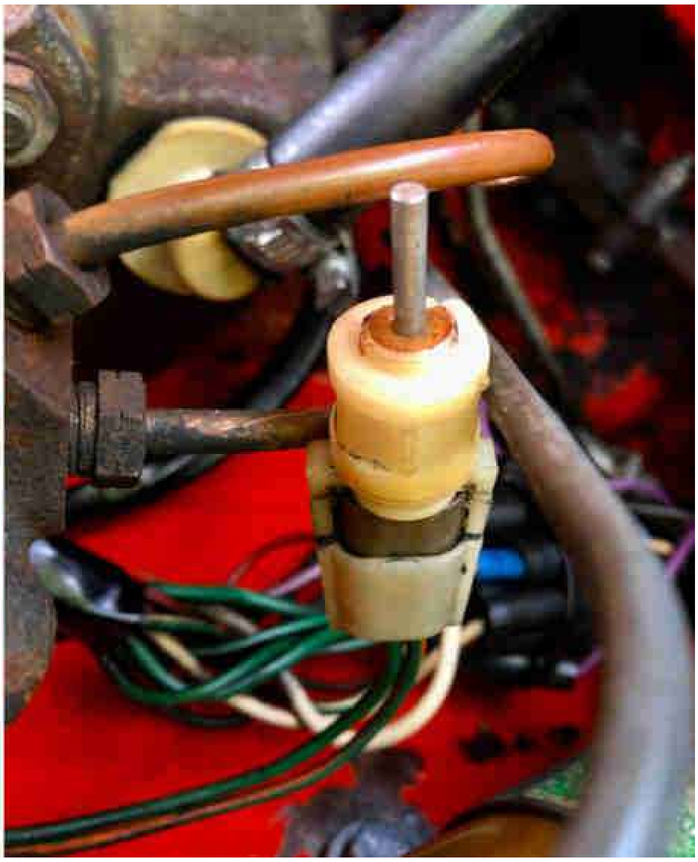
Next three images from John Maguire in Australia:


1978 MGB GT Used dual system brake master cylinder
Locking pin
years of poor servicing. Sludge build up in reservoir ports
4 Sept 2018


1978 MGB GT Disassembled used dual system brake master cylinder.
Locking pin
A
C
A
B
Rear brakes piston and cups.
Front brakes piston and cups
4 Sept 2018



Care is needed with the switch (AAU2454). It's only plastic and screwed into a casting it can seize, snapping off if too much force is used as here: (*anon*)



Drawing from Haynes. Note the reservoir on the MGB is rectangular, not the wedge shown (probably TR7). In the images above John has removed the plug and spacer for the differential switch unit from the master but not the differential unit (shuttle) itself. The two O-rings 17 are probably what fails and causes fluid to leak from the switch. The BL Parts Catalogue shows repair kit 18G9081 which only came up with a couple of sources in the US (which didn't look like they had these O-rings) and an Amazon page (unavailable). But the Amazon page listed several equivalent part numbers and Googling those one took me to Brown & Gammons GRK1004. This has several more components than the US sites including some small O-rings which hopefully will be for the shuttle:

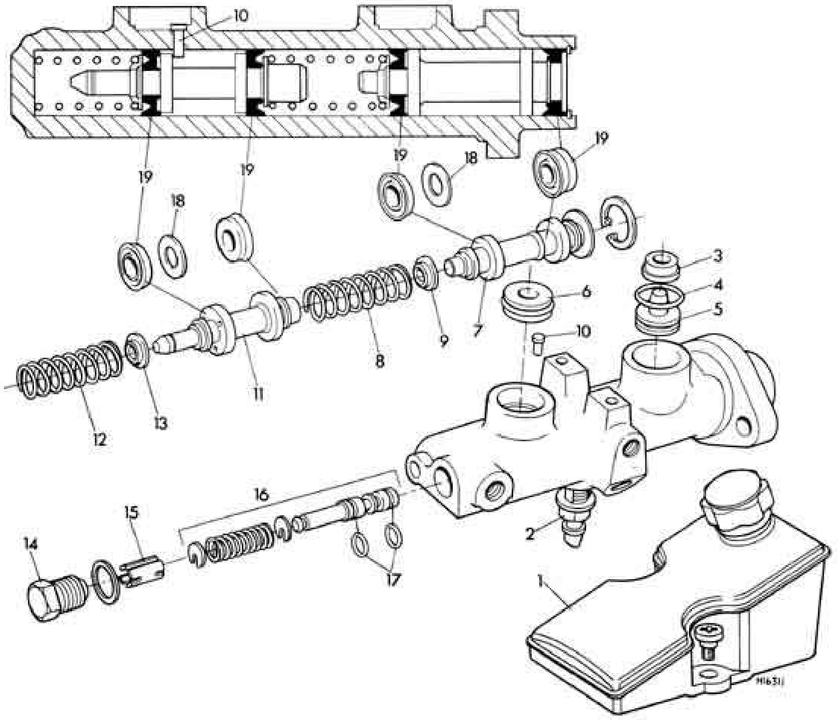
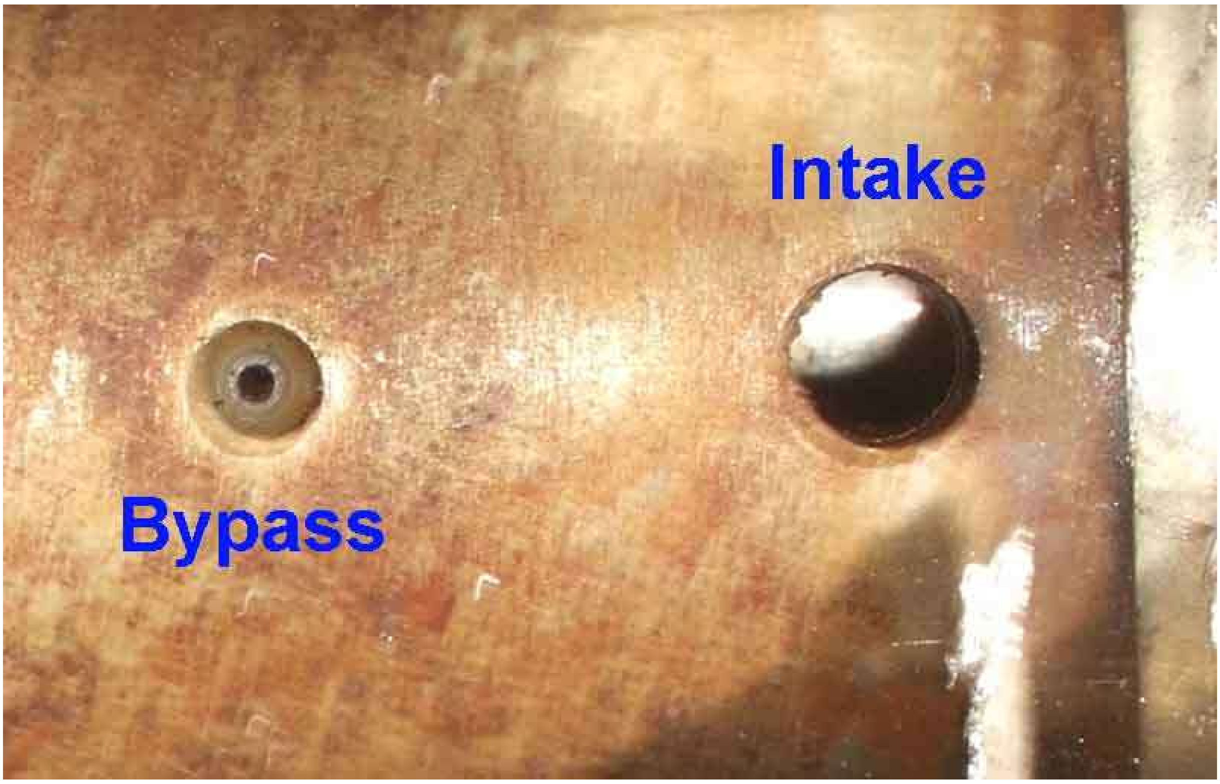


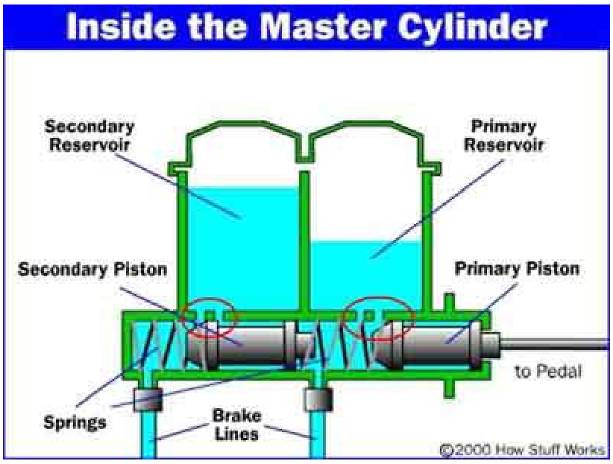
Fig. 9.13 Tandem master cylinder with Pressure Differential Warning Actuator (Sec 20)

1 Fluid reservoir
2 Pressure failure switch
3 Primary feed port seal
4 Primary feed port O-ring
5 Primary feed port adaptor
6 Secondary feed port seal
7 Primary piston
8 Return spring
9 Cup
10 Stop pin
11 Secondary piston
12 Return spring
13 Cup
14 End plug
15 Distance piece
16 Pressure differential unit
17 O-ring
18 Shim washer
19 Seals

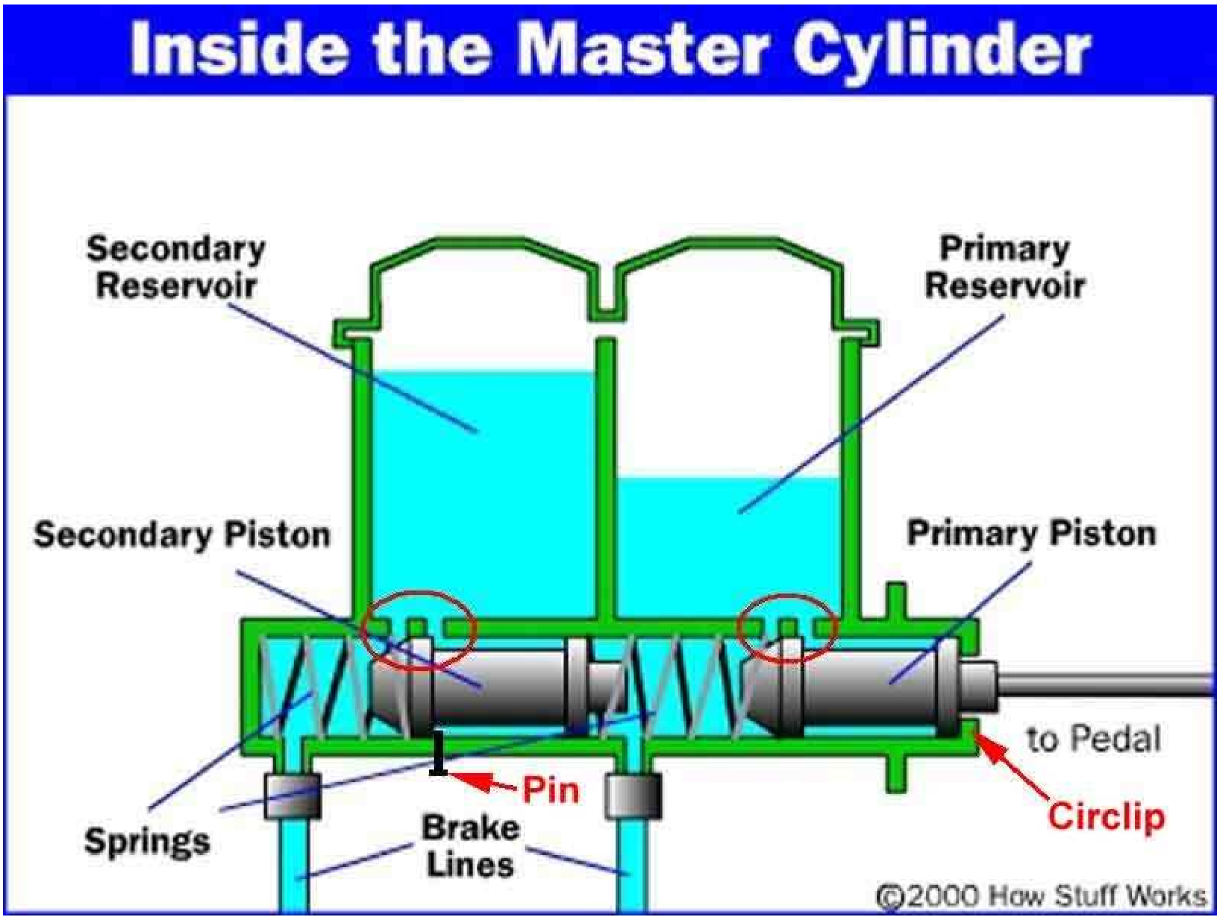
Although Haynes shows different arrangements for the front and rear passages from the reservoir to the main casting John Maguire just shows two identical seals and that all John Birbeck found. John B had fitted a new master cylinder but couldn't get any fluid to flow from the reservoir to the front brakes. There is a passage from the shuttle valve to the front ports, but not down from the reservoir! John M shows two small holes in the casting under the reservoir which are probably the inlet and bypass ports for in front of and behind the pressure seal, perhaps the inlet in John Bs is blocked. In the single circuit master this is a very small passage, which looks like it has been drilled then a bead with a tiny hole pressed in closing most of it off:



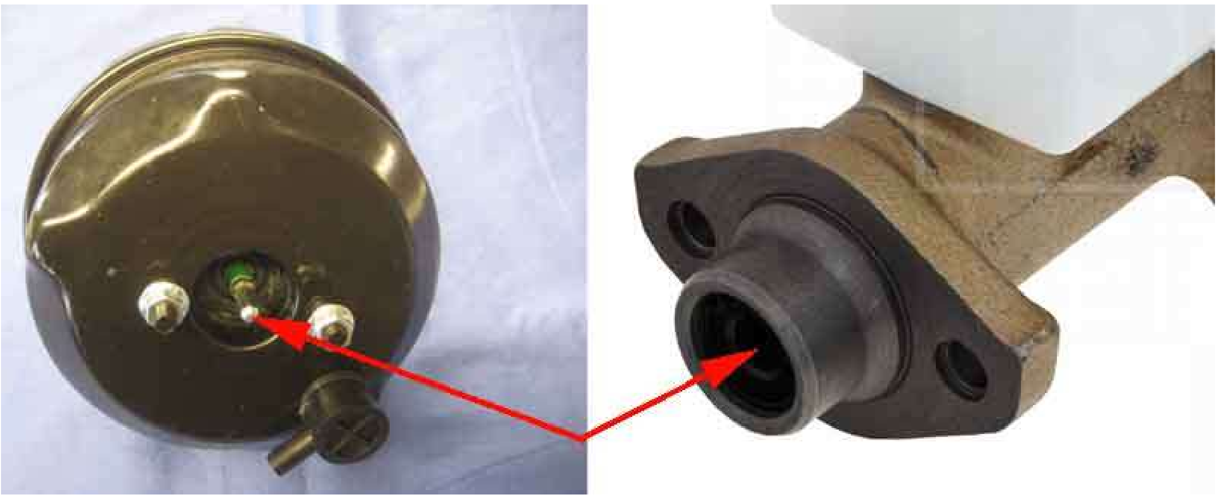
From 'How stuff works' but I believe the drawing to be incorrect, the passages from the reservoir to the right-hand cylinder are different to those on the left:



I.e. the inlet or equalisation port should be connected to the space between the two seals on the primary piston, just as it is on the secondary. The locking pin is also omitted above, this is necessary to position the secondary piston in exactly the right place between the two ports with the pedal released. Also it seems logical that the secondary spring should either be stronger or compressed more than the primary spring with the pedal released, to be certain that the primary spring isn't pushing the secondary piston forwards off the locking pin:



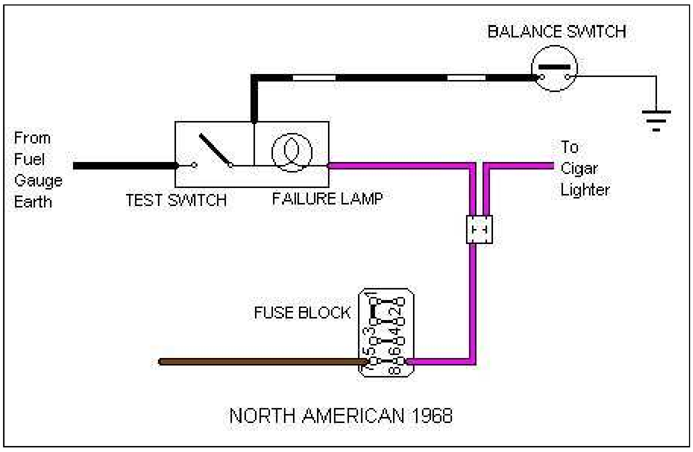
Servo:
The push-rod from the servo acts directly on the master cylinder piston:



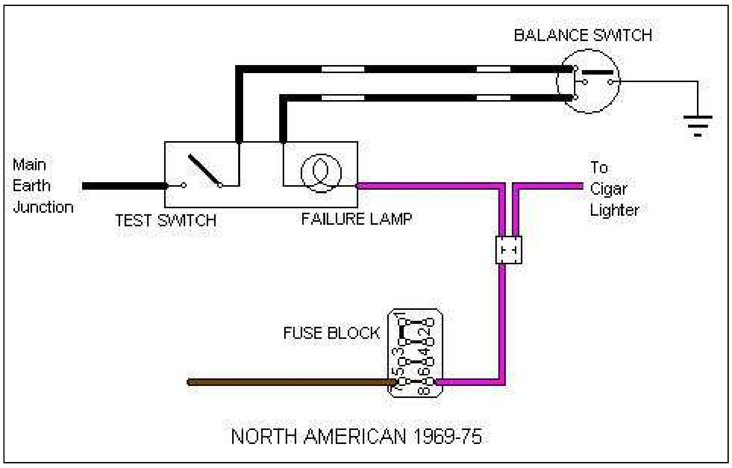
Brake Balance and Handbrake Warning

[North America 1968](#) [North America 1969-75](#) [North America 1976-on](#) [UK 1977-on](#)

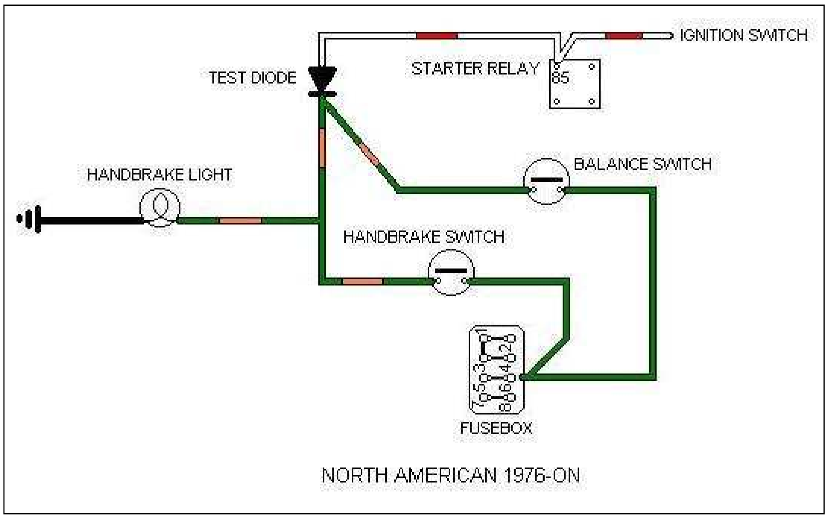
North America 1968 A simple circuit where the manual test switch merely tests the bulb and the 12v supply to it:



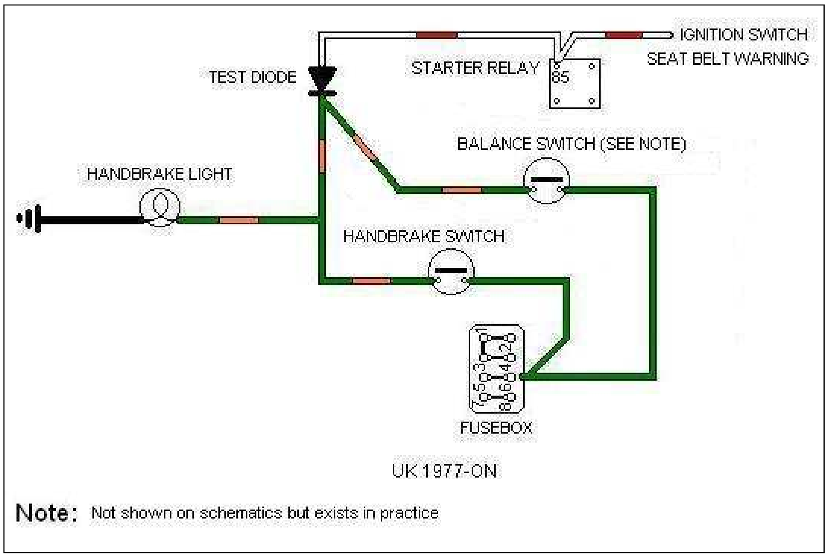
North America 1969-75 A more comprehensive circuit that tests all the wiring to and from the balance switch and bulb, only the switch itself is untested:



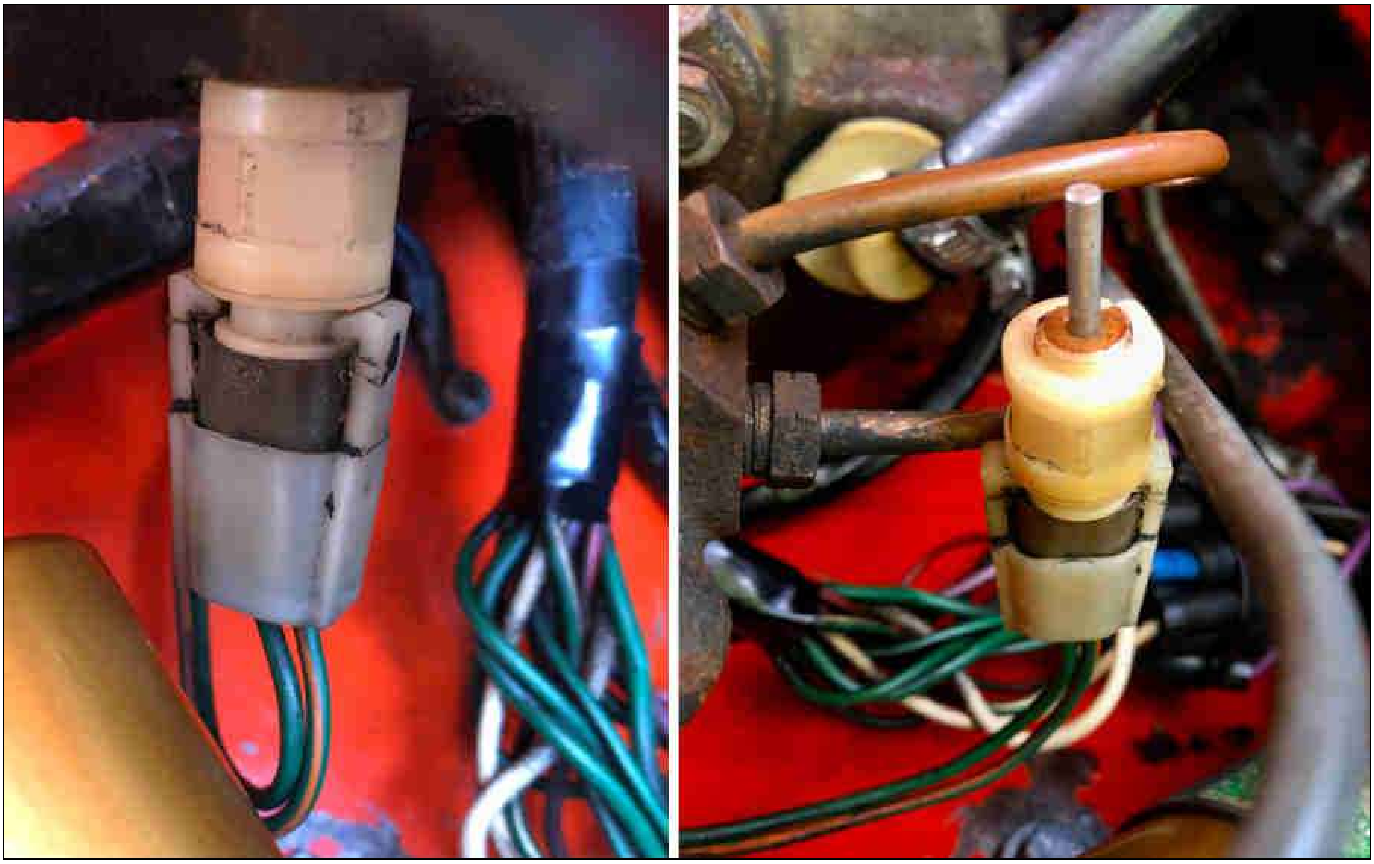
North America 1976-on A completely different approach. No manual test switch, the balance switch now only lights the handbrake warning lamp, and only when the ignition is on. The handbrake switch lights the same lamp, and for some reason the (USA) powers that be decided that the lamp should also be illuminated while cranking, even though the handbrake will almost certainly be on anyway! Not unreasonable for automatics perhaps, when one has used Park rather than the handbrake, but not relevant to MGBs by that time. The wiring to and from the balance switch isn't tested at all, one wonders why they bothered, especially when if the [diode fails short-circuit](#) it causes the starter to crank continuously! (In which case drop the handbrake ...):



UK 1977-on According to the schematics all this system does is light the handbrake warning lamp when the handbrake is on or when cranking with it off (even though the handbrake is likely to be on and illuminating it anyway while cranking). No brake imbalance switch is shown, so completely pointless, especially as it has the same problem when the [diode fails short-circuit]() and causes the starter to crank continuously as above. However the lack of brake balance switch seems to be an omission in the schematics as all the cars checked do have the switch and wiring, making it the same as for North America, so the switch has been included here:



Switch AAU2454 mounted under the master cylinder, but the threaded portion can break leaving the switch dangling: (*Graeme Stoten*)

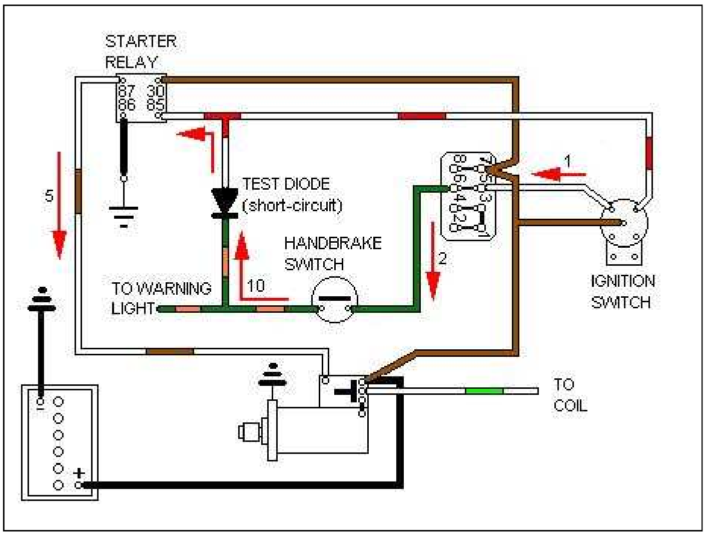


AAU2454: (*[Moss Europe]()*)

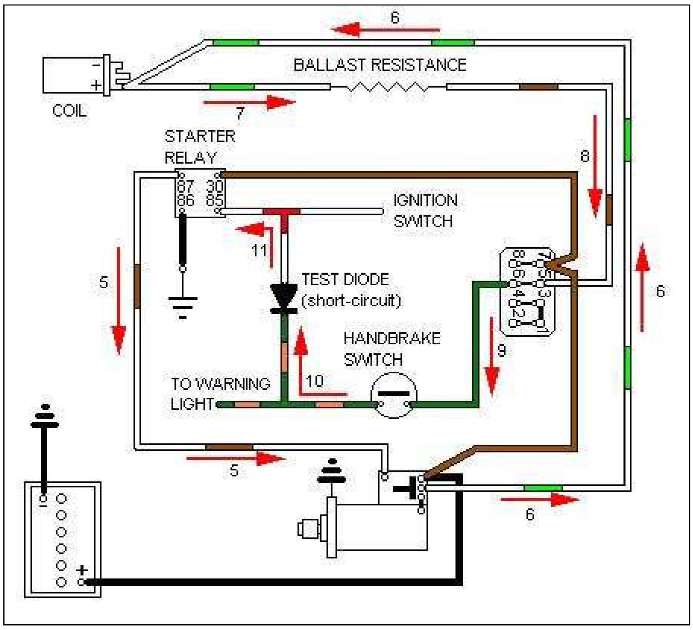
The UK seat-belt and handbrake switch wiring:

The handbrake switch used is AAU2492: (*Brown & Gammons*)

What happens when the test diode goes short-circuit? As soon as you turn on the ignition, power goes from the white circuit (1) through the fusebox to the green circuit (2). With the handbrake on it passes through the handbrake switch onto the green/orange circuit (3), and with a short-circuit diode onto the white/red circuit (4) to operate the starter relay, which connects 12v to the white/brown solenoid circuit (5) to start cranking immediately:



The real problem comes when turning off the ignition - the starter keep cranking! Once the ignition switch has operated the starter relay 12v is sent to the solenoid (5). With this operated 12v is sent on the white/green circuit to the coil +ve (6), and backwards through the ballast resistor to the fusebox (7, 8), even though the ignition switch is off by this time. 12v on the white/brown at the fusebox passes through the fuse onto the green circuit to the handbrake switch (9), which is normally closed when cranking i.e. handbrake pulled up, and on the green/orange to the diode (10). With the diode short-circuit 12v flows backwards through it onto the white/red and thence to the starter relay (11), which keeps it operated and keeps the starter cranking. Hence dropping the handbrake is the only way of stopping it cranking short of pulling the wires off the starter relay or disconnecting the battery:



Warning light test diode showing the male connector for the white/red wire ...

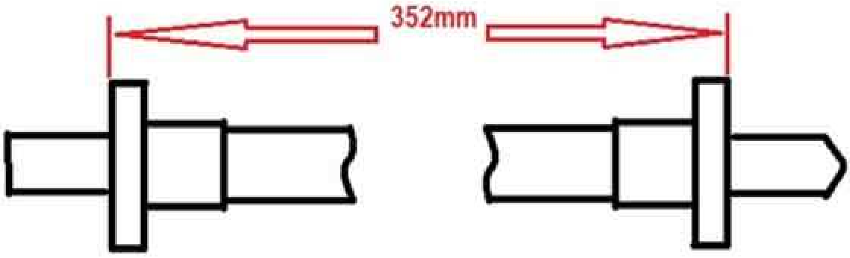
... and the recessed female connector for the green/orange wires:

Front Brake Hoses - a question of length

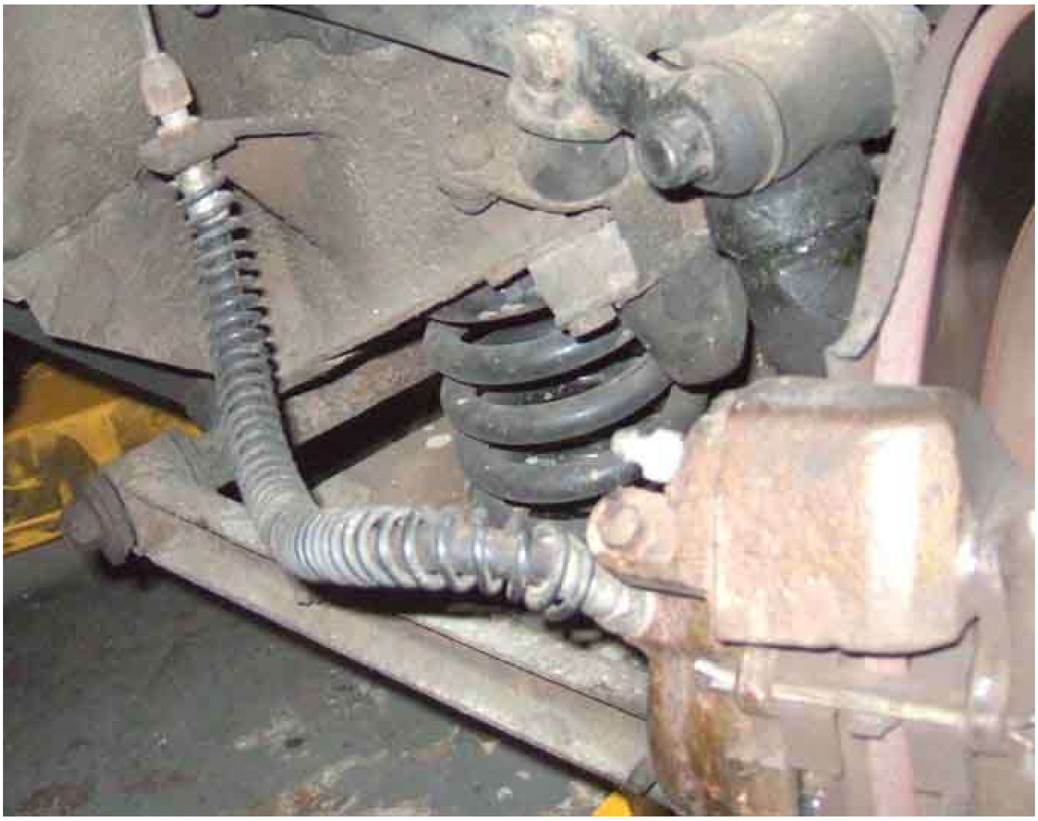
The hose pictured in this V8 Register document - pretty tight:

Measuring the length of the metal ends - minus threads:

Measuring length from hex face to hex face (*Dave O'Neil*):



Bee's, with 321mm as far as I can judge from hex face to hex face, and metal ends 22mm at the bracket and 25mm at the caliper:



Alignment of bracket to damper:

Vee's, with 330mm from hex face to hex face, but with 33mm metal ends:

Rear Brake Hose

Originally the pipe points more-or-less straight back to the hose, which is secured to a bracket welded to the side of the battery box, and the hose attaches to the top of the 3-way union on the axle, this from my 75 V8:

But for UK 77 and later at least the bracket changed to one bolted to a welded nut on the rear of the battery box, and the pipe now connects to the hose pointing downwards. Also the hose now attaches to the off-side of the union on the axle, and the off-side pipe comes off the top. This is probably because the union had to move closer to the diff because of the ARB brackets. Image from Charles9 UK on the MG Enthusiasts BBS.

The Leyland Parts Catalogue shows the hose as having 'gasket' 233220 to the union on the axle, which the catalogue drawings show as having a notched edge, but all the suppliers pictures I have seen show it as a plain copper washer.

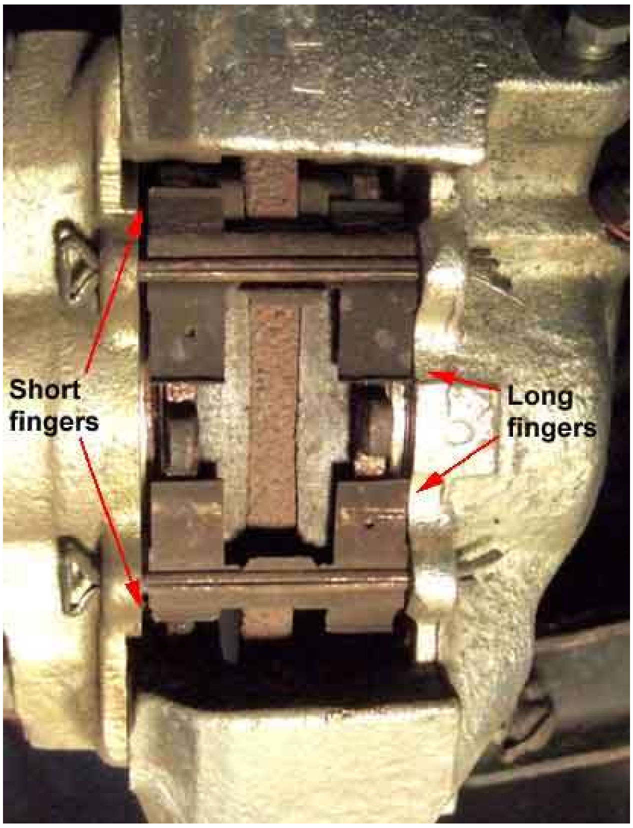
3H2424 from Motaclan/Leacy at £7.50 - what would be the top port for the hose pre-77 definitely different to the other visible port.

BTB657 for Triumph models from Moss Europe at £17.10 - the two visible ports with the same recessed thread, although the mounting boss is in a significantly different position.

AJA5028 for the MGA from Brown & Gammons at £16.07 - possibly four ports although one could be blanked off, the lower right (in this image) port looking correct although the lower left is completely different.

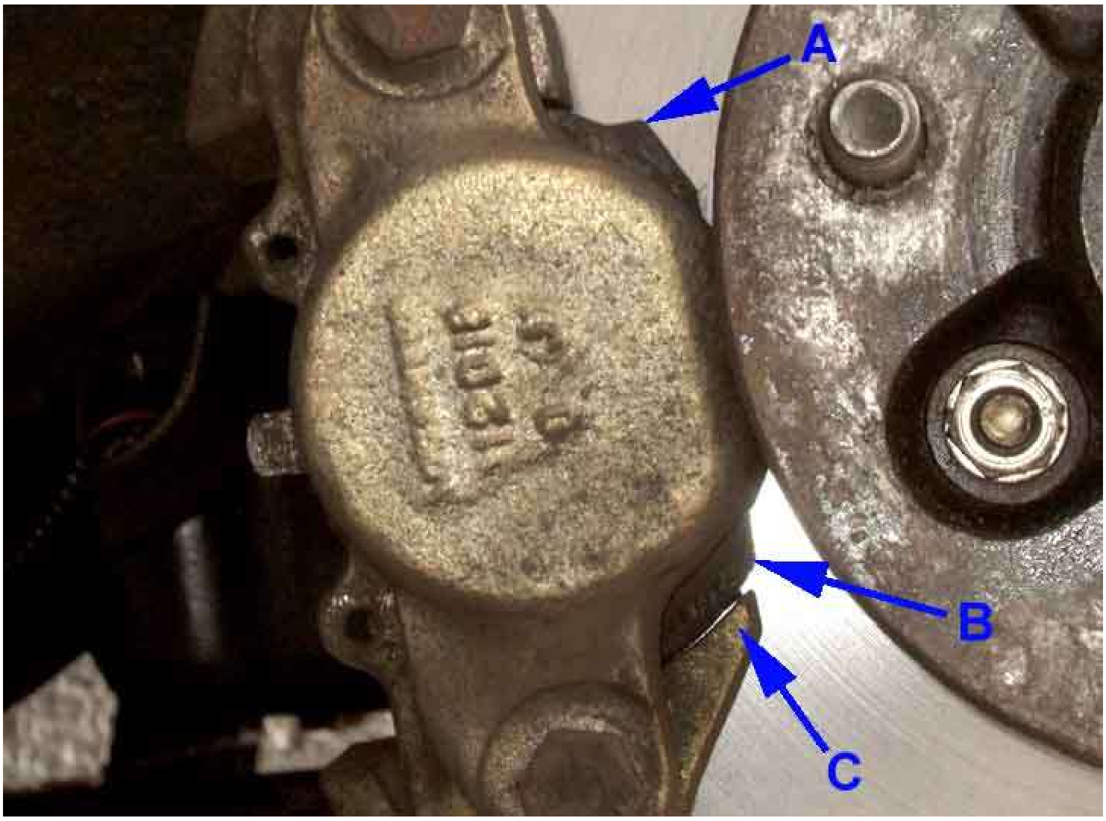
Brake Pads

The pad retaining springs, showing the two longer fingers on each retainer facing each other. These also have a pin-hole in the longer fingers.

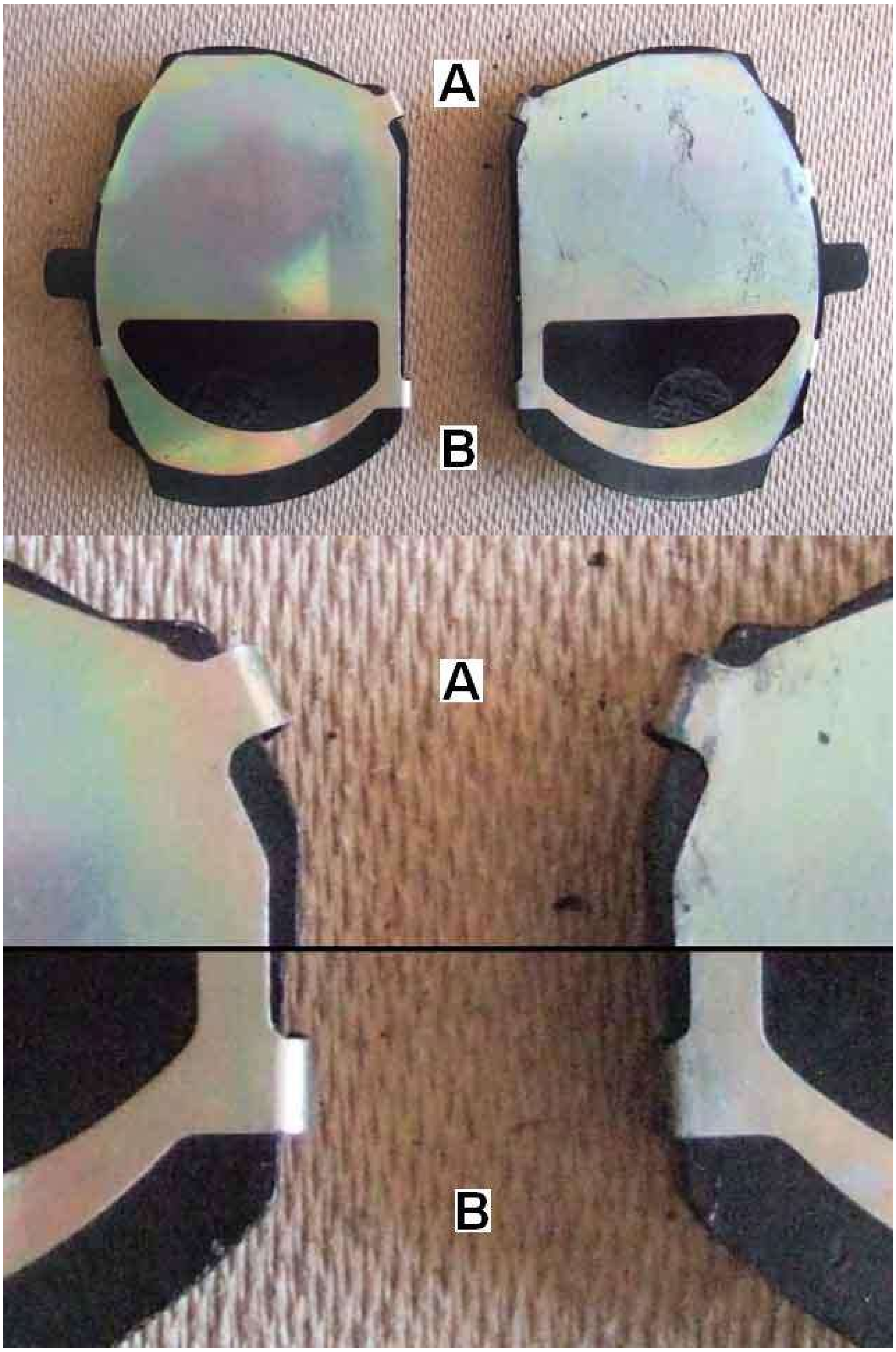


V8 pads are handed - there is an inner and an outer for each caliper, the 'handing' can be seen as a sticking-out bit on one inner corner of each pad, circled. Below shows a pair for one caliper on the left and another pair on the right. Both pairs are the same, which may seem to be incorrect, as the pad that goes in the outside half of the caliper one side of the car goes in the inside half of the other! That puts the circled sticking-out bit on each pad in the same position in each half of each caliper.

With the pads fitted you can see the sticking-out bit uppermost (A), and the curved corner at the bottom (B). You can also see how a protrusion on the lower caliper bridge (C) is what prevents the pads being fitted the other way round:



Note also that the shims are handed - the tabs at A and B are at different angles. This means that they only go on one pad each side, as well as each pad only going in one side of the caliper. After 20 years I only recently wondered how the cut-outs in these shims were orientated relative to the cut-out in the caliper piston, which has to face the spindle. I soon realised that with both shim and pad being handed there is no room for error, but it does mean the cut-out in the piston is at right-angles to the cut-out in the shim, resulting in a rather complex force of the piston on the pad, and - from back pressure of the pad on the disc - of the piston in its bore.



Comparison of 4-cylinder (left) to V8 (right). Rubberised coating on the back of the 4-cylinder with no shim. And despite shims being included with the above set none with this set, even though they did come with retaining springs and split-pins, which isn't always the case.

V8 pads in 4-cylinder calipers: With the 'tops' aligned the 'bottoms' of the V8 pads extend a bit further:

There is noticeably more friction material closer to the stub-axle:

V8 pad on 4-cylinder disc: On the outer face of the disc some of that extra material is not doing anything and as the pads wear that unused part will lodge in the recess in the disc meaning the piston will have to be retracted more than usual to remove them:

Whereas on the inner face all the friction surface is used. Some dismantling will be required to clean up that additional area on the disc when fitting V8 pads to 4-cylinder calipers for the first time - or new or skimmed discs, but it will result in imbalance between the two faces of the disc, which may have unwanted effects including warping:

Confirmed in the caliper - 4-cylinder pad with 4-cylinder caliper and disc:

V8 pad with 4-cylinder caliper and disc:

V8 pad with V8 caliper and disc. Both discs are 273mm diameter, but note the narrower 'channel' between the inner edge of the pad surface and the hub, which gives the wider pad area. V8 discs are thicker and won't fit the 4-cylinder calipers with new pads:

In the above pictures of the V8 pads the apparent gap between friction material and disc is due to the chamfering on these new pads, thought to be in response to squeal:

MG ZS shims with prongs that project into the pistons, similar to Peugeot shims which some have said have cured their MGB squeal. Only one per side on the ZS, whereas I need two for each MGB, or three more ZS pad changes ...

Brake Pipe Heat Shield

AHH8890: *(Moss Europe)*

Fitted on top of the heater flange using the centre and carb-side heater mounting screws:

Brake Calipers

Cross-section of the MGB brake caliper from the Leyland Workshop Manual

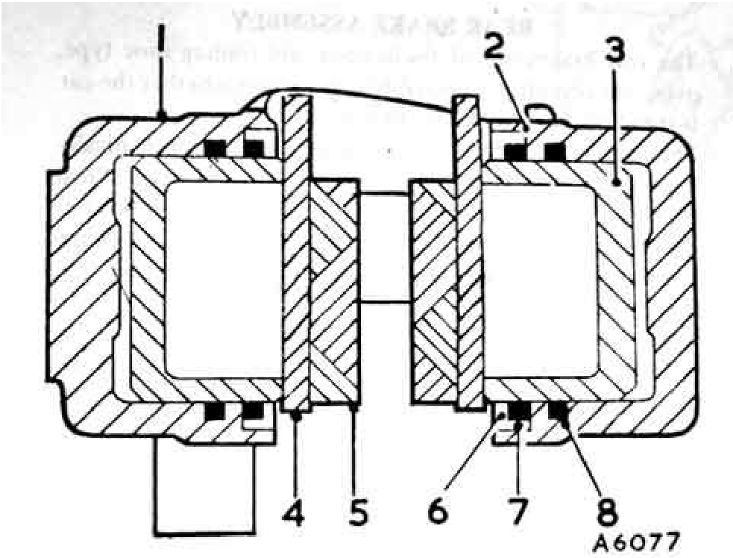
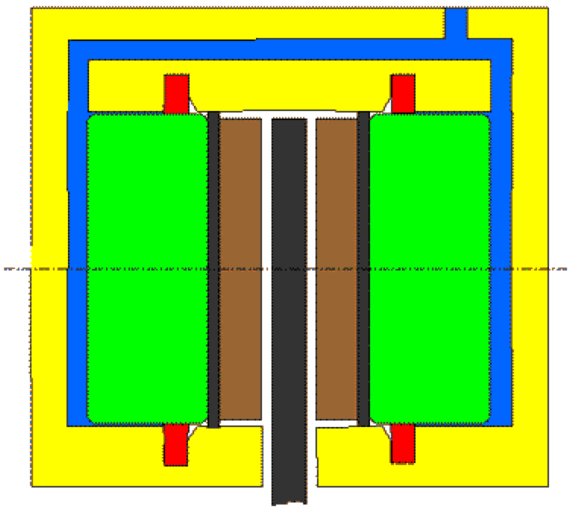


Fig. M.5
A disc brake in section

1. Calliper–mounting half.
2. Calliper–rim half.
3. Hydraulic piston.
4. Pad backing plate.
5. Friction pad.
6. Dust seal retainer.
7. Dust seal.
8. Fluid seal.

Animation showing how the piston seals in the caliper are distorted when fluid pressure is applied and the pistons move out, which pulls the pistons back in as the pressure is released. (*Motor Vehicle Maintenance & Repair Stack Exchange*)



Caliper piston showing the cut-out (Brown & Gammons)

WSM drawing showing the cut-out facing the centre

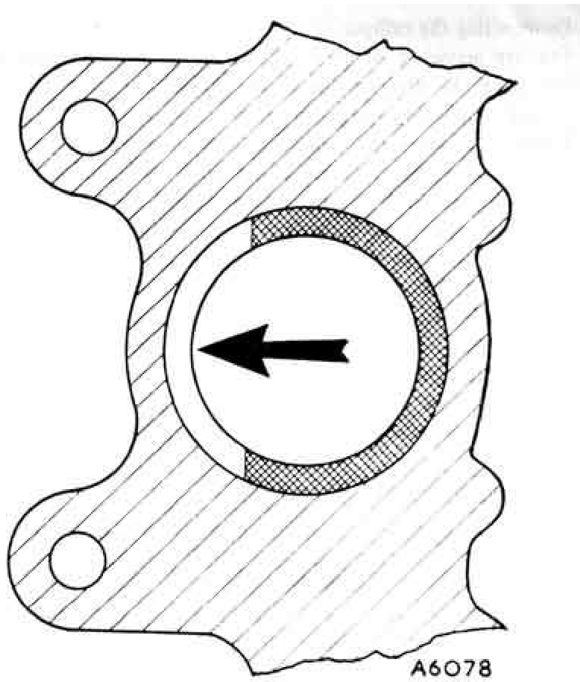


Fig. M.6

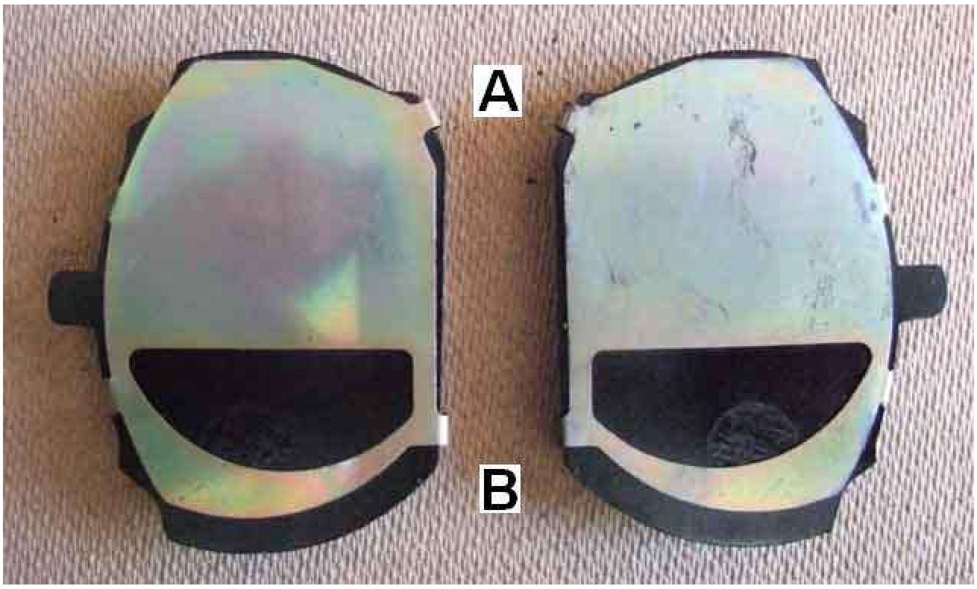
The cut-away portion of the piston (arrowed) must be located at the inner edge of the calliper, i.e. towards the hub

MGB pad with piston witness marks ...

... showing that without the cut-out the lower edge of the piston would be off the pad ...

... but with the cut-out it is effectively in the middle and will apply even pressure of pad to disc.

However, when that is combined with the shims on V8 pads which have a gap across half the piston, who knows what the effect might be?



Caliper and Disc Change

Blued disc. Swept depth also seems to be noticeably smaller than the other disc. This is the very thin disc, but I opt for replacing both.

Using 'ground effect' to assist in undoing the nuts and bolts. All the bolts turned before the nuts cracked loose so I had to have a socket either side. That on the bolt head needs to be kept as square as possible and pushed onto the head as much as possible as the socket only fits on about half-way due to a step on the disc flange. When I knew I was going to do the same job on a pals car I got hold of a large bench vice which I was able to use to grip the disc while my pal pushed the socket/box-spanner (see below) onto the bolt head while I used a breaker bar on the socket.

One of Bee's discs showing no clearance at all between the angle on the bolt head and the raised portion at the bottom of the well. This is a result of the flange being cast much thicker than it needs to be, so quite a lot of metal has been machined off, but not out to the wall of the well. This leaves a step on the flange which significantly reduces how far a socket can go on the head and also puts it an angle, making it very likely to slip off damaging the head in the process.

The new disc has a larger clearance, but still isn't enough for a socket to fully seat. However a box-spanner (inherited from my Dad, been in my toolbox unused for probably 40 years) did when the bolt head flat was aligned as shown, as the box-spanner is only 0.747" across the flats externally whereas my sockets are 0.809" OD.

My pal's original disc with significantly greater clearance, enough for a socket to fully seat. This is cast differently as the rough wall of the well goes straight down almost to the machined face, so very little machining, and what there is goes right out to the wall.

One of the old discs not much more than half the thickness of the new, the other is not so thin so probably has been replaced in the past.

Shiny new calipers, discs and pads

Old pads, overheated side on the right showing them badly crumbled as well as reduced in thickness. Annoying, as they were only replaced a couple of years ago.

Hose clamp. Halfords had two, this was about a pound cheaper than the other, so got my vote. However they are only plastic whereas the others are steel. If they get brittle and break than they will have been poorer value. Also the part that grips the hose is 'V' shaped on these plastic clamps whereas it is 3/16" or so round bar on the metal ones which is probably less harmful to the hose.

Vee's disc change. Old discs with very shallow machining and a good distance to the wall so a standard socket grips the head for removal.

But the new discs have very deep machining, almost as deep as the head, with negligible clearance to the side of the bolt head so not even the box-spanner will go on, let alone a socket.

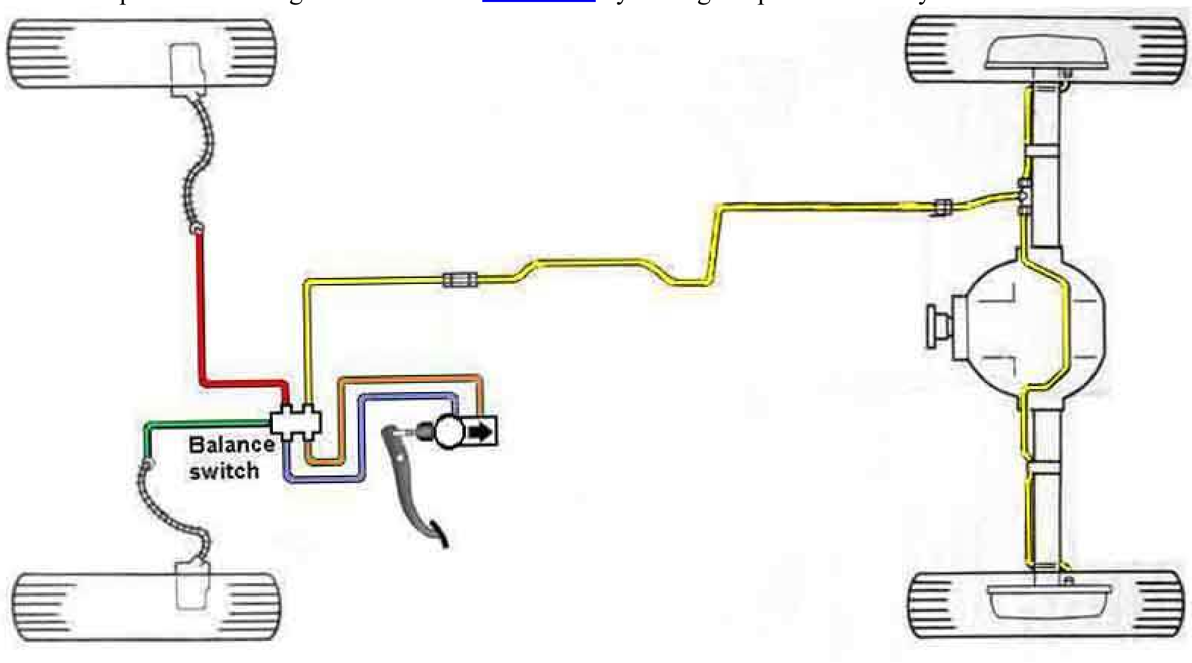
In the end I had to wedge the flat blade of a screwdriver in between a flat and the side of the machining. That gap was even narrower on the second disc, not enough space to grip the screwdriver as with the first one. The second one I tried was fractionally too thin and went round with the head, but finally an in-between size locked the head. A thick washer would raise the head enough to get a socket on, but would need a longer bolt to get the same number of threads protruding.

Dual Brake Plumbing

Unboosted Boosted

Unboosted:

Early (unboosted) LHD dual system with separate master cylinder and balance switch. The primary circuit is nearest the pushrod and feeds the front brakes via the balance switch assembly with individual ports for the two calipers. The secondary circuit is furthest from the push-rod and goes via the balance switch assembly and a single port to the rear brakes. I have adapted the drawing from the one at Moss.com by adding the pedal for clarity:



The WSM is of no help as it doesn't even indicate which is the primary circuit and which is the secondary, but going by the item labelling it could be construed that the lower numbers as represent the primary circuit whereas in fact they are the secondary:

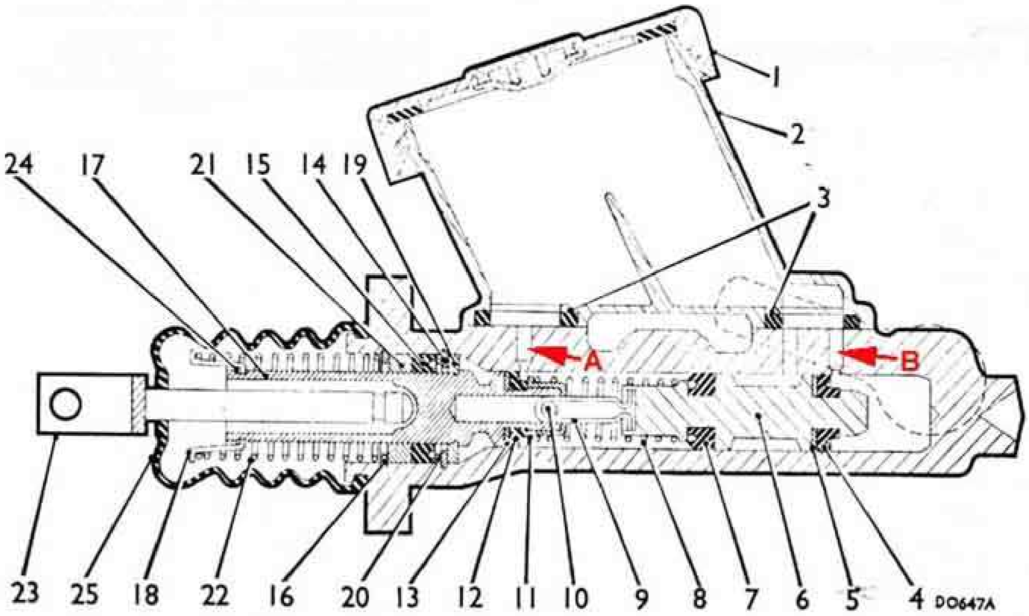


Fig. Ma.2
A section through the master cylinder

1. Filler cap.
2. Plastic reservoir.
3. Reservoir seals.
4. Main cup.
5. Piston washer.
6. Piston.
7. Main cup.
8. Spring.
9. Piston link.
10. Pin.
11. Pin retainer.
12. Main cup.
13. Piston washer.
14. Circlip.
15. Cup.
16. Circlip.
17. Piston.
18. Spring retainer.
19. Stop washer.
20. Washer.
21. Bearing.
22. Spring.
23. Push-rod.
24. Spirolox ring.
25. Rubber boot.

MGB. Issue 1. 15676 Ma.3

Haynes is slightly better in that although it uses the same numbering it does indicate which is 'primary' and which 'secondary':

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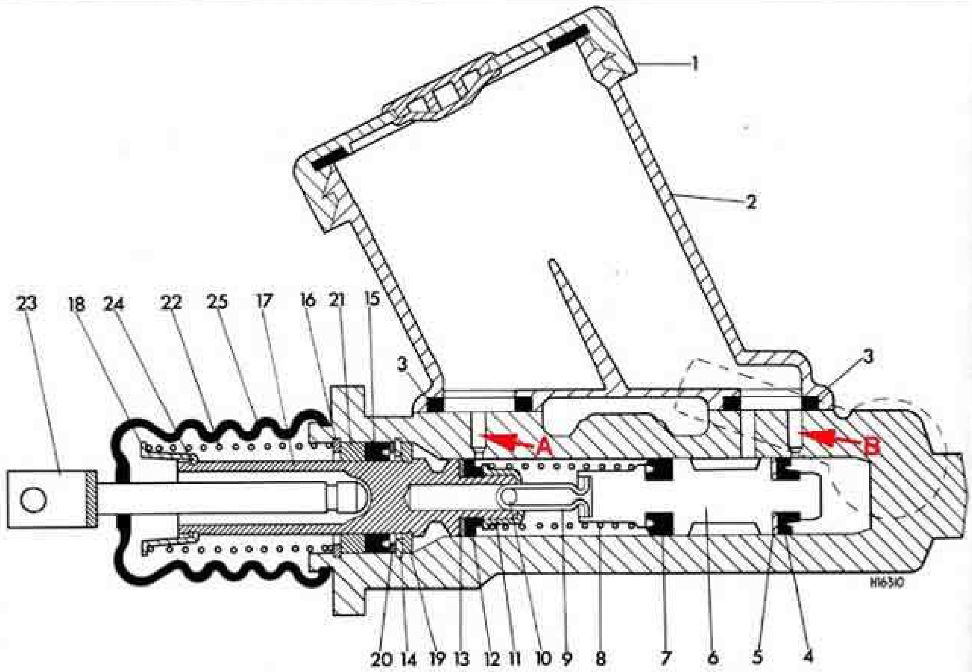
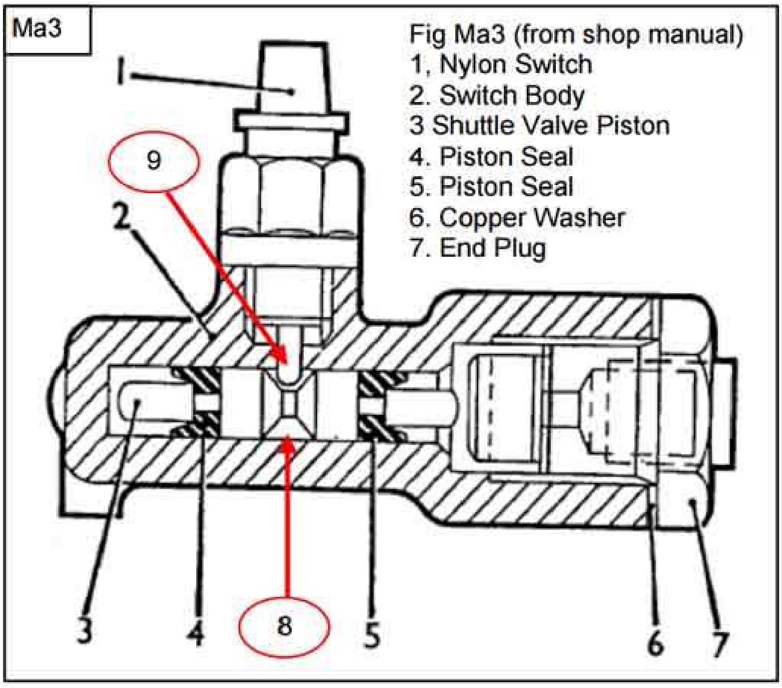


Fig. 9.12 Tandem brake master cylinder – sectional view (Sec 19)

1 Filler cap
2 Reservoir
3 Reservoir seals
4 Second main cup
5 Piston washer
6 Secondary piston
7 Separating cup
8 Separating spring
9 Piston link
10 Link pin
11 Pin retainer
12 Main cup
13 Piston washer
14 Circlip
15 Seal cup
16 Circlip
17 Primary piston
18 Spring retainer
19 Stop washer
20 Washer
21 Guide bearing
22 Return spring
23 Pushrod
24 Spirolox ring
25 Rubber boot

The remote pressure failure switch assembly 13H5905: (*Somerford Mini*)

Internals from Moss Motors:



Boosted:

1977 and later RHD dual system with combined master cylinder, servo and balance switch. The primary circuit is closest to the driver and individual ports are plumbed to the calipers. The secondary circuit is furthest from the driver and goes to the rear brakes. The lower primary port goes to the caliper on the same side of the car as the master cylinder. The upper port goes to the caliper on the other side of the car, over the heater: (*Haynes 1989 edition*)

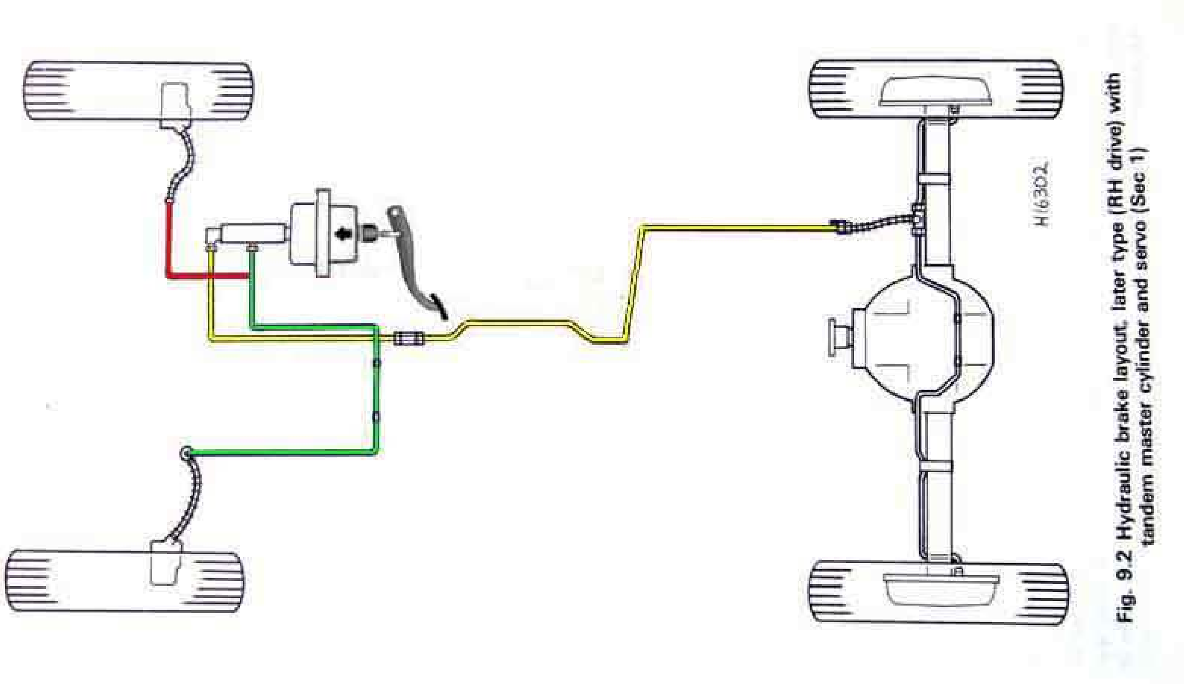
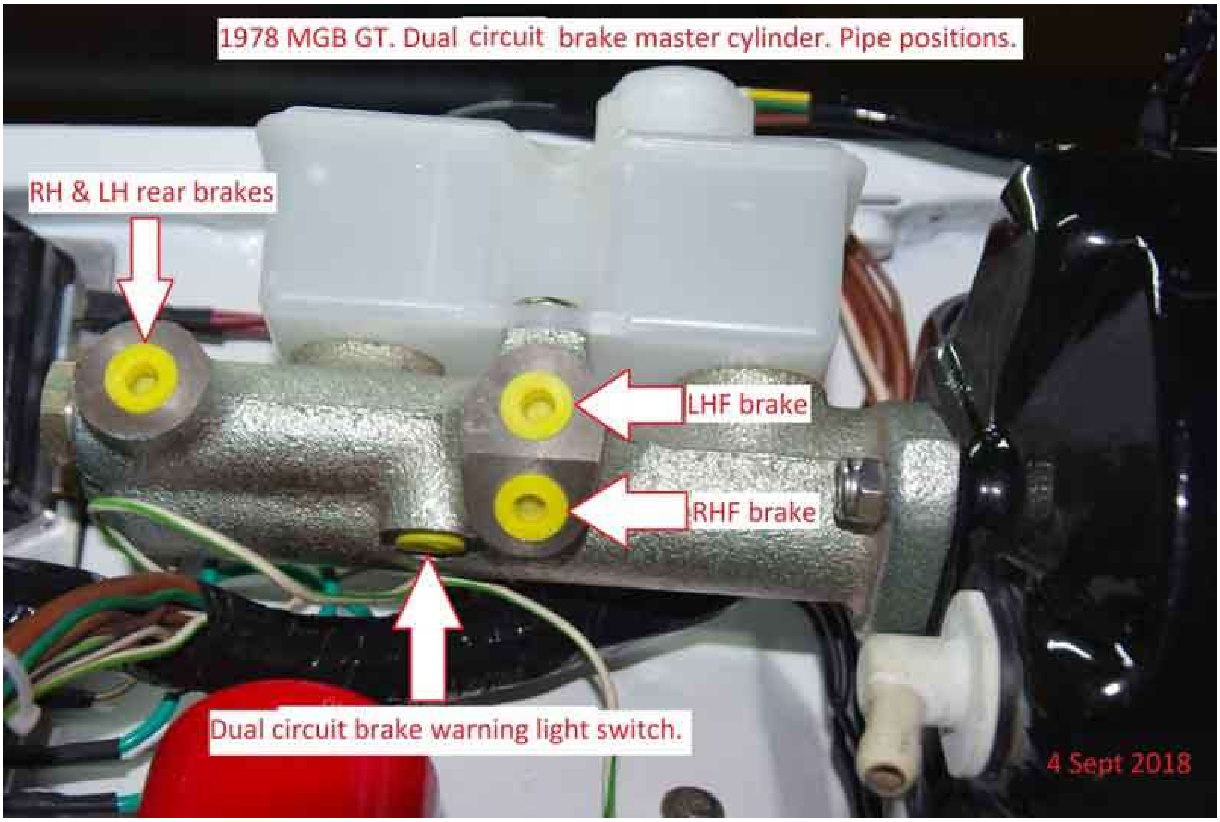
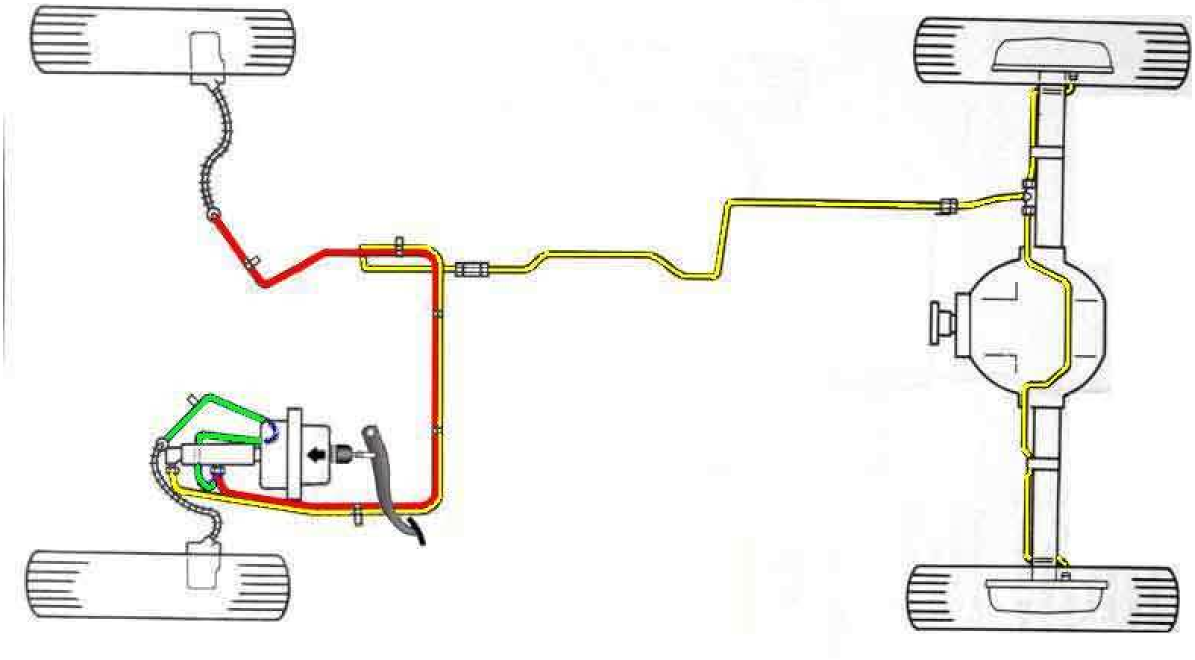


Fig. 9.2 Hydraulic brake layout, later type (RH drive) with tandem master cylinder and servo (Sec 1)

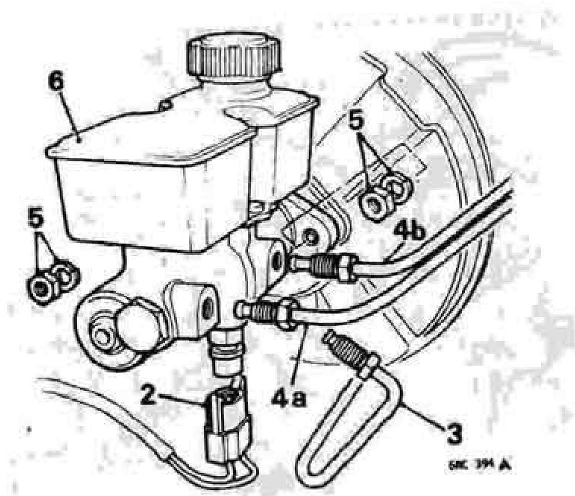
Port arrangement on the above master cylinder of an RHD car: (*John Maguire in Australia*)



Later LHD dual system with combined master cylinder, servo and balance switch. The primary circuit is closest to the driver and individual ports are plumbed to the calipers. The secondary circuit is furthest from the driver and goes to the rear brakes. As with RHD the lower primary port goes to the caliper on the same side of the car as the master cylinder. The upper port goes to the caliper on the other side of the car, over the heater: (*Haynes*)



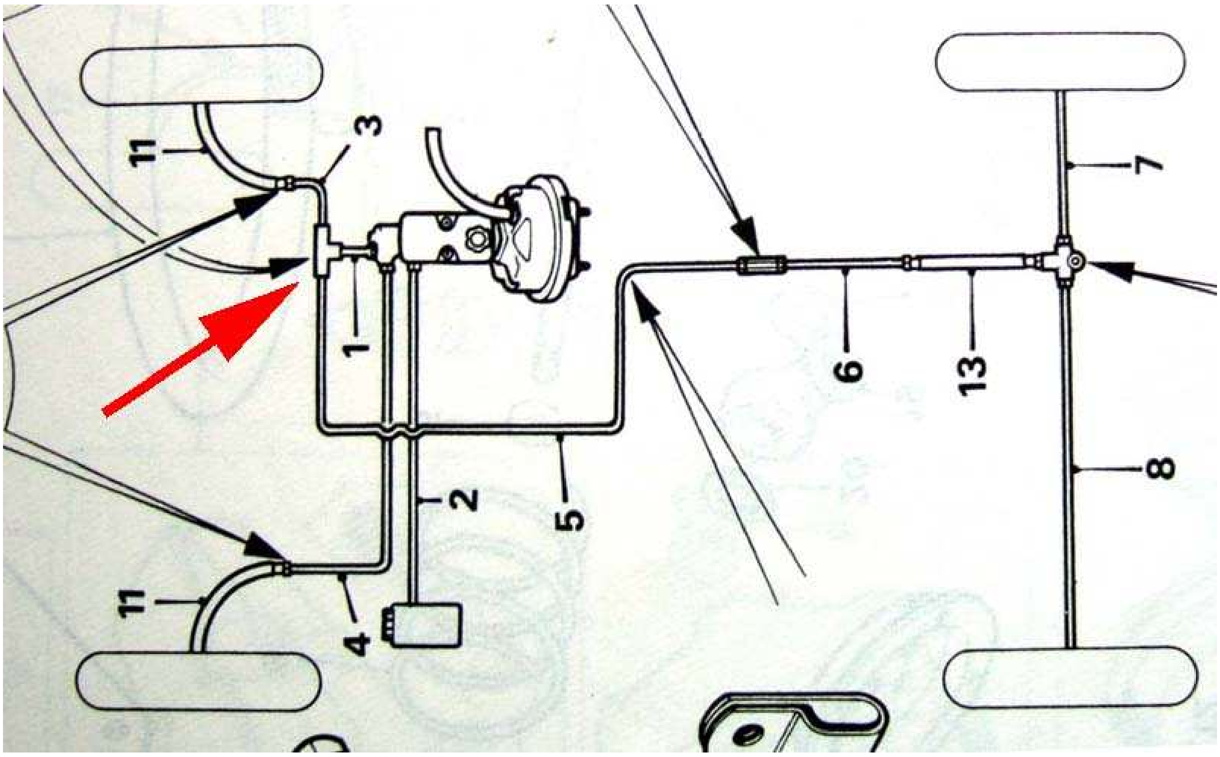
Justalad posted this on the MGOC forum from the 1978 Repair Operation Manual AKM4070 which clearly shows and describes how the pipes connect to the ports ... or does it? Step 3 says 'Disconnect the secondary feed pipe', but pipe 3 is shown positioned and angled for the lower primary port for a caliper. Step 4 says 'Disconnect the primary feed pipes ... a Left-hand brake b Right-hand brake' but shows 4a positioned by the secondary circuit port which is for the rear brakes. So the drawing has the labelling for pipes 3 and 4a reversed. Also it is for an LHD car with one primary and the secondary going up to cross the engine bay over the heater for the right-hand caliper and the rears, the other primary going down to the left-hand caliper. An RHD car would only have one primary pipe going over the heater to the left-hand caliper, the other primary and the secondary would go down to the right-hand caliper and the rears:



Removing

1 Syphon the fluid from the brake master cylinder reservoir.
Alternative:
Attach a bleed tube to a front brake bleed screw, open the bleed screw and pump the pedal until the primary reservoir is empty.
Attach the bleed tube to a rear brake bleed screw and empty the secondary reservoir.
2 Disconnect the pressure failure switch wiring.
3 Disconnect the secondary feed pipe.
4 Disconnect the primary feed pipes. Plug the ports and pipe ends.
a Left-hand brake
b Right-hand brake.
5 Remove the two nuts and spring washers securing the master cylinder to the servo.
6 Remove the master cylinder assemblv.

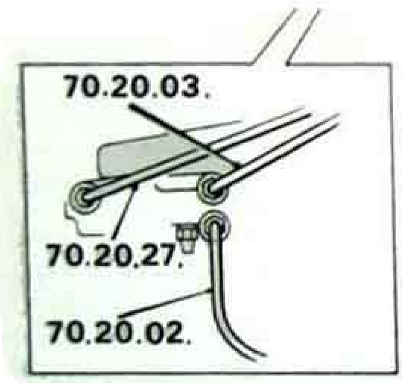
The September 76 Parts Catalogue is even worse as it shows the right front Teed with the rear (red arrow) with some other component piped (2) to the 3rd port on the master. This is quite possibly harks back to the remote plastic reservoir that France and the Benelux countries had from car number 119500 in April 67. How long for isn't known, but it would definitely have gone by the time either of the dual masters were provided as they were both translucent anyway: (*Leyland Parts Catalogue*)



I subsequently obtained copies of both the 1978 Repair Operation Manual AKM4070 and the 1977 LHD Workshop Manual AKD3524 section on master cylinder removal which has the same drawing and description. These drawings indicate two of the pipes going up and one down. Indications such as this can't be taken as gospel, although one should be able to believe the words and the labelling are correct. Clausager shows an RHD with this braking system with one pipe going up and two down, which would be logical, with the one going across to the left-hand caliper and the other two going down to the right-hand caliper and the rear, without being able to tell which is which. Clausager doesn't show how the left-hand caliper pipe goes across but this picture does - over the heater (which is how rubber bumper remote servo pipes were routed):

For LHD cars to avoid the pipes crossing over it would be logical if the left-hand caliper pipe went down, and the right-hand caliper and the rear pipe go up and across the heater in the other direction, then down to the caliper and under the floor. This would make the pipe orientation on the drawings correct for an LHD car, and 4b correctly in the upper port, but the labelling of 3 and 4a is still reversed. Kelvin Dodd of Moss Motors in the US has access to a 1979 LHD LE with only 40 miles on the clock and unmolested, and he confirms that both calipers go to the primary ports and the rear circuit to the secondary port.

And both the Leyland AKM manuals have the full plumbing layout on an earlier page which do show that the calipers are connected to the primary circuit and the rears to the secondary. From the LHD perspective though as the right-hand is shown connected above the left-hand, on an RHD they would be reversed:



PIPES

Feed to front left-hand hose – primary	70.20.02
Feed to front right-hand hose – primary	70.20.03
Feed to two-way connector rear – secondary	70.20.27

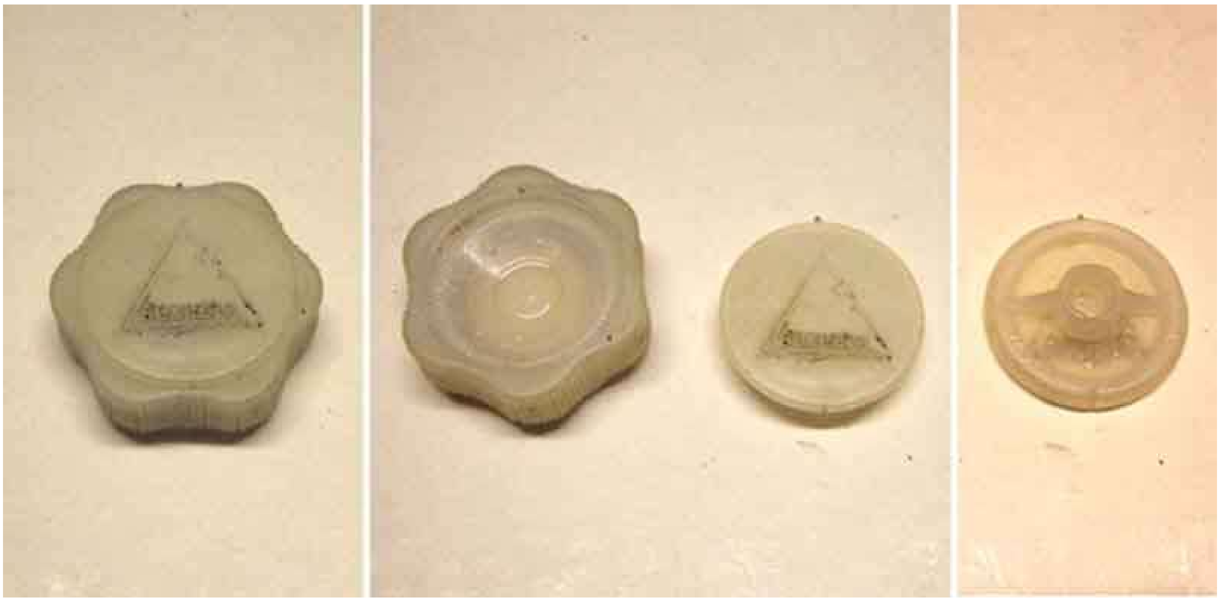
Brake Fluid Level Monitor

Last updated 22-Dec-2023

The 'electronics' is easy, at the simplest level it need not be anything more complicated than a buzzer, with a switch that closes when the fluid level drops. An enhancement is if the buzzer is made to sound by the switch **opening** when the fluid level drops, which also monitors the wiring between the buzzer and the switch. A further enhancement is if the buzzer can be made to buzz briefly each time you turn on the ignition, to let you know that the buzzer itself is working OK and the wiring to the switch is complete.

The tricky bit is the switch. BL cars in the 80s had a master cap that contained a float and a switch, which are probably still available if you look around, but the masters and even the caps are much bigger then the MGB items, and would not fit in the same space even if everything else about them was 'correct'. So I started experimenting, and knowing that water conducts electricity, I wondered if brake fluid did, and it does! Old fluid did, but that could already have absorbed water, but new fluid did as well. However that was glycol fluid, I didn't know if silicone (which I don't have anyway) would be the same. But more importantly I wasn't happy about passing a current through brake fluid, no matter how small with the appropriate electronics, as voltages and currents where metals and fluids are brought together can cause corrosion. I looked at capacitive fluid detection, some of which can be external to the reservoir, but it would have to be a plastic reservoir, it doesn't work with metal as both mine are. Replacement masters come with plastic reservoirs from the usual suspects and are the only type available (although the same applied to clutches until recently, now metal reservoirs are available again, perhaps OE-style brake masters will be too). You can also do capacitive detection with something dipping in to the fluid, but the circuitry required for that is quite complex. That left floats, as used by BL earlier.

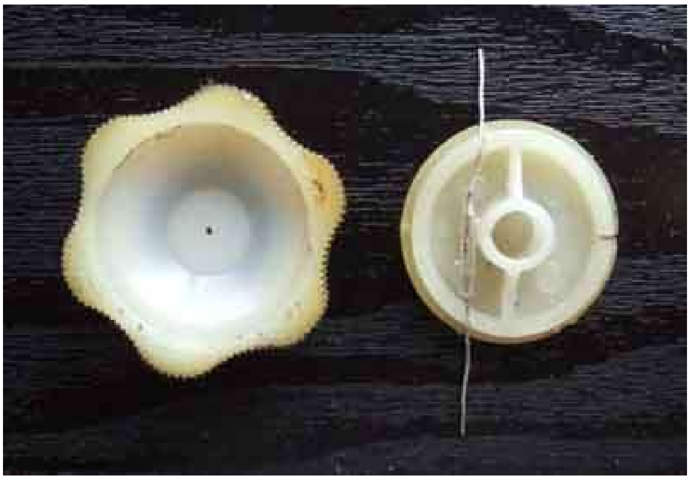
I have plastic caps which very conveniently have a flattish top that clips into the main part of the cap:



This gives a convoluted air path, for air to move in and out of the reservoir as the fluid expands when heated through driving, and cools again when parked. It's essential that air pressure can escape, or it will increasingly apply pressure to the fluid which will apply the calipers at least, generating more heat, more expansion, and more pressure on the brakes. The down side of this air going through the cap is that it can suck moist air in, which will be absorbed by glycol fluid. Silicone fluid is no real solution - it won't absorb the moisture, but the same amount of moisture will be in there, and it condenses into droplets and lies around inside the system. But I digress. Because the top flips off there is the possibility of mounting something inside the cap, or attached to the lower main part and projecting down inside the master.

I considered various types of hollow container that might go through the filler hole, and cork. Attaching the tube but allowing it to move up and down was a non-starter as being too fiddly, but the cork was a possibility as a hole could be drilled through the middle for it to float up and down on a spindle attached to the cap. I wondered whether the cork would soak up fluid and become too heavy, so left one floating in a small container of fluid for some weeks, and it didn't seem to be sinking over time. However once I had fitted a spindle through it, it tended to stick to the spindle and not go up and down freely. Vibration from driving may well be enough to jiggle it down if you were losing fluid, but I wasn't that happy with it.

But that's only part of the requirement - the other is some kind of switch to be operated by the float. Mechanical operation just seemed too iffy, the contacts would have to be very light to be moved by a float in brake fluid, and really would need to be sealed from the atmosphere to prevent contamination and bad connections. Reed contacts are the obvious choice as the contacts are sealed in a glass tube containing an inert gas, and are operated by bringing a magnet into close proximity.



I had some rectangular surface-mount burglar alarm door switches which contain just such a reed contact in the part that attaches to the frame, and a magnet in the part that screws to the door. But two problems - the reed contact was very flimsy and as soon as I tried to do anything with the wires coming out of the ends of the glass tube the ends would break away and the two halves would fall apart. The magnets were also too large to sit on a float.

But researching magnets I came across very small ring magnets, which were worth a punt. However with the reed contact lying across the underside of the cap, the magnet rings had to be on their sides to operate the contact, which meant I couldn't have a hole up the middle and a spindle. I tried them inside a copper guide tube attached to the cap, but it stuck even more, and I didn't like the idea of copper parts in the fluid.

A pal was also experimenting and he had a different type of flush-mounted door contact that can be fitted in the upper part of the cap. This has the reed contact orientated differently, so that the ring magnets can lie flat on the top of the cork, with a thin spindle passing through them and the cork acting as a guide and a retainer. However the cork tended to stick to the spindle as well.

More research into float switches came up with a commercial product that looked to solve both problems. These have a polypropylene foam float containing a ring magnet, that slides on a spindle that contains a reed contact. Furthermore by turning the float over, you can arrange for the contact to close when the float drops, or to open when the float drops - this latter being just what I wanted. If that wasn't enough they have a thread, sealing ring and plastic nut at the top end where the wires come out which will be ideal for securing it to the master cap. There were various offerings from a couple of suppliers, with different dimensions, the most important being the float diameter, as it has to fit through the filler neck. Float diameters were either 15mm or 19mm, and checking my masters they varied between 17 and 19mm. The length is also a factor, there is 56mm available from the top of the neck to the metal plate over the cylinder inside the reservoir. But for the items on sale only overall lengths were given at 72mm and 44mm respectively. And although the overall length included the mounting flange and thread, I couldn't be sure if the longer one (which had the narrower float) would fit. So I ordered the shorter one, very cheap and free P&P even though it comes from China, but it does mean a wait for them.

When it arrived I found the float would not fit through the neck. The neck size can be pretty variable, as although the OD is fairly precise as you have to be able to screw the cap on and tighten it down i.e. it can't be too big or too small, but at the top of the neck it is turned over and back down inside itself so it doesn't leave a sharp edge, and the ID can vary by quite a bit. I had two options - try and turn down the float a bit, or expand the neck. The float was first, I put it on an arbor and spun it on a drill, and used glass-paper gently on the surface. It did very gradually reduce the diameter, but of course left tiny flakes hanging on that I didn't want dropping down inside the master, and it was on the verge of melting even with light pressure. That left modifying the master.

By experimenting on an old master that had rusted through (I knew it would come in handy one day ...), and with an old nut driver I had found years ago in my father-in-laws 'bits drawer' I found that it was relatively easy to carefully press the turned over edge outwards, making the hole bigger, without distorting the thread on the neck. A large pair of pliers can do the same job, as long as it has rounded faces to the outer edges of the jaws so fragments of metal are not scraped off the opening.

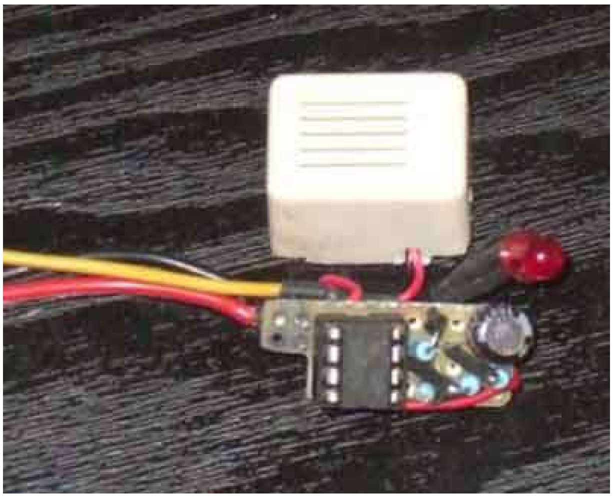


I've got two choices - I can either fit the threaded part of the spindle up through the main part of the cap and have the nut under the top cap, or I can fit the spindle down through the main part of the cap, and have the threaded part going through the top cap and the nut above that. Unfortunately not so easy, having set the float correctly so that it opens the reed contact when fluid level falls, I find that not even the lower position i.e. with the nut inside the two halves of the cap, does the float rise high enough to close the contact.

I pondered spacers and brackets to position this short switch lower down, and a pal did opt for that method. However it does mean that as you unscrew the cap the switch and the wiring from it twists as well.

I decided to go for the longer switch, but that has its own issues. The float rises far enough to close the switch, but even in the higher of the two mounting positions the bottom of the switch spindle hits the internal plate over the cylinder before the cap is fully screwed down. The float is retained on the spindle by a plastic circlip in a groove, and there is about 1/4" of spindle below that, giving me some scope to shorten it. This I do, and now it fits, but has exposed the end of the reed contact connection wire! Not ideal, as it puts an electrical circuit in contact with the fluid which I was tying to avoid. But as one side of the switch will always be at earth, and the metal can of the master is always at earth potential, as long as I connect the earth to the exposed side of the switch there shouldn't be a problem. Also because the flange on the switch is between the upper and lower halves of the cap I don't need to fit the nut which means the float switch can swivel, and hence its wiring can stay still while I'm turning the cap to remove or refit. But there is another issue with the float this way round, and that is if the float rises high enough up the spindle, the reed contact opens again. It may never rise that far in practice, but to be sure I cut a groove round the spindle and fit another circlip above the float, limiting its upwards movement to below that at which the reed contact opens. After that it was a relatively simple matter to strengthen the thin wires by replacing most of the length with stouter wires, covering them with layers of heat-shrink including over the thread at the top of the switch, and connecting them to a 2-pin plug (of which more later).

Next the electronics. I wanted the full 'self-check' version, with LED and buzzer, and as most of my electronics experience has been with discrete transistors started off with that. I also wanted it to be as small as possible, and found a Hammond ABS enclosure just 35mm square and 20mm deep. At the time I had a Maplins 12v buzzer which with a little trimming did just fit into the case, but only left enough space for a bit of 4 x 11 stripboard, but a 4 x 4 section had to be cut off the corner of that to fit round the column for the lid screw! I needed two transistors - one as the detector and timing circuit to give the self-check buzz, and the other to switch the LED and buzzer on and off. It worked, but after its self-check period gave an annoying dying squawk as it switched off, as without additional circuitry the transistors only switch on and off gradually.



So I tried another version using a voltage comparator IC and managed to squeeze that into the same space as well. It has a fixed potential divider to deliver a reference voltage on one input, and a variable potential divider on the other. The 'variable' part consists of a fixed resistor on one arm and the float switch being open or closed on the other, to deliver the variation in the signal voltage. With the switch closed the signal voltage is lower than the reference voltage which turns the IC off and silences the warning. With the switch open the signal voltage goes higher than the reference voltage to turn on the IC and give the warning. A capacitor across the fixed resistor on the signal input initially pulls the signal voltage high to switch the IC on and sound the warning - the self-check - but over a short period of between half a second and a second the signal voltage falls to its normal level - as long as the level switch is closed - to turn the warning off again. With positive feedback from the output to the reference input the IC switches on and off very rapidly - no dying sound.

It worked, but I still didn't like the buzzer, and LEDs coloured red when they are off are not very easy to see in direct sunlight when they are on. I found an electronic sounder on eBay which is much smaller than the buzzer and allows me a lot more space for electronic components. I also selected a different LED - a very much brighter, narrow angle water-clear type which is very easy to see come on even in direct sunlight. That all worked fine on the bench, but when connected to the roadster I found that turning anything on caused the alarm to sound briefly, and when cranking it was squawking like hen with a fox in the coop. That is almost certainly caused by the large spikes generated when any conventional electric component like incandescent lights, motors etc. is turned on and off. So I add a large electrolytic capacitor across the 12v supply leads, which stops everything but the cranking interference. That is annoying, but my ignition switch has the accessories contact that disconnects during cranking, so powering the electronics from here solves that problem. But only eventually, because when I first connected it to the accessories circuit it did exactly the same thing as on the ignition supply. Investigating the wiring of the ignition switch revealed that two wires were swapped over, so the white that fed the overdrive was on the accessories circuit, and the accessories wire was on the ignition! I'd never dug into those wires, so it must have been like it for years, maybe from the factory. With that corrected the only minor drawback is that as I turn the ignition key the circuit is powered up from the accessories and ignition circuits, is disconnected while cranking, then powered up again as I release the key, so sometimes I get two self-check beeps. But that's a minor inconvenience. It's installed on the side of the centre console, at the top, with double-sided sticky tape, angled such that the LED is pointing straight at me.

At one point I bought a couple of after-market warning lights - one with a brake symbol and one with an oil can for an oil pressure warning light. However they weren't very bright, certainly no good for the roadster with the top down and the sun shining, so didn't use them. But eventually I worked out how to prise the lenses out without damage. Underneath is a standard red LED (behind an red lens, orange behind orange for the oil) with dropper resistor to operate off 12v. These old-style coloured LEDs are not very bright at all, and the lens reduces it still further. Interestingly the led/resistor legs had two fine springs pushed onto them, and they fitted onto two spikes which came up from the external terminals of the light unit, making removal and refitting very simple - no soldering. So it was a simple matter to take a super-bright white LED and fit that instead without a resistor, which is inside the electronics module. With the corner of a bit of square, black plastic drain down-pipe I fabricated a mini-panel to hold both, which simply pushes into the gap between the dash and the crash-pad. Much brighter than before, it's only in full direct low-level winter sun that the light becomes less easy to see. Not a problem as that has an audible warning as well.

After-market warning lights modified with superbright LEDs: Visible from the driving seat, off ...

... and on in bright but not direct sunlight.

However less visible in low direct winter sun - off on the left, illuminated on the right. Maybe a cowl? They are angled towards the driving position.

First fitted over a year ago, and it's been working fine ever since, and the fluid level hasn't dropped enough to set it off. Also no apparent change in the polypropylene float or other plastic components. Time to make one for the V8 as well. Going back to the squawking problem I thought that if I ran the electronics at a lower voltage, I could get them to ignore the voltage fluctuations caused by turning other circuits on and off. So got another set of components on a bread-board, powered those from 12v, and tested it on both cars to confirm I was still getting the unwanted son et lumiere which I was. I found a data sheet for the IC I was using which said it operated from 4 to 15v. I had a 5v zener diode and used that with a suitable resistor and capacitor to produce a regulated and smoothed power supply to power the electronics. It didn't work with the resistor values I had originally chosen, which didn't surprise me as now it was running at less than half the voltage. But try as I might I just could not get the circuit to switch, no matter which of the input voltages was higher than the other. I wondered if I'd blown the chip so put it back to 12v and the original values, and it was fine. Much pondering, head-scratching and testing, but no change. Until I suddenly wondered if a higher supply voltage might make a difference. Upped it to 6v - and it worked perfectly! The data sheet I had found was for a chip of that number, but from a different manufacturer, obviously mine needs a higher supply voltage. So I used a 7.5v zener diode which I also had in stock, to give something of a safety factor. After that it was relatively easy to find a set of resistor and capacitor values to give me the required switching and self-check beep. Back on the cars, no interaction at all on the roadster including when cranking, and on the V8 just a tiny flick of the LED (but no buzz) when cranking, so a result. By upping the power supply smoothing capacitor from 10uF to 22uF even the V8 flick on cranking was eliminated.

The sounder I'd used in the roadster circuit was for 12v, but as I was planning to run it at a lower voltage I bought a 3v version. I could have used a 6v, but the connections are easier running it in series with the LED, that needs a series resistor anyway, and 27 ohms in series with the LED and the sounder gives the correct voltage and current conditions for both. That all fitted neatly in the same sized box as before, and the next job was to design the component layout on strip-board. That proved easier than the first circuit, with less linking and strip-cutting. I did need to buy a second 22uF capacitor as I only had one in stock. Normally I get my components from Maplin as we have a shop locally, but the last two times I've ordered stuff online for collection, shown as available in that store, but they have then said they don't have them. So ordered them from eBay - cheaper - but when they arrive I find that instead of the dumpy type that I already have they are taller and narrower and won't fit in the box standing up. Fortunately there is enough room around the other components to lay them over, so building proceeds. When complete I bench test - and the buzzer and LED are on all the time, even when I simulate the switch being closed. I'd built the circuit-board version using the same components that had tested OK on the bread-board, precisely to avoid problems with different tolerances of different sets of components. I wondered if I had damaged the IC from heat by soldering it direct into the strip-board, which I had to do to make space for the laying down of one of the capacitors. Testing the voltages at the IC pins in both switch open and switch closed modes I found that touching the meter probe on one of the pins was enough to cause it to switch off, and removing the probe it stayed switched off. Testing the voltages on the two inputs instead of there being a clear difference between switch open and switch closed, as I thought I had done on the bread-board, I found the switched input voltage was only fractionally lower than the reference voltage, when it should have been about 1v lower, so it looked like a marginal signal voltage problem. Fortunately the input resistor was accessible, and relatively easy to swap for a lower value to give a bigger voltage differential, and all was well.

I had pondered what to do about the connections to the electronics - a 12v and earth supply pair, and a switch pair. The first two were easy - just a length of 2-wire coming out of the box with a piggy-back spade on the 12v and a ring-terminal on the earth, going to the instrument voltage regulator which has a fused ignition supply on the B terminal and earth at its mounting screw. But the other two were a problem - I need some kind of connection that I can connect and disconnect relatively easily. I can't cable direct from the electronics to the float switch as one or other would then have to be pushed through the bulk-head grommet or some other grommet! The large grommet behind the master is a possibility, but I'm not keen, as it would also mean cutting a hole and slot in that for the cable. I could have a pair of wires coming from each and solder them together behind the dash, but that would mean cutting them if I needed to remove either switch or electronics. Individual bullets would be OK as long as I got the polarity correct (to keep the lower reed contact at earth). I had already used a 2-pin plug and socket on the short tail from the float switch, and made up a length of 2-wire with a matching socket for the electronics end, but they wouldn't push through the grommet. I can push the cut end of that through the bulkhead grommet into the cabin, but that still left me with the problem of how to connect to the electronics, and would need a second method of connection. I settled for a small 'chocolate block' connector attached to the back of the electronics box, which means I still have to be careful about polarity. In hindsight the best option would have been to have a long tail from the float switch with a crimp bullet on one wire and socket on the other (to maintain polarity) which would be easy to push through the grommet and be in the relatively benign environment of the cabin, and a matching socket and bullet on another tail from the electronics. But there we are.

On the roadster I had stuck the box of electronics to the side of the centre console, at the top, where the LED can be angled towards me. But on the V8 with its wider binnacle the same place is concealed by the binnacle. And a bit lower is concealed by the solid spoke on the wheel in the straight-ahead position. Further down on the side of the centre console is unobstructed, but moving further away from line of sight, so I opt to stick it on top of the column cowl, alongside my coolant level warning. A bit of a mish-mash with the coolant level warning, which was only ever intended to be a temporary thing while I had a cooling system problem. I fixed that years ago but could never bring myself to remove it. However the area above the cowl on both cars does lend itself to positioning various warning lights, I have in mind a purpose-built narrow housing that fits under the dimmer rheostat and between the main dials, and would include an oil pressure warning light as I have on the roadster. Just for the LEDs, the electronics would be elsewhere to keep it as small as possible. The coolant level warning has three red LEDs as at the time high-brightness ones weren't available, are now in 'water clear' packages so only one would be needed.

First time out it does what it is supposed to, but as we arrive at our destination and switch off I think I hear a slight noise, which could be from the buzzer as the power is cut. Back home when switching off I don't notice it, but turn the engine on and off a couple of times while looking at the LED, to see a very brief flick but no sound (the same thing happens with my alarm LED when I turn the main power switch off). That's fine, but on the second switch-on instead of the normal self-check beep it barely makes a noise! Rapping it with a knuckle during the beep phase makes it sound correctly, so it sounds like an iffy buzzer. However next day when everything is cooler it's back to working normally again, so it sounds like a heat thing. Subsequently I change the buzzer, and in some pretty warm weather it sounds as it should.

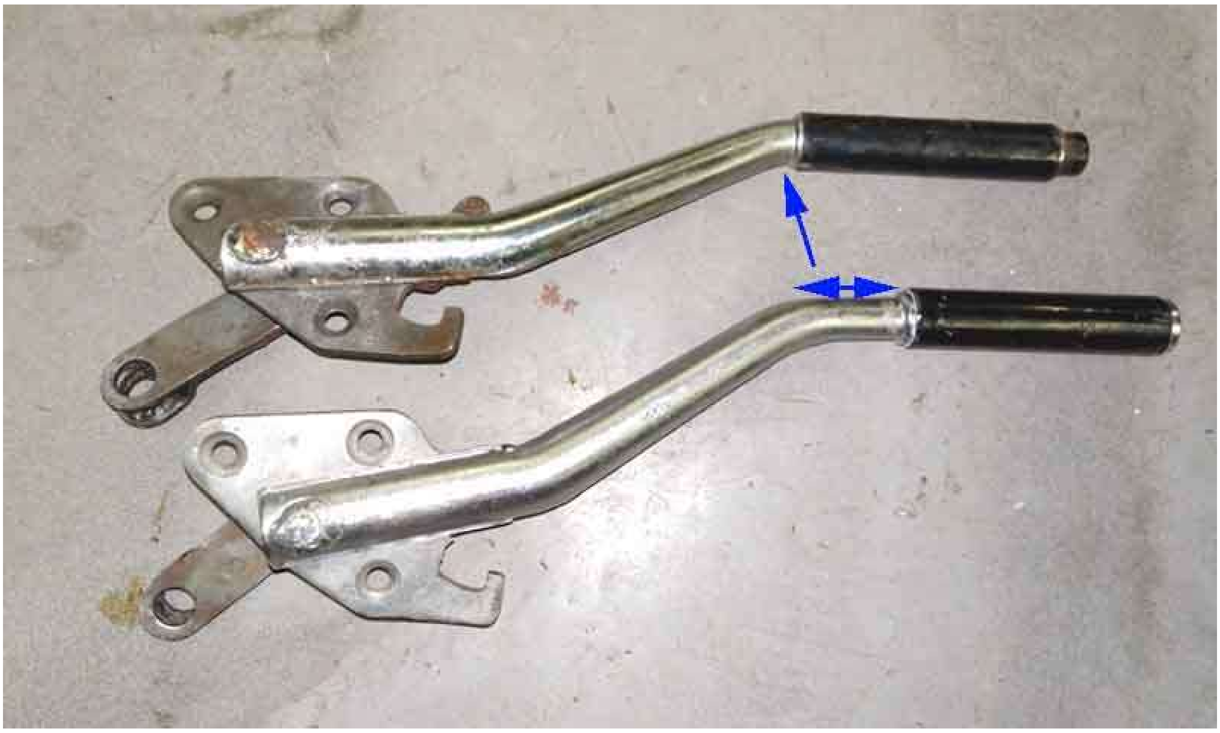
Eventually I do add an oil pressure warning light to Vee and even though the additional warning LED is quite neat in itself the three together are a mess, and even more eventually I get round to making a panel just for the warning lights and put the electronics behind the dash.

Brake fluid conductivity: As mentioned above some brake fluid I tested did conduct as shown on an ohmmeter, however how much of this is due to the fluid itself and how much to any moisture it might have absorbed since I bought it I didn't know. There are many home-use brake fluid testers about which do use conductivity to measure moisture content, however this Brake Engineering page warns against their use. Fluids vary in their conductivity depending on whether they are DOT3, 4, 5 or 5.1 and also between manufacturers. So unless the tester is calibrated for a specific fluid, the indications can not be relied upon. Brake Engineering says that only by measuring the boiling point can you accurately gauge moisture content, and that is a pretty specialised piece of kit.

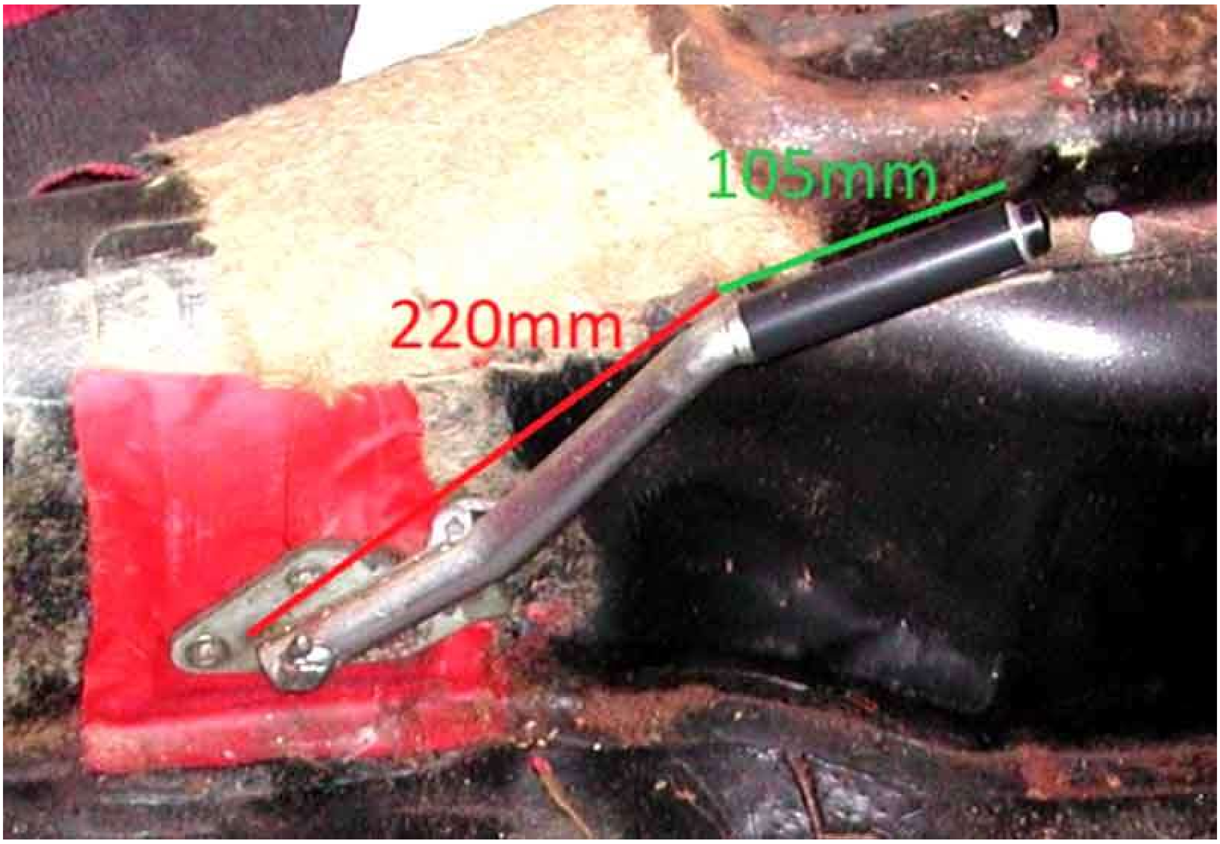
Handbrake Cabin Lever

Adjuster

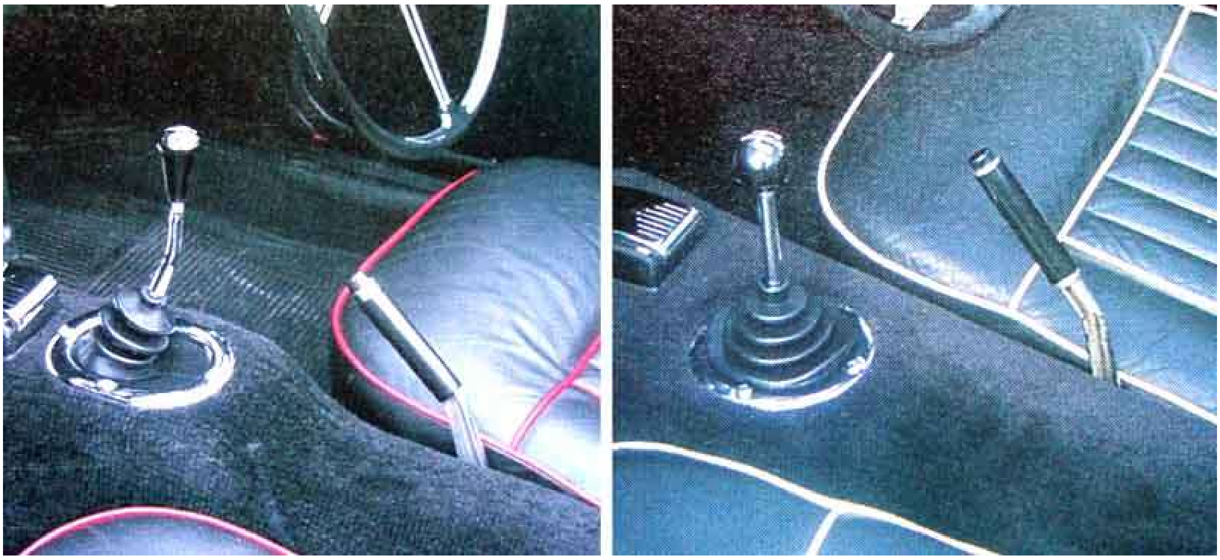
Two cabin levers posted by Colin Parkinson on the MG Enthusiasts forum. The top one is the 'short' lever where the tube bends right at the end of the grip, whereas the 'long' lever has about an inch of additional tube between the grip and the bend:



Dave O'Neil's 'short' lever and Mk1 tunnel in the same thread, an overall length of about 325mm or 12.8":



'Short' on a 64 (Mk1) and 'long' on a 68 (Mk2), changing at chassis number 115596 in March 67: (Clausager)



A 64 (Mk1) and a 68 (Mk2) both pointing pretty-well straight forward: (Clausager)

A 73 cranked to the right to clear the tunnel console, changing at chassis number 258001 for the 1972 model year, albeit on an LHD: (Clausager)

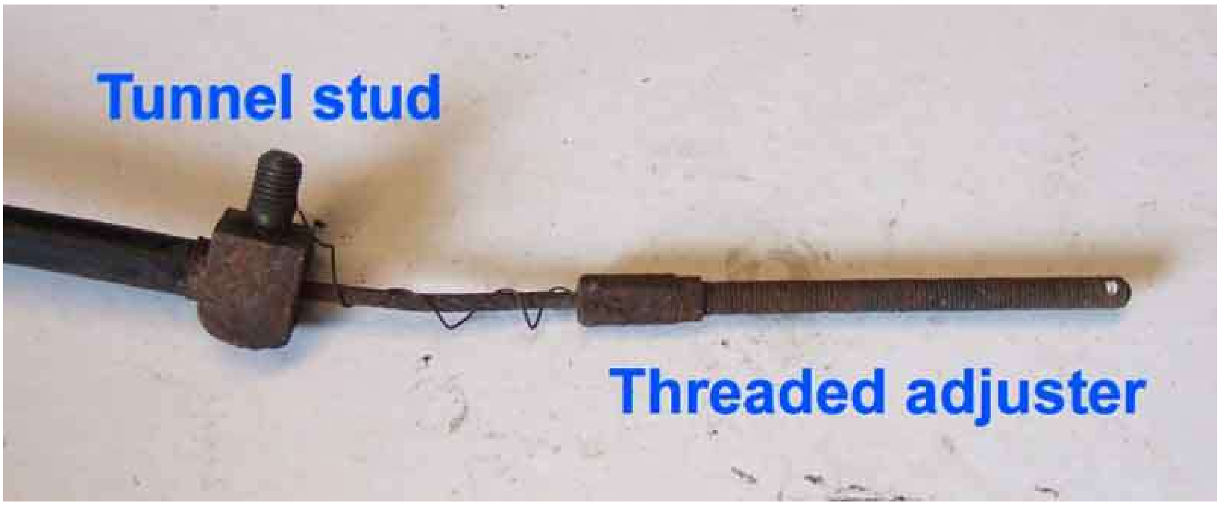
Bee (73) and Vee (75) both cranked to the right, albeit Vee's more noticeable:

Bee's CB 'long' chrome lever measuring about 13.75":

Vee's RB 'long' lever painted black instead of chrome-plated. It appears the grip is longer covering what was the chrome trim ring just under the button of Bee's. Maybe the grip has slid up the tube a bit, but it doesn't interfere with the button:

Adjuster:

An old cable showing the stud that goes through a reinforced section of the tunnel to secure the outer (left), and the threaded adjuster rod:



The handbrake assembly has a lever (BHH1469) in the tunnel that is similar to the compensation lever on the diff casing, but the two halves are welded together: (*Brown & Gammons*)

Trunnion AHH5322 (left) and brass adjuster nut ACH5104: (*Motaclan/Leacy*)

The trunnion (26) fits in the two holes of the handbrake lever (37) (it can fall out when removing or refitting the cable and roll some distance!), the threaded section of the cable fitted with a 1/4" x 3/4" washer (28), an expanded spring (24) and another washer (27) is passed through the fitted trunnion, and finally the adjuster nut (25) is screwed on: (*Brown & Gammons*)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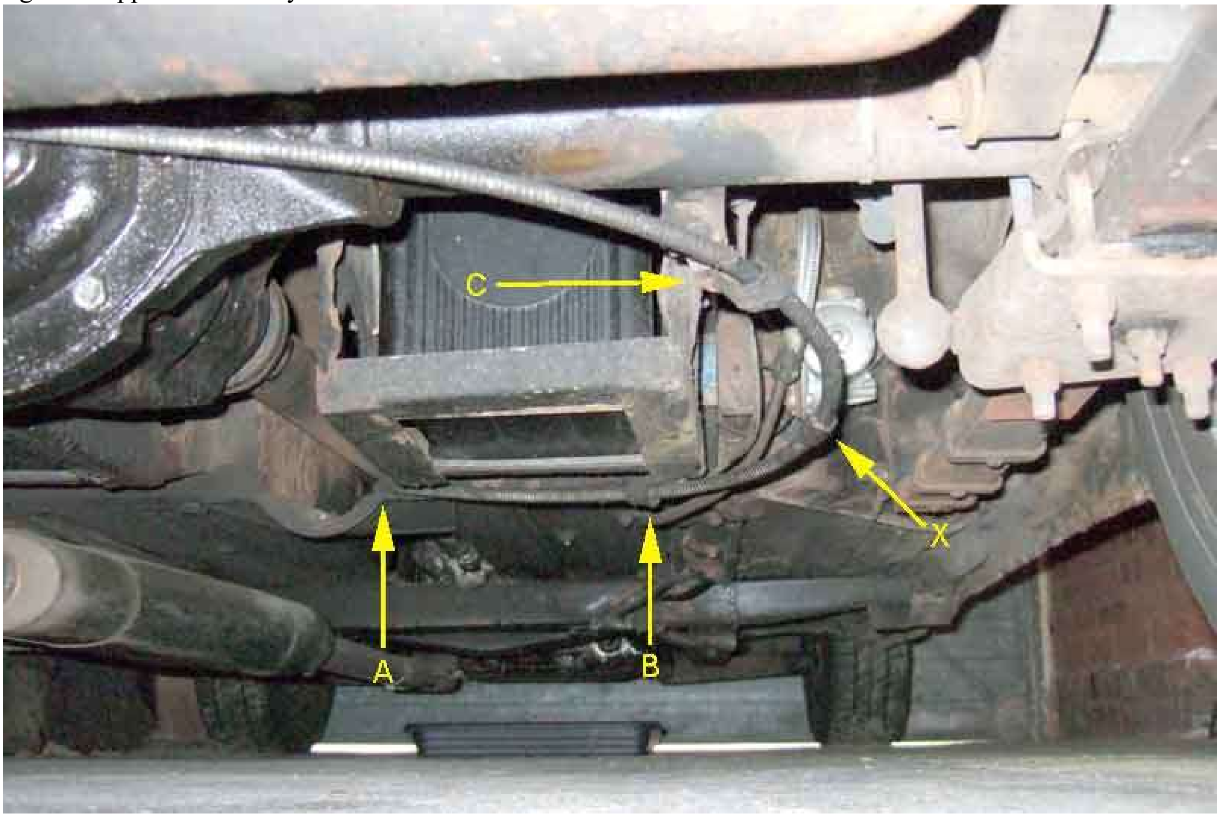
Handbrake Cable

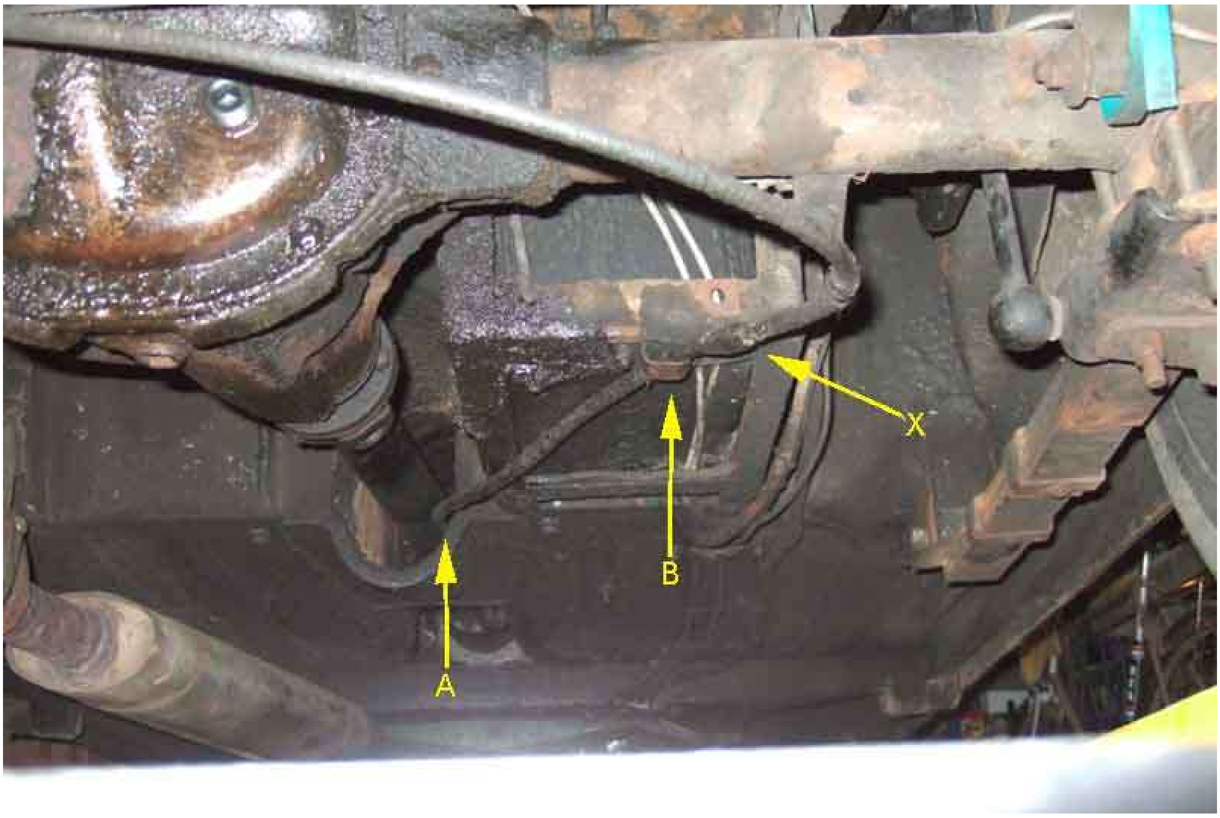
[Clearance to wheel weights](#)
[Compensator](#)
[Adjuster](#)

Cable Length:

Late chrome bumper: The cable exits the prop-shaft tunnel A, with two mounting points B (battery box) and C (axle tube), and the grease nipple X relatively close to the outside of the car.



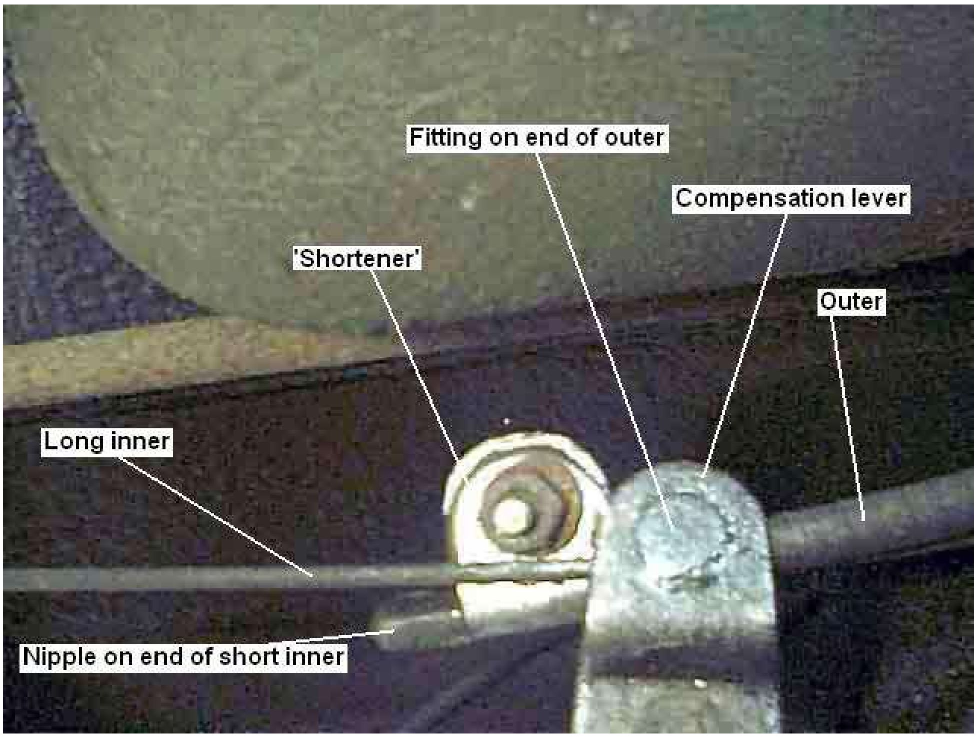
Early rubber bumper exits in the same place but only one mounting point B and the cables are about 8" shorter. This would put the grease nipple much further underneath the car, but originally they didn't have one. This is the longer CB cable on an RB car so makes the routing less than ideal and puts the grease nipple further away, and the longer cable can flap and hit the tank. Now I've discovered the difference I'll probably reposition the existing bracket as per the CB car and add the second bracket, which should make the grease nipple more accessible as well support the cable better. It can easily be reversed as and when I need to fit a pukka RB cable.



Cable Stretch:

An old stud-wheel cable measuring 30" from the tip of the nipple in the short cable at the compensation lever end, to the tip of the U-clip that attaches to the lever sticking out from the back-plate. A new, almost certainly wire-wheel axle cable measures 28.5" here.

A 1" 'shortener' fitted between the nipple and the fitting on the end of the outer sheath at the compensation lever



Clearance to wheel weights: The cable and lever should not project past the edge of the brake drum:

Leaving plenty of clearance - at least 1/2" - for stick-on wheel weights:

Compensator prior to 1977:

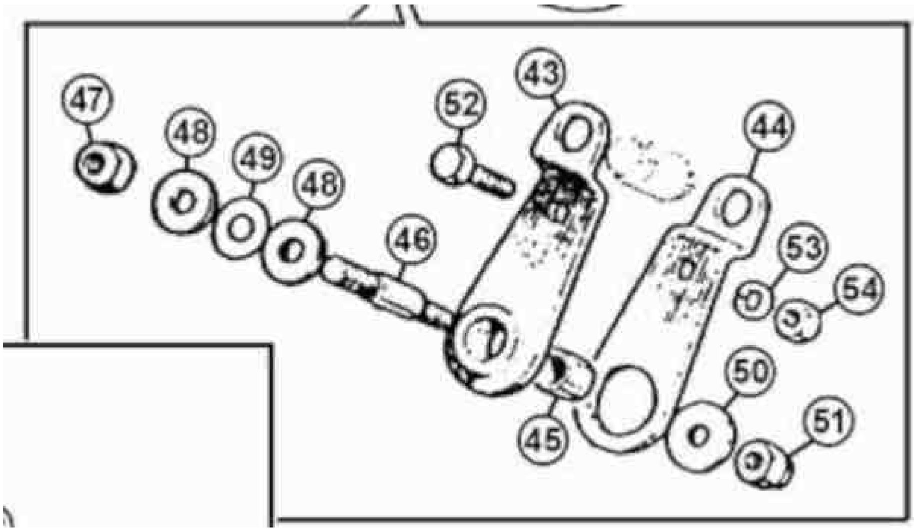
Orientation on Bee - released on the left, applied on the right:


Vee ditto, with shortener hence the compensator points more towards the off-side ... somewhat muckier than when first fitted:

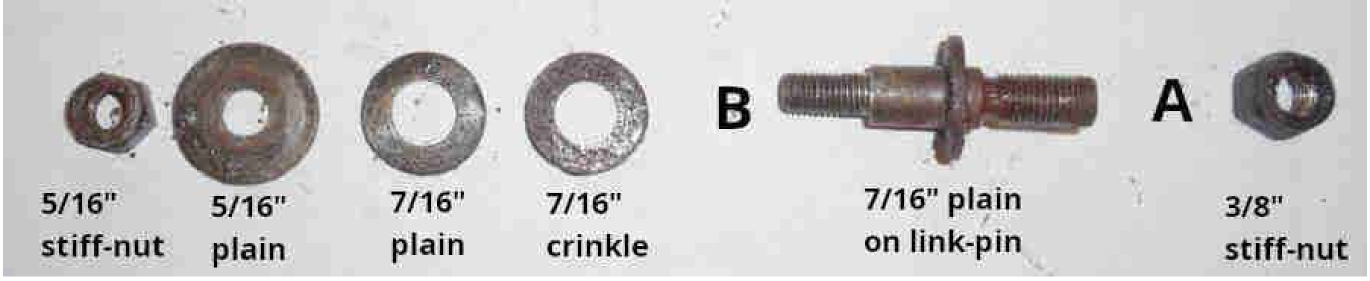
 

Decades later and I've just noticed that Vee's cable trunnion is the other way round to Bee's, putting the end of the outer away from the viewer on Bee and towards the viewer on Vee - I've changed both at various times. Pictures elsewhere show it both ways, but as Vee it allows the outer to drop away from the short cable as it goes under axle, whereas the other way round they can rub together.

Compensator components as shown by Moss Europe (Brown & Gammons and the Leyland Parts catalogue drawings omit several washers). The two halves of the compensator lever 43 and 44 are clamped together by the screw, lock-washer and nut 52, 53 and 54 around the trunnion (shown faintly between 43 and 44 and should be free to pivot) on the cable outer at one end, with bush 45 at the other end of the two halves. This assembly should then pivot freely on the 'link-pin' 46 when the stiff-nuts 47 and 51 have been tightened:



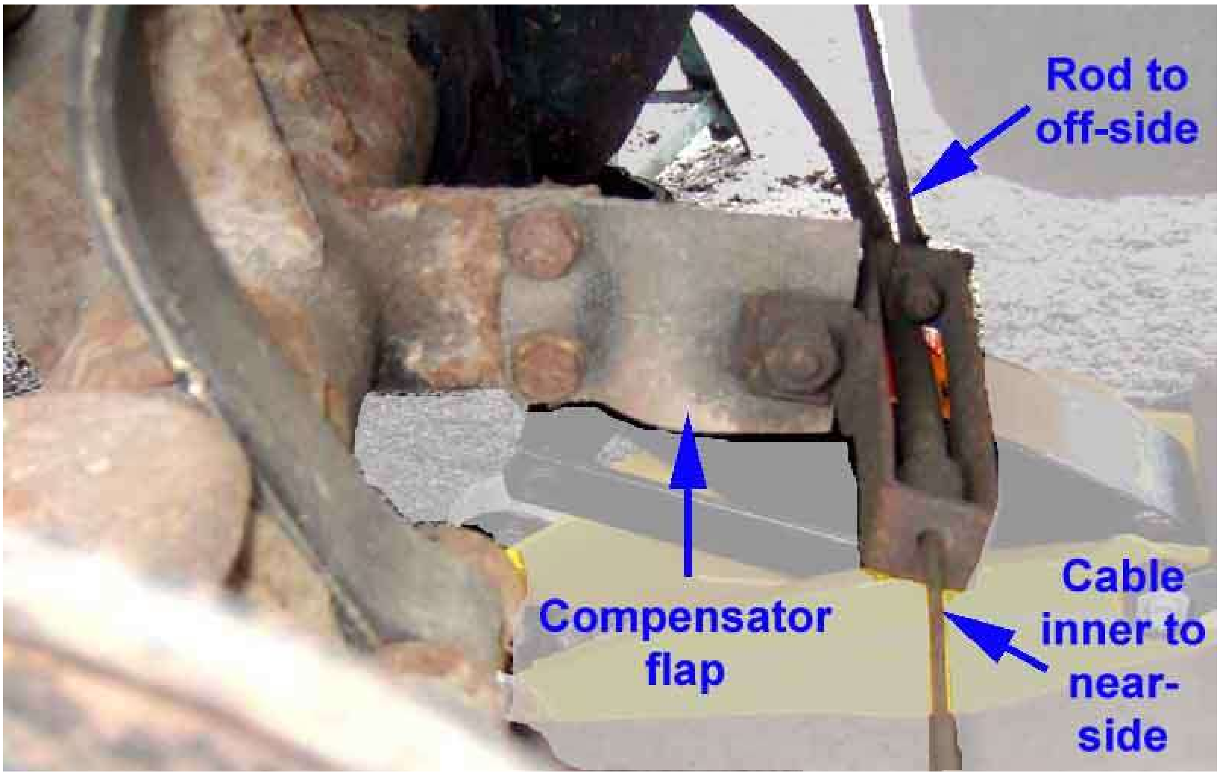
Not even that shows the full story though as using the key and part numbers the parts are shown in the wrong places. The larger thread on the link-pin screws screws into the diff bracket positioned at 'A' the plain section flush to the bracket, with the larger 3/8" stiff-nut LNZ106 behind it as a lock-nut. One of the larger 7/16" plain washers GHR303 has been slid onto the link-pin ready for the lever assembly and bush which goes on next at 'B'. Then the 7/16" crinkle washer AWZ107 and other 7/16" plain washer go on the plain section of the link pin, then the 5/16" plain washer PWZ205 butts up against the shoulder on the pin, and finally the 5/16" stiff-nut LNZ105:



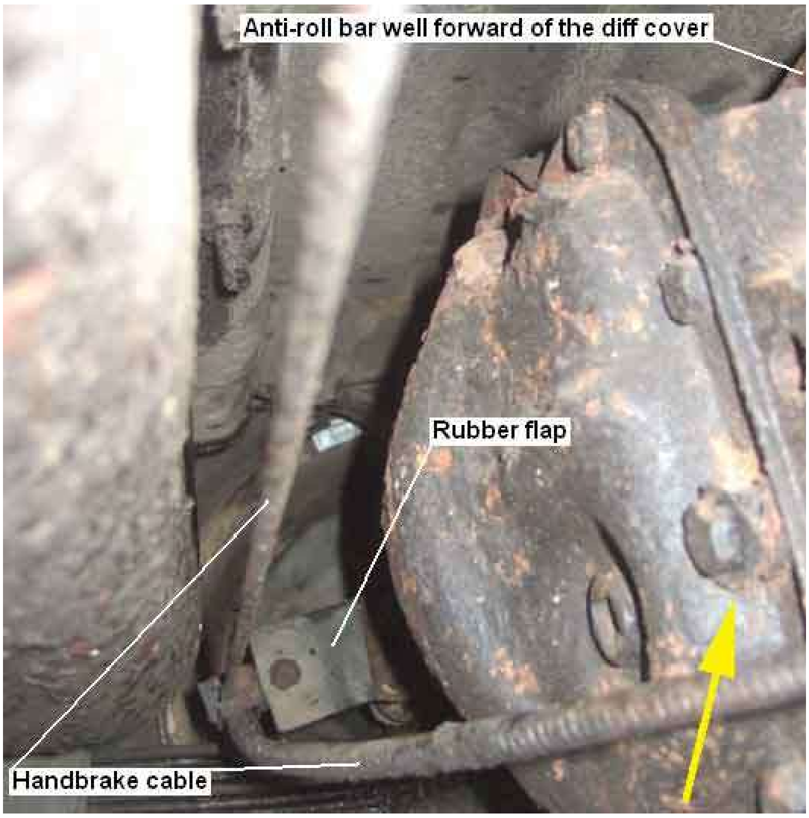
If the 7/16" washers are too thick, or a 7/16" washer is used in the outer position in place of a 5/16", tightening the nuts will quite likely jam the compensator lever in position preventing the off-side wheel being braked by the handbrake, or even worse locking it on. If slackening the visible nut frees the compensator up then that is what has happened. The same will happen if the compensator bush is seized to the link pin, but in that case only if the nut behind the bracket is left slack will the compensator be free to move, which allows the link pin to wobble about in the bracket wearing both parts.

Compensator 1977-on:

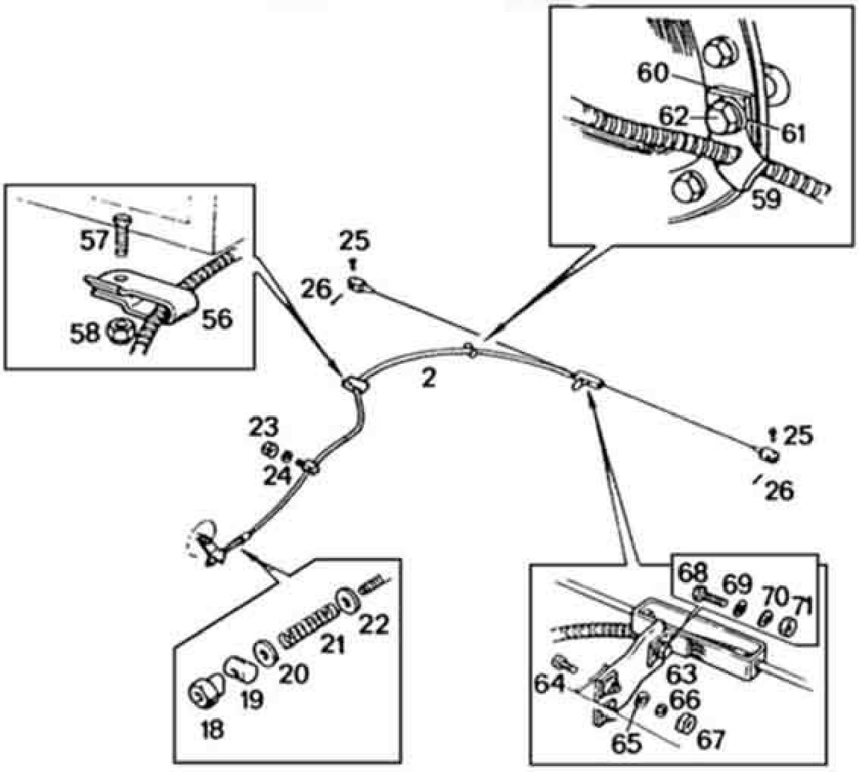
Showing the rubber flap attached to a flange on the axle casing, to which a bracket on the handbrake cable is attached. The rear pivot and mounting for the anti-roll bar can be seen on top of the axle casing (top left), but other than both being attached to the tube in adjacent areas the two are entirely separate.



Showing the rear of the diff, where the handbrake pivot used to be, with the anti-roll bar well out of the way.



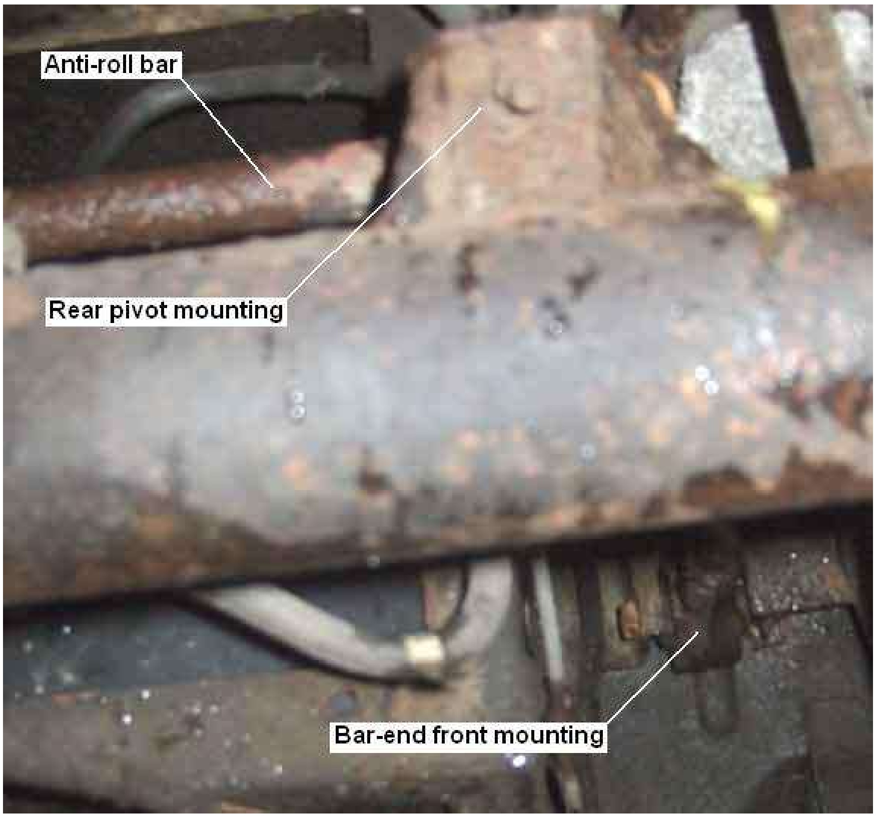
November 2016: It was only when someone asked a question about an additional support for this cable that I realised something is missing from my pal's car. There should be a rubber strap (BHH2136) through which the cable passes, attached to the diff cover bolt to the right of the level/filler plug in the above image, and indeed there does seem to be the spacer and remains of the strap under the bolt (arrowed). The [Moss Europe image](#) below shows how it is used (item 59). This strap deteriorates rapidly and apart from the bit under the bolt and washer may well vanish. Lack of it does not affect handbrake operation, but may allow the cable to rattle against the axle.



The strap has a cut from the middle-sized hole for the cable towards the large hole for the fixing bolt, ending at a small hole, and this slot should enable the cabin lever end of the cable with the tunnel stud on the outer to be passed through for retrospective fitting. However that does need the cable to be disconnected from the cabin lever and tunnel, and the support under the battery box, to fit from that end: *Motaclan/Leacy*

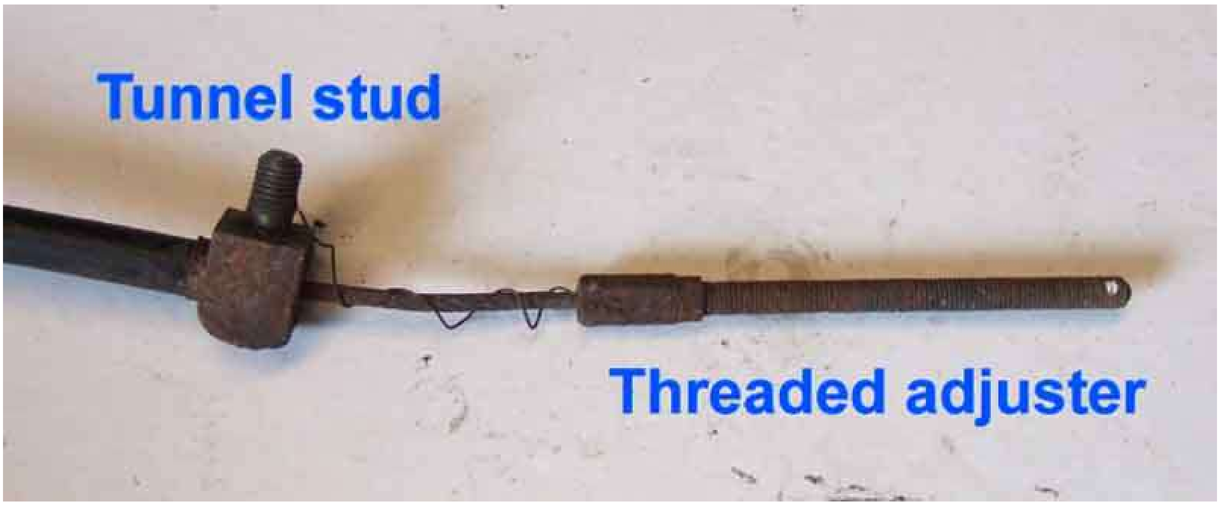
I've seen claims that the strap can be fitted over the 'box' that is at the end of the outer which needs the near-side clevis pin to be disconnected as well as the screw between the box and the flap. It's also going to be a bit of stretch to get the box with its tab for the compensator flap through the cut in the strap. I've also seen a claim that the box doesn't always have the tab that attaches to the compensation flap, or the flap on the axle, but that seems unlikely as it would mean the cable is unsupported at that point, other than from the strap, which would be subjected to the cable flapping up and down when under-way. And when the strap fails - which they do and was what started off the thread on the MG Enthusiasts forum - the majority of the cable will be unsupported and flapping up and down.

Showing the anti-roll bar, rear pivot on the axle casing, and front pivot mounting point on the body.



Adjuster:

An old cable showing the stud that goes through a reinforced section of the tunnel to secure the outer (left), and the threaded adjuster rod:



The handbrake assembly has a lever (BHH1469) in the tunnel that is similar to the compensation lever on the diff casing, but the two halves are welded together: (*Brown & Gammons*)

Trunnion AHH5322 (left) and brass adjuster nut ACH5104: (*Motaclan/Leacy*)


The trunnion (26) fits in the two holes of the handbrake lever (37) (it can fall out when removing or refitting the cable and roll some distance!), the threaded section of the cable fitted with a 1/4" x 3/4" washer (28), an expanded spring (24) and another washer (27) is passed through the fitted trunnion, and finally the adjuster nut (25) is screwed on: (*Brown & Gammons*)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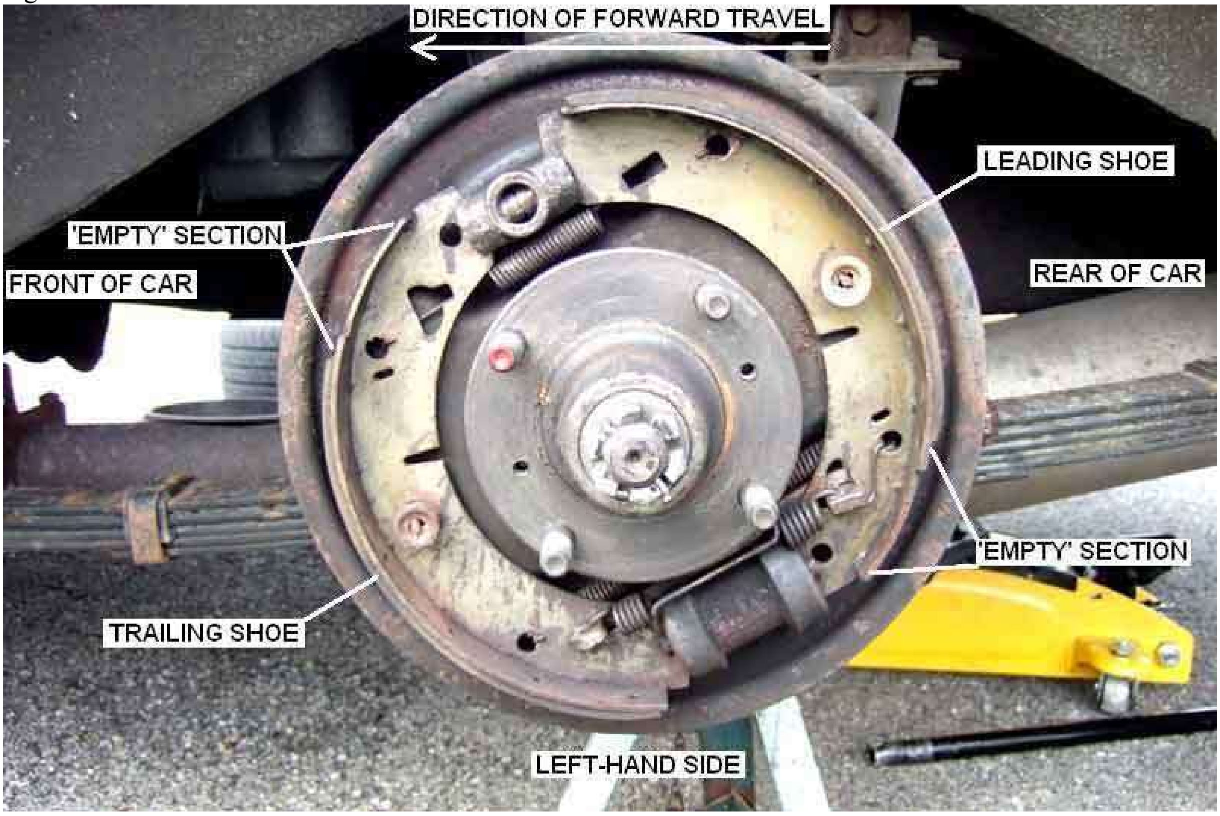
Rear Brakes

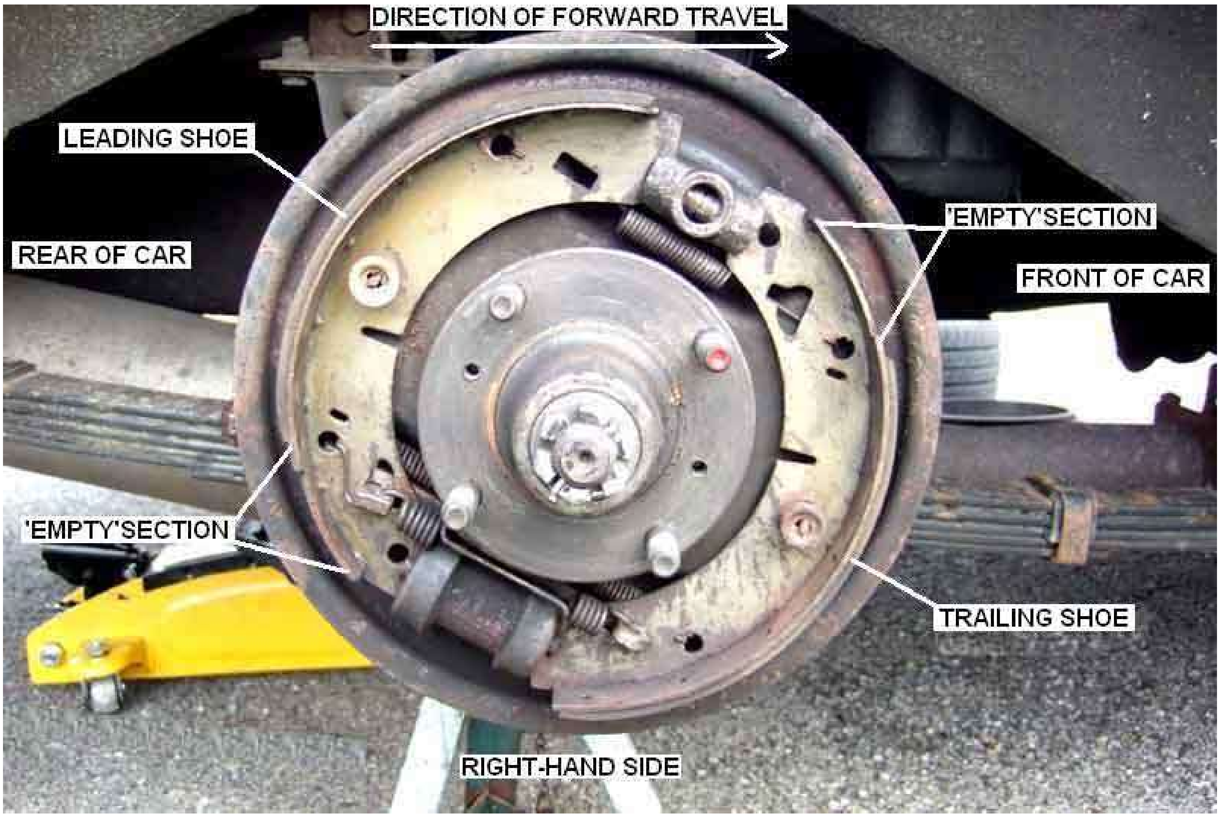
Shoe Orientation Handbrake Levers Springs Adjuster

Shoe Orientation:

Left-hand side. A given point on the drum will pass over the 'empty' portion of the shoe first, on both shoes, when travelling forwards:



Right-hand side ditto:



Handbrake Levers:

[Banjo axle](#)

Early lever (top) with the short lever with a curved profile, and about 1" shorter than the later lever. Other than that the long lever has exactly the same profile on both types (note extension circled) ...

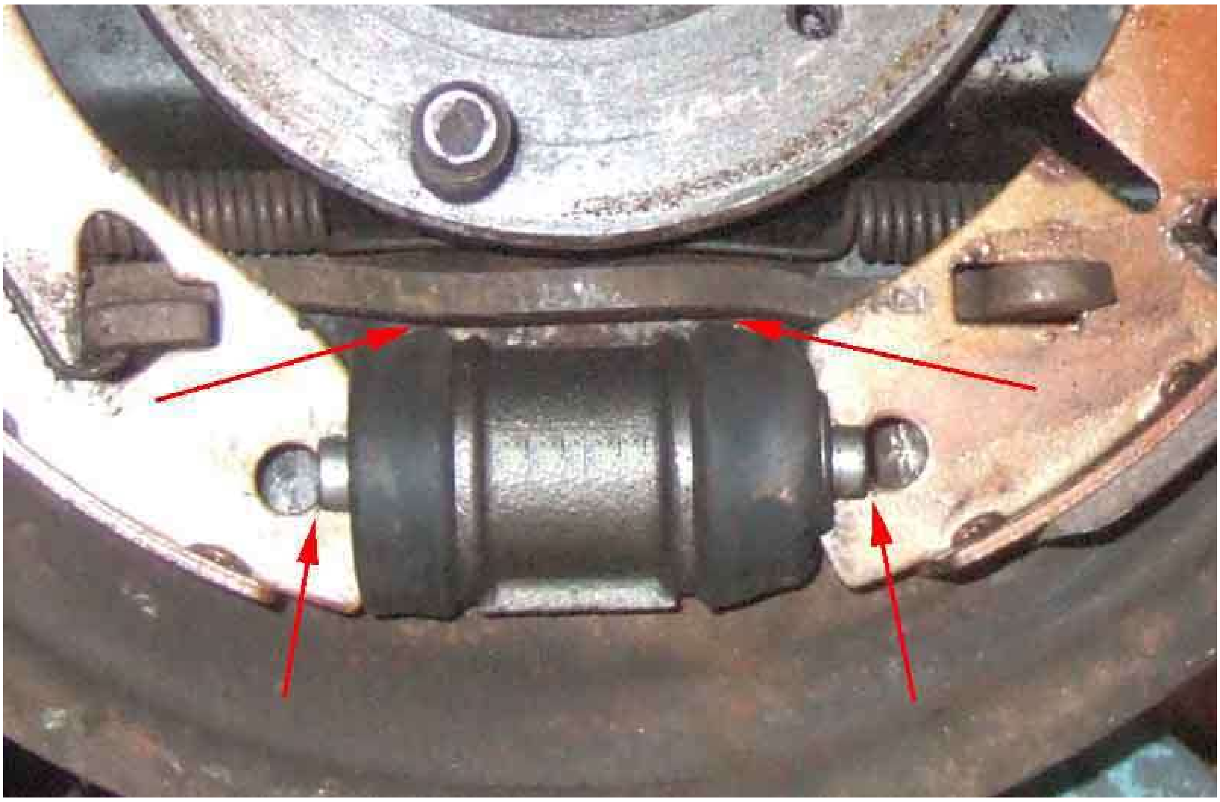
... and the same bends.

A pair of the same type have mirror-image bending of the long levers ...

... but identical short levers, they are just fitted to the other side of the long lever. That is why the numbers stamped into the short levers are the same for both sides, and when installed one faces up and the other down. (Circled is the waisted section where the slot in the rubber boot is pushed down to when fitted).

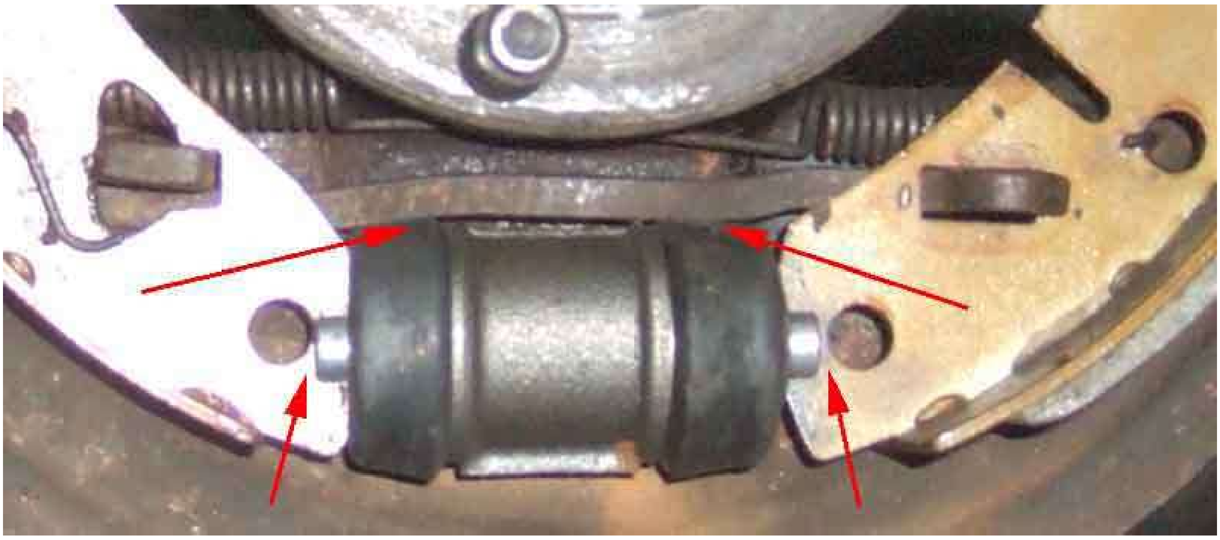
Toni Kavcic's original (short lever detached) on top, new one below, both being for the right-hand side. The excess material on the long lever of the new item was fouling the back of the rear shoe and holding it further out such that the drum could not be refitted, even when the levers were installed the correct way up i.e. long lever above short lever.

Salisbury/tube axle: Installed correctly the long lever has one kink so it is lifted away from the slave dust-cover (right arrow), and another to further lift it over the short lever (left arrow). This allows the shoes to sit such that the holes are pretty-much in line with the slave pistons. Notice also how the holes sit just inside the slots in the pistons.



Looking from the backplate side (placed in a drum), installed correctly the projection at the pivot end of the long lever just clears the back of the shoe (arrow) and the ends of the shoes are about the same distance apart.

Installed incorrectly (before fitting the third spring) the long lever turns down to lie on the slave dust cover (right arrow) then turns further down (left arrow). This lifts the shoes up - holes in shoes are now above slave pistons - and forces them out - the holes are now pushed away from the slots in the pistons, and both of these aspects can prevent the drum fitting over the shoes. The rear shoe doesn't want to sit flat against the back-plate, and the long lever binds on the slave dust-covers making handbrake operation stiff and weak.



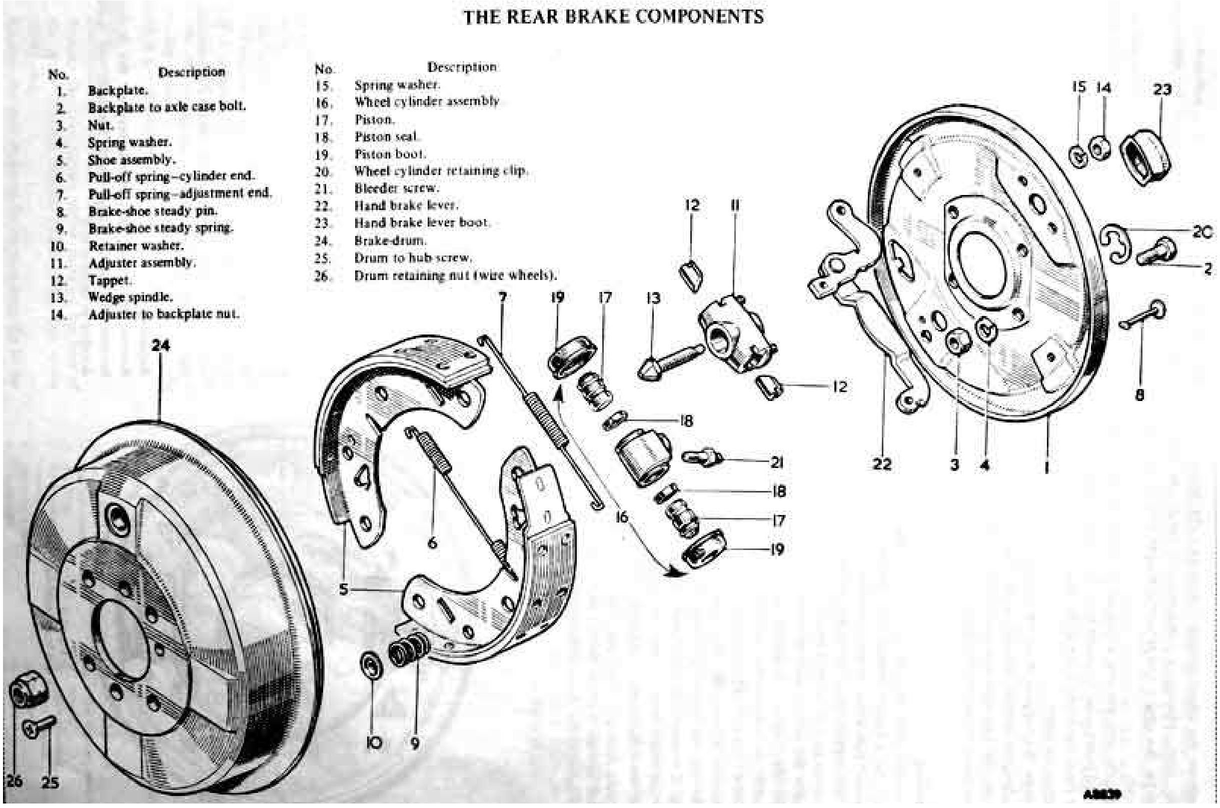
Installed incorrectly the projection at the pivot end of the long lever fouls the back of the shoe (arrow), pushing the tops of the shoes closer together and the bottoms further apart, and pushing the rear shoe away from the short lever.

Installed incorrectly because the pivot end of the long lever is pushing the rear shoe away from the short lever, there is a huge amount of free play in the short lever (unfortunately I didn't notice the poor focus until after everything was back together on the correct sides). All of these issues are exactly the same with both the early and the later levers, when the levers are incorrectly installed with the short lever above the long lever. All of these aspects are exactly the same no matter which lever type is fitted to the axle, which is a Salisbury in this case:

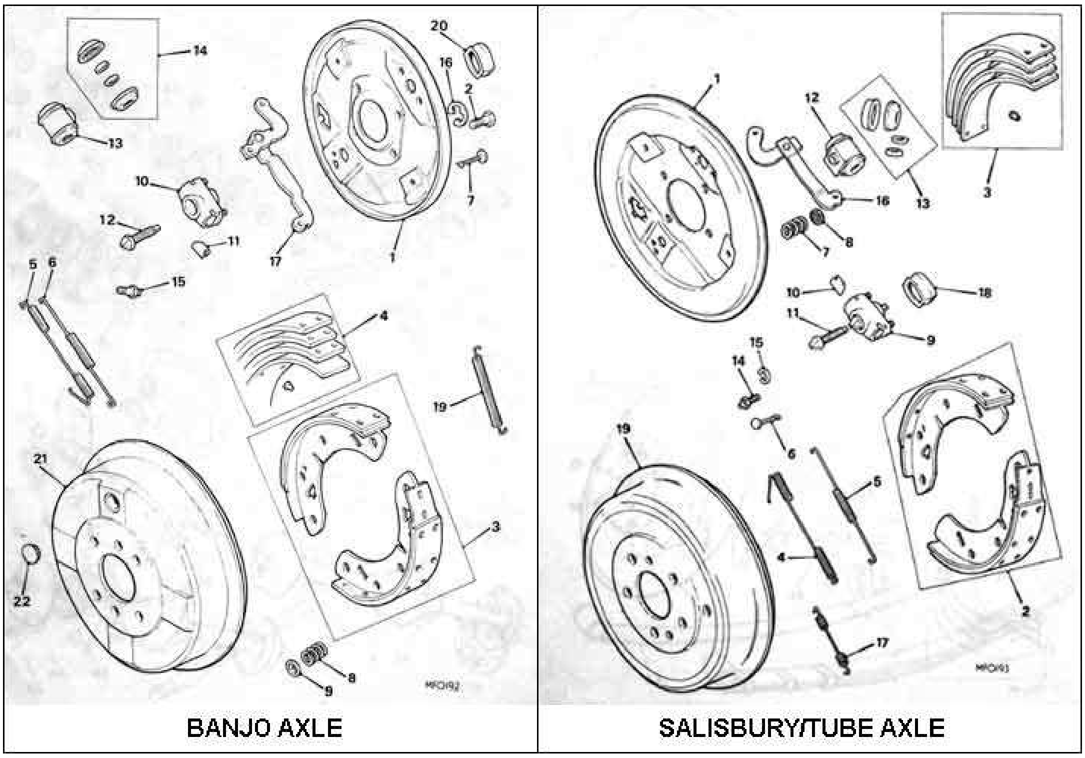
But what about the banjo axle? John Eklof has done the same tests with the earlier levers on the banjo axle and found the same thing, but several sources are incorrect. Drawings from the Leyland Workshop Manual, Parts Catalogue, and Moss Europe at least all show the banjo lever to be the other way round to the Salisbury/tube axle lever i.e. long lever **below** the short lever. But this MGOC page (about sleeving a banjo axle to cure a hub oil leak) has pictures that clearly show the long lever above the short:

It's complicated by that page being about a repair done to an MGA, with a rear brake arrangement identical to the Salisbury tube axle on the MGB, whereas other sources show the rear brake arrangement on an MGA as being completely different to the MGB having a sliding wheel cylinder with only one piston, the handbrake acting on the cylinder and not the shoes. Then again yet more sources talk about converting the MGA rear brakes to MGB for reasons of cost, and MGB banjo parts do show the levers acting on the shoes, so at the end of the day the levers must be the same on both banjo and Salisbury/tube.

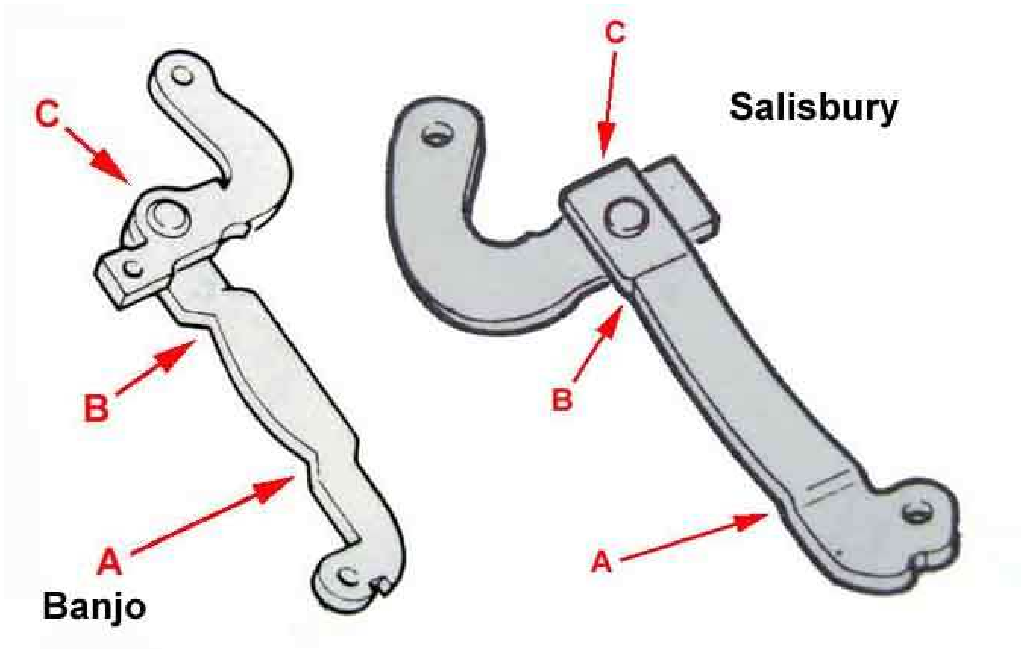
This from the Leyland Workshop Manual clearly shows the long lever below the short lever, with the banjo brake drum with the large hole in the face. One end of the lower inner spring (6) can't be seen, but the Parts Catalogue indicates it is the same part for both banjo and Salisbury, and so the end with the long wire hook must be in the front shoe. There is a drawing in the Haynes manual that also shows the short lever above the long lever i.e. in the banjo position, but it doesn't show the face of the brake drum so at first sight it isn't possible to work out which axle it represents. Haynes also shows the lower spring with the long end in the front shoe. Neither Haynes nor the Workshop Manual have drawings of the Salisbury arrangement.:



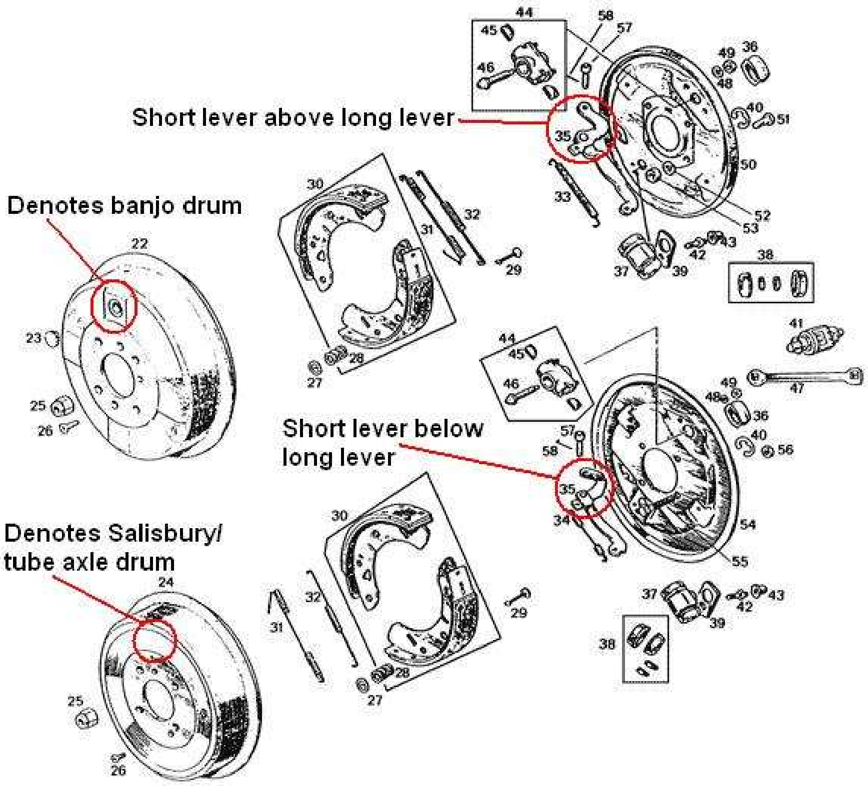
Drawings from the Leyland Parts Catalogue showing the banjo and Salisbury/tube axles. This shows the long lever below the short lever for the banjo axle as per the Leyland Workshop Manual, and above the short lever for the Salisbury/tube axle. On the banjo axle the lower inner spring (5) is orientated with the long end in the front shoe, and shows the handbrake spring (19) with a single long coil. For the Salisbury axle the lower inner spring (4) has the long wire in the rear shoe, and the handbrake spring (17) has two fatter coils. The banjo drawing depicts all the components as if looking onto the right-hand end of the axle, but confusingly for the Salisbury axle the backplate and most of its components are as if you were looking outwards from the middle of the car towards the left hand end of the axle, but the adjuster, shoes and drum are depicted as looking from the right-hand side. Even if this confusion has resulted in the Salisbury levers being shown the other way up, which other parts suppliers have simply followed, it still doesn't explain why the banjo long lever is shown on the wrong side of the short lever:



Detail from the above. Note how the long lever for the banjo axle is kinked up from the front shoe to clear the slave cylinder (A), then back down again to pass under the short lever (B). Neither of the two lever types that I have seen are like this, and there is no extension of the long lever past the pivot at C. Not quite as easy to see but for the Salisbury axle the implication is that the long lever kinks up from the front shoe as before (A), then kinks further up to pass over the short lever (B). There is also the extension to the long lever past the pivot at C. Both lever types in my possession are like this:



Drawings from Moss Europe web site showing the banjo and Salisbury/tube axles. The orientation of most of the components is correct, and helpfully shown from the same (right-hand) side of the car looking onto the shoes, but it still shows the banjo long lever passing under the short lever, and the Salisbury long lever passing over the short lever (circled). This also shows the lower inner spring (31) with its long wire in the front shoe and the handbrake spring (33) with the single long coil for the banjo axle. For the Salisbury axle the long end of the lower shoe spring (31) is in the rear shoe, and the handbrake spring (34) has two short and fatter coils. Moss US only shows the banjo arrangement:



Other suppliers show the levers without any indication as to which side it might be for, some the 'mystery' type and some the later type. However all depict them with (incorrectly) the long lever under the short lever with the exception of David Manners Group, but even that is incorrect as the one shown as being for the left-hand side was actually the one for the right and vice-versa. Motaclan/Leacy goes one further by mixing up the left and the right as well as showing the long lever on the wrong side of the short lever. So if you only purchase one, shop carefully! If buying mail order it will be less hassle to get both even if you only need one ... unless they send you two for the same side.

Springs:

The top spring is fitted to the holes in the shoes and not the slots, and is orientated such that the coil is below the line of the arms of the spring where it sits in a depression in the backplate. Haynes shows the slot being used on one side instead of the hole, and the coil is above the line of the ends so it fouls the bottom of the adjuster. The spring shouldn't foul either backplate or adjuster:

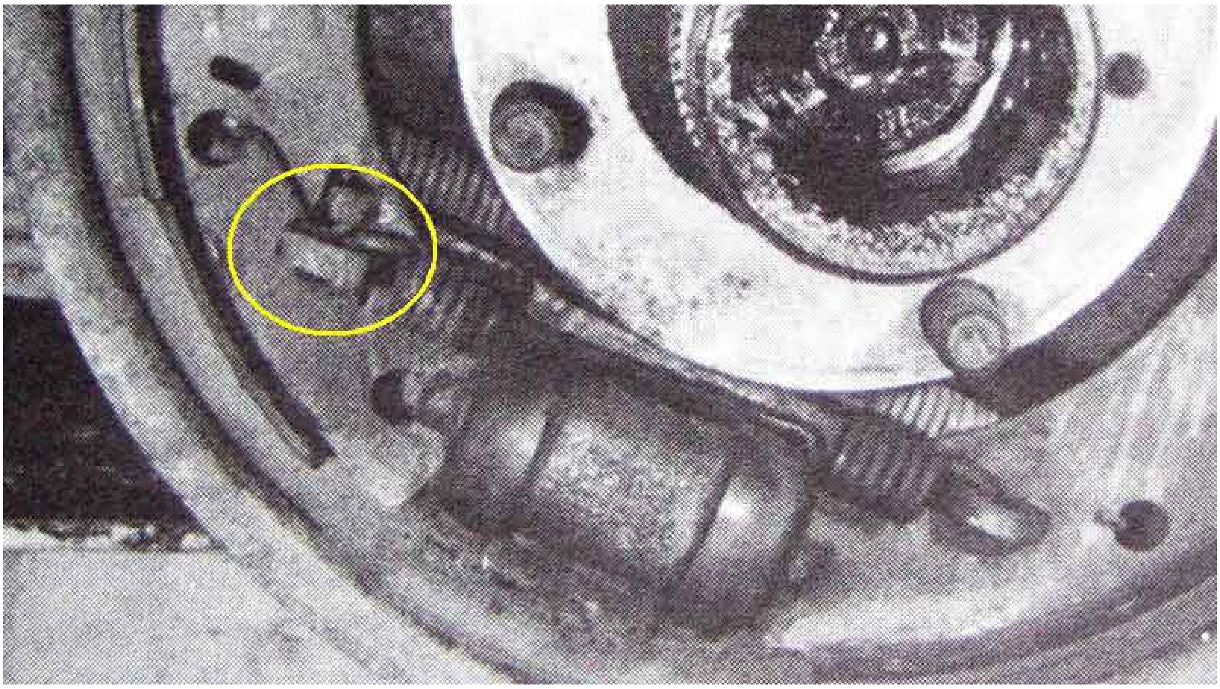
It's always been a fiddle fitting the top spring behind the shoes, I wondered if it could go on the outside, and out of many images showing it behind I came across this one with it like that. I've asked the site owner how that came about and he said that is probably how he found them to begin with. As part of stripping one wheel to replace the handbrake lever boots I refitted that spring on the outside and it was way easier. Drives fine, MOT next month so I'll be able to see if there is any difference between sides. This also shows the lower shoe inner spring on the outside as well (and using one hole and one slot instead of two holes). I don't think I'd do that as that's the one I put in the shoes before offering them up to the brake lever and wheel cylinder as a pair, and that is relatively easy:

Detail of bottom springs showing the inner spring also mounted in the holes and not the slots. The outer handbrake spring goes through holes in the ends of the handbrake lever, with the wire between the coils positioned away from the long lever. Haynes incorrectly shows this in the inner position, where it rubs on the long lever. This is the later spring, the earlier version has a single long coil. The change point seems to have been with the levers, not with the axles as implied by the drawings. Maybe the orientation of the inner spring i.e. whether the long wire end came through the front shoe or the rear, also changed with the levers and not the axle:

I'd never understood why the inner spring has the long extension coming through the rear shoe as in the above picture (Salisbury axle, drawings show it in the front shoe for banjo axles, which may be an error - there are many of them). Haynes shows this correctly using the hole in the shoe and not the slot, but resting on top of the handbrake lever. I've always felt that was wrong as it was easier to fit underneath - until I saw a drawing for Sprites/Midgets that described it as an anti-rattle measure for the handbrake lever, also curled round the lever as I fit it, and [John Twist specifically states it goes like this at 5:05]:

If it **is** an anti-rattle measure then it probably should be above as Haynes shows it for two reasons: One is that underneath the lever is only resting on the spring and there is plenty of free-play in the slot in the shoe above the lever for it to move around. The other is that when underneath the lever is resting on the cut end of the spring, which for moving parts seems poor mechanical practice, and having it above with the smooth loop of the spring pressing against the lever would be preferable, as well as being more effective as an anti-rattle measure. It can be positioned either below or above, although to position it above takes more effort. However with it below there is no tendency of the levers to rattle in the shoes given the third spring on the levers, so there is no point in struggling to get it on top, and no drawbacks to having it below:

Haynes showing it above the lever:



Shoe adjuster:

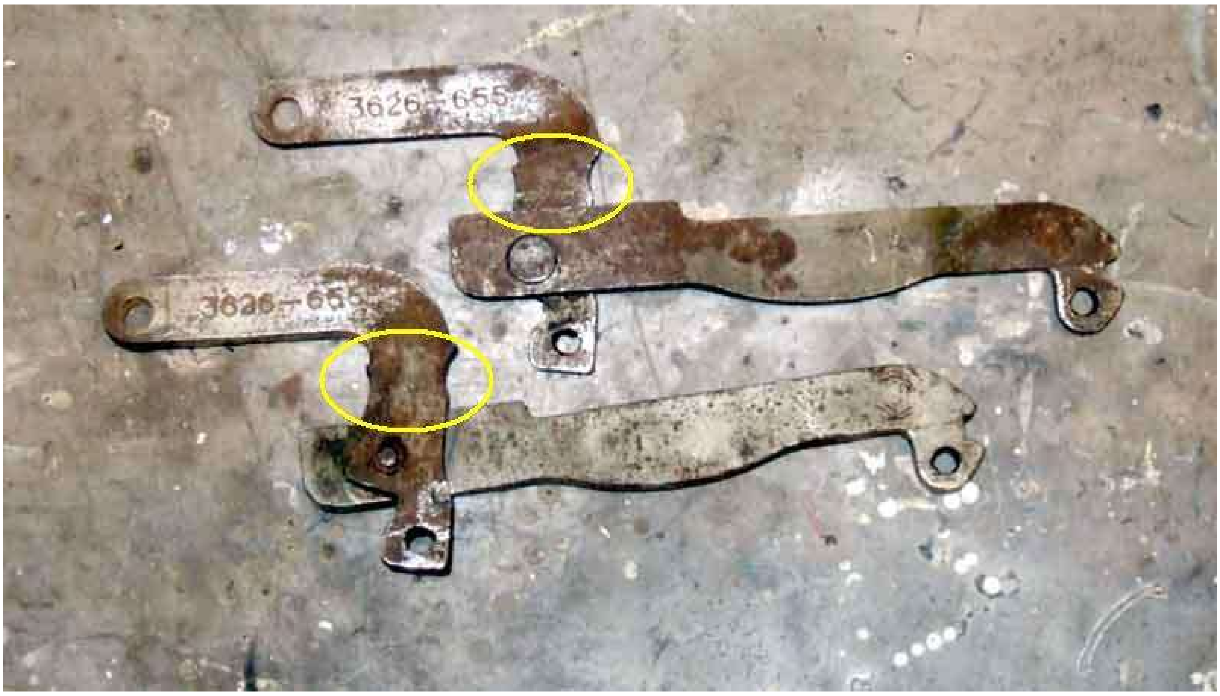
Slot cut in end of adjuster so it can be removed and refitted with a screwdriver. Note this is not for adjustment of the shoes!:

When looking at a couple of John Twist videos while investigating the 'anti-rattle' feature mentioned above I noticed he was using a ratchet spanner with a 1/4" square hole which directly fits the adjuster, and he happened to mention it was a refrigeration spanner. Various Googles later I come up with this, with [four square-drive sockets including 1/4"](#) - select CT122, which is a bargain at £4. OK I may not use the other three very often if at all, but seeing as how a single 1/4" from Sealey is £14, it's no contest. Makes winding the adjuster out from all the way in with the shoes refitted a doddle, although to be fair having the plain adjuster spanner as well for the final adjustments back and fore is slightly easier than flipping the ratchet to change direction each time:

Handbrake Lever Boots

Vee's split and hanging off, after just three years.

Circled is the 'waisted' section that the slot in the boot should be pushed onto, which helps prevent it getting pushed off the back-plate tabs



Bee's after six years and 10k. Vees having been replaced three years ago showed no signs of deterioration.

Master Seal Kits (clutch and single circuit brake systems)

Clutch and brake master cylinder repair kits are confusing for several reasons:

- There were two different types of internals, changing "sometime in 1973" (Clausager), but any car could have either now:
- Early brake and clutch masters had one cup-type seal (the pressure seal) and one ring-type seal (the secondary seal).
- Later brake and clutch masters have two ring-type seals.

There are four repair kits: (*images from Moss Europe unless otherwise stated*)

GRK1026 for the early brake master with cup seal and restrictor, the washer goes between the piston and the back of the cup seal:

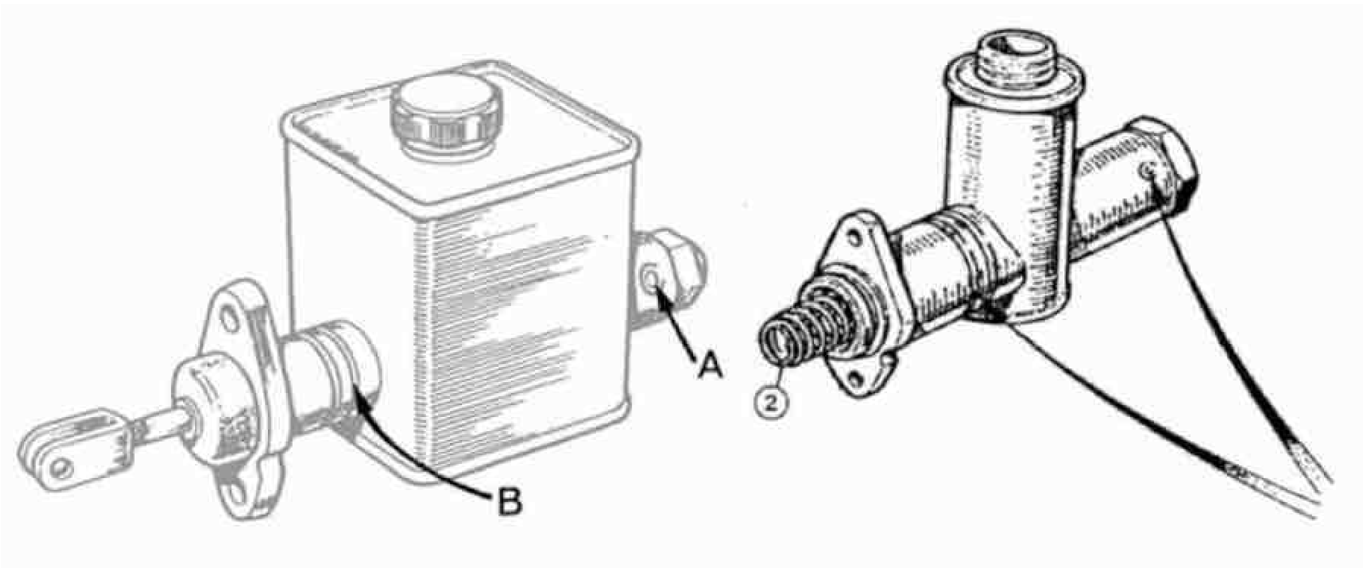
GRK3007Z for the early clutch master with one cup and one ring seal:

GRK3004Z for later brake **and** clutch masters with two ring seals. This includes a restrictor valve which MUST be fitted to the brake master, and must NOT be fitted to the clutch master:

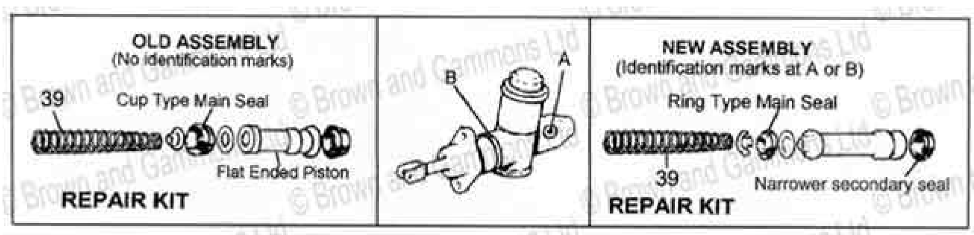
GRK3007 converts the earlier clutch internals to the later type and uses two ring-type seals, at about three times the price:

Not all suppliers show all four kits and some show GRK3007 i.e. without the 'Z' suffix as being the basic cup-type repair kit **not** the conversion kit to ring-type seal that most suppliers show.

There are identification marks on the later masters originally fitted with ring seals but supplier information is confusing if not incorrect as here from Moss. This shows two grooves around the bore by the flange and a smaller symbol (two concentric rings) by the banjo:

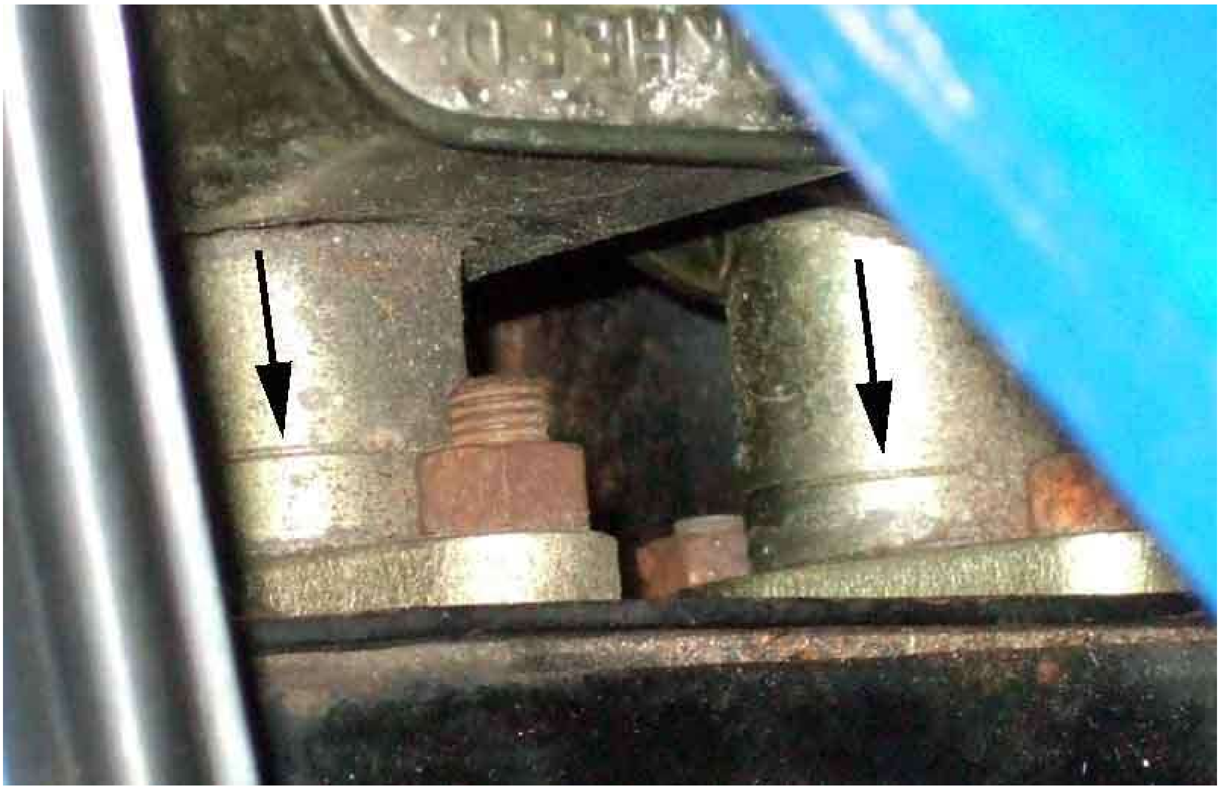


This from Brown & Gammons could be showing the same but isn't clear enough to see if there are one or two grooves by the flange:



I have never seen the type A symbol.

Both masters on my 75 V8 have a single groove by the mounting flange:



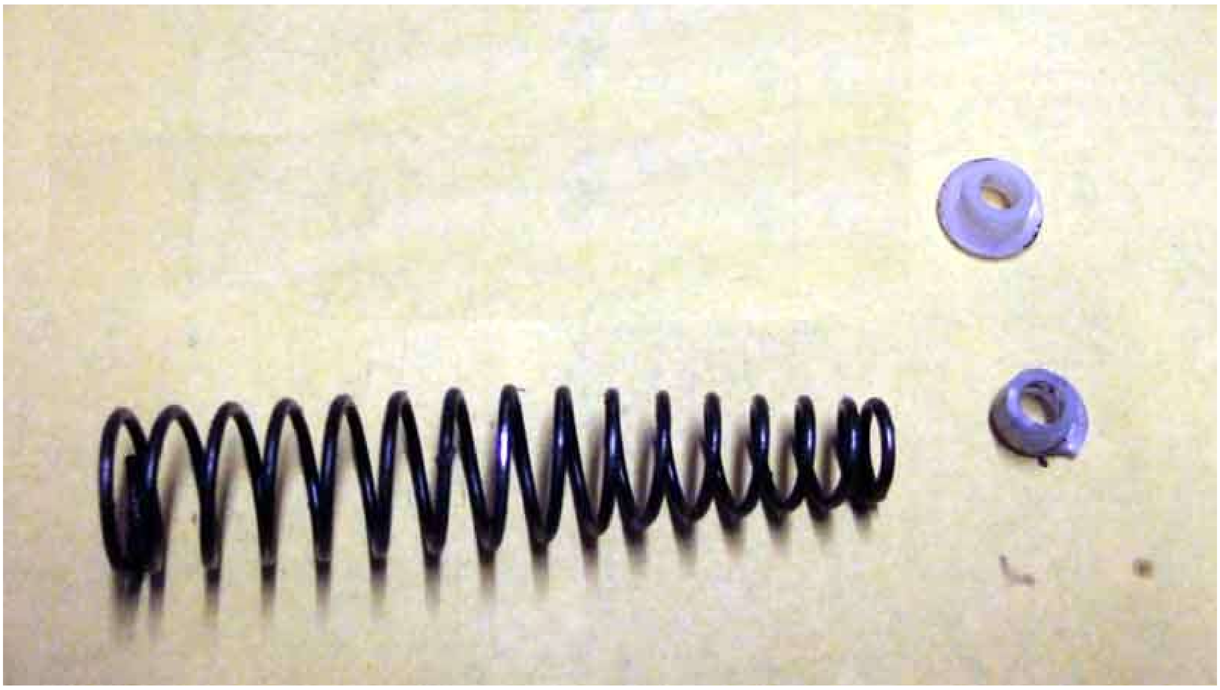
Groove barely visible on the replaced brake master on my 73, the clutch master is the earlier cup-seal type so no markings:

To get the correct seal kit for your master you would need to remove the existing piston first to see what seals are present, or you could go straight for the conversion kit albeit wasting money if you already have the later or already converted master.

But there is another factor and that concerns the seal spreader inside the cup seal, which none of the seal kits show. I had the clutch master seal leaking back on Bee so the clutch would slowly engage while I held the pedal down, and on removal of the piston and seal I could tell that the seal had been cocked to one side because the spreader had broken, but fortunately I had kept an old master and reused the spreader from that. Otherwise I'd would have to go for the conversion kit.

Cup-type seal internals: The shim (arrowed) goes between the seal and the piston, and on all pistons both primary and secondary seals face forwards. When fitting the dust cover to the push-rod do so from the piston end before assembly to the master cylinder, the sharp edges and large size of the clevis pin fork can rip the seal:

Bee's broken clutch seal spreader that came out (bottom) and a good one from an old cylinder (top):



The spreader does not appear to be available meaning if this is broken or lost the ring-seal conversion kit would have to be fitted.

The distorted seal. The vertical line runs through the centre of the pip that is at the bottom of the cup and sits in the hole in the spreader. That should be central, but is clearly displaced to the right because of the broken spreader:

A selection of pistons and seals: A is the new piston from the conversion kit, B an identical item from a previously changed cylinder. C is from the V8 clutch and has two parallel rings! D is probably from the roadster brake master and identical to the one from the clutch master:

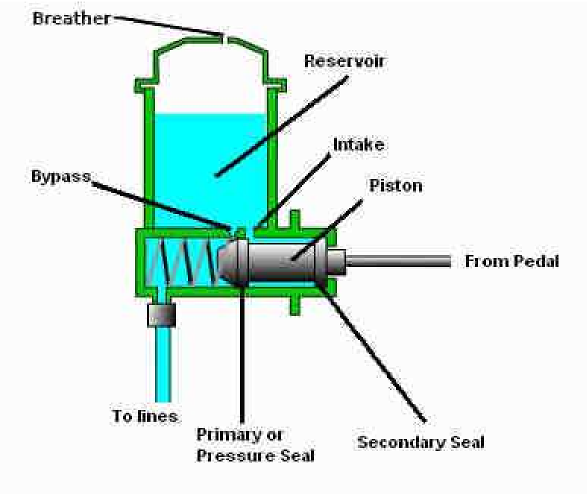
The cup-type seal removed from Bee's clutch (A) significantly longer than a similar seal from another cylinder (B). If the replacement seal is like B, that would explain why the biting point is now lower. (It wasn't, that turned out to be a problem with the release arm and bearing alignment with the cover plate):

Piston and cup-type seal from Bee's clutch (A) significantly longer than the piston and ring-type seal of the conversion kit:

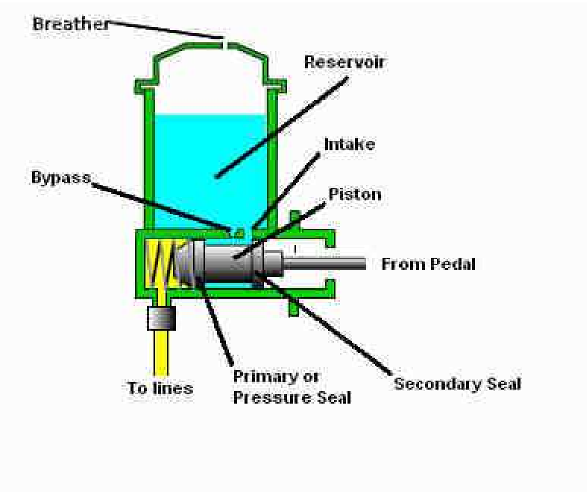
Three from Richard Massey on the MGOC forum - top from a 100 mile no-name plastic-bodied replacement that started leaking, middle from an older TRW plastic, bottom from a metal can. Slight differences in thickness of the flanges either side of the seals which is irrelevant as long as the seals are in the same position. Also slight differences in diameter of the flanges but only 3 thou max between any of them. Speculation that it was deliberate to give greater clearance to the bore, but I can't see that after all these decades, and it would allow for more lateral movement of the piston in the bore which could impact the sealing. Whilst my old pistons do show some polishing on the sides of the flanges there was no scratching or scoring in the bore which the 100 miler shows. What (to me) is more interesting is the long extension inside the spring of the no-name plastic. It shows how much free space there is at the bottom of the cylinder, and I can see it being needed in some applications to prevent the piston going too far and tangling up the spring, which then may not push the piston back as it should when the pedal is released. Neither do you want to push the secondary seal past the inlet port which will cause fluid to leak out:

Brake Master Cylinder - single circuit

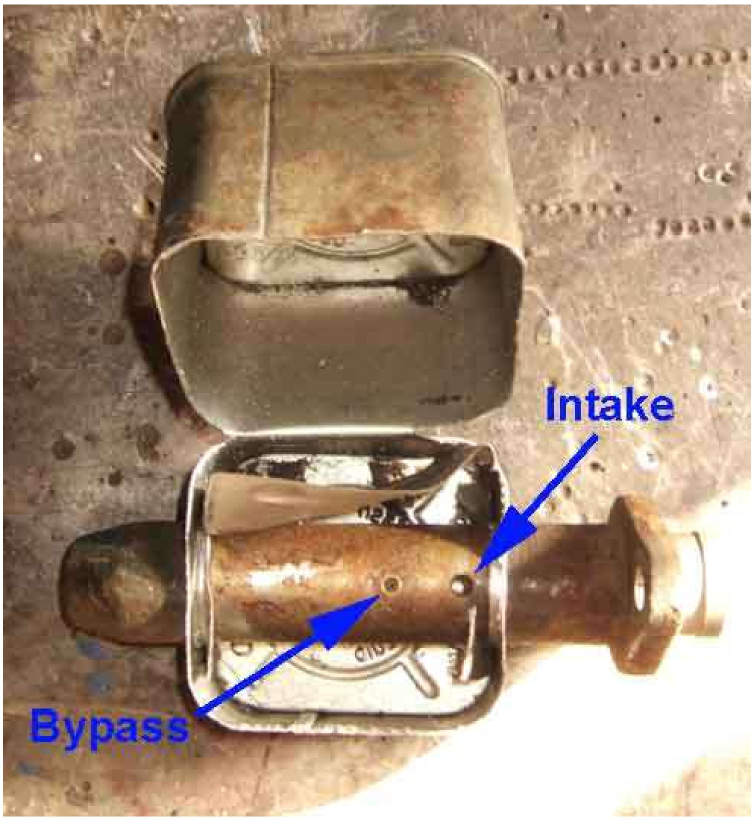
Showing how fluid fills the main part of the cylinder via the bypass port and the space between the two seals via the Intake port. This and the following drawings have been adapted from the dual-circuit system described in How Stuff Works.



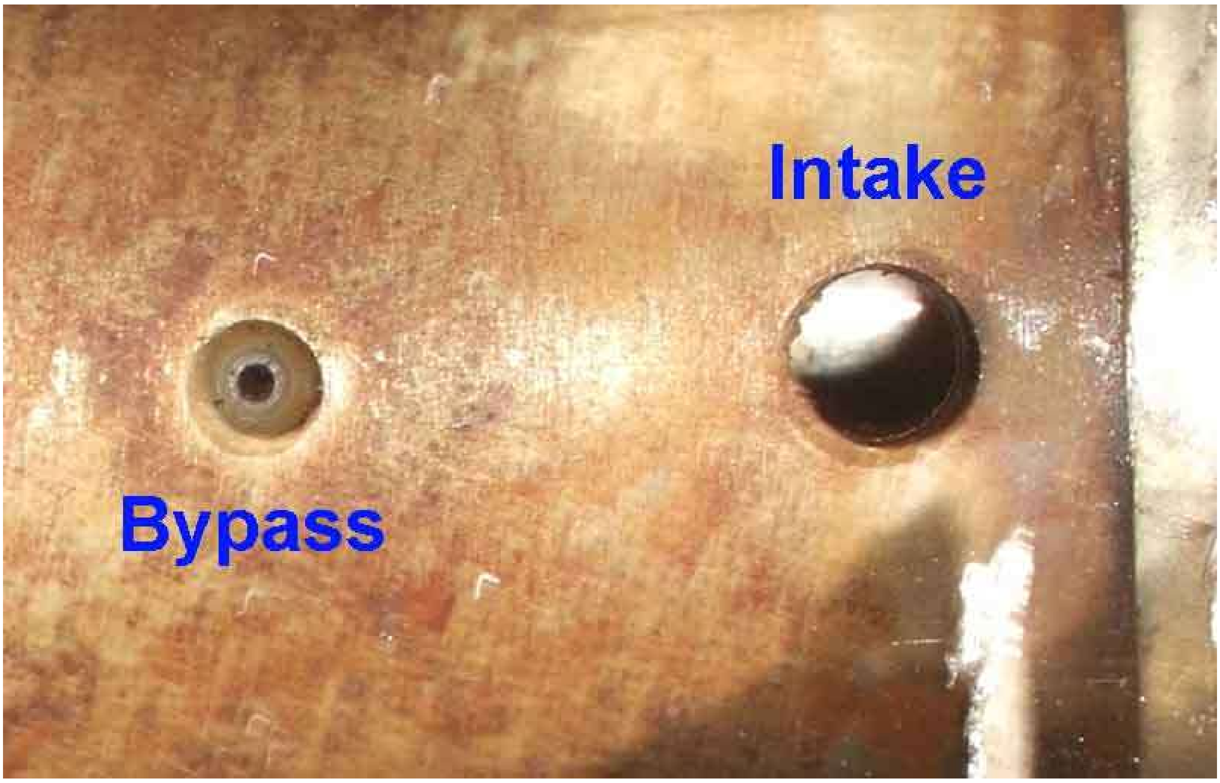
On depressing the brake pedal the primary seal must pass the bypass port for pressure to be developed in the lines, and on return must clear the bypass hole to allow fluid expansion and contraction to pass in and out of the reservoir. If this doesn't happen - for example if the mechanical brake-light switch is screwed in too far - and the fluid expands, the brakes will be applied without the pedal being operated.



The Intake and Bypass ports, the clutch master has the same arrangement.



The Bypass port is tiny.



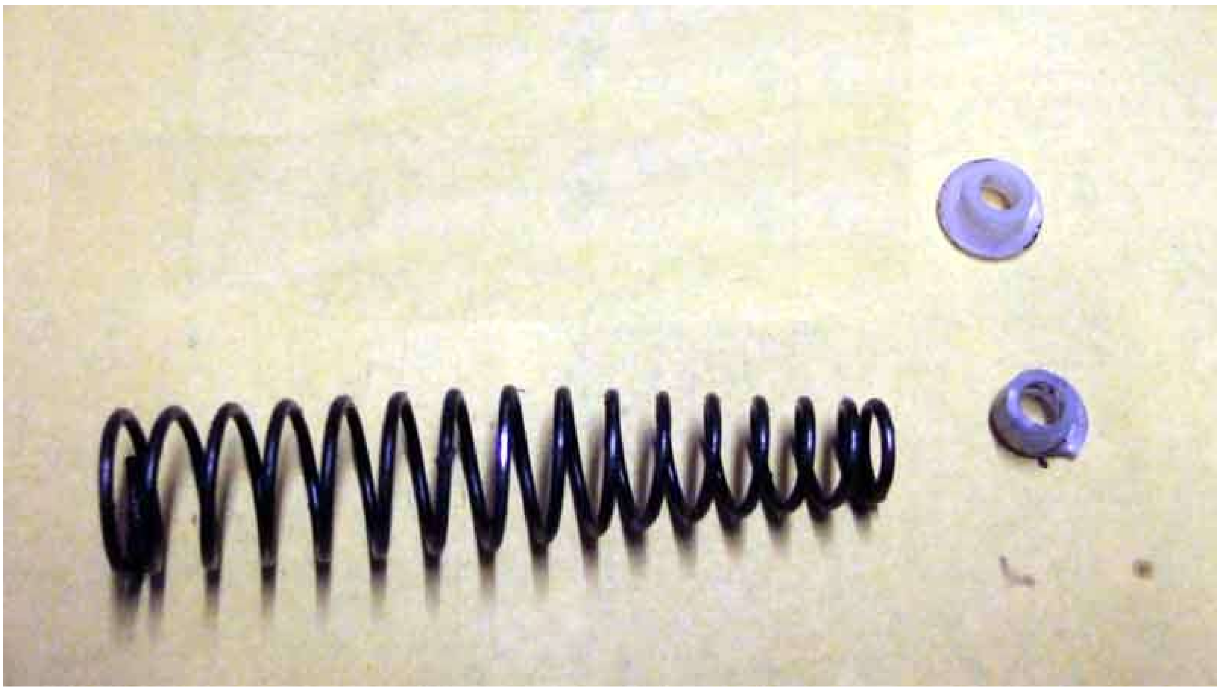
Clutch Master Seal

About 150 miles into a 520 miler for the Pendine Run I became aware the clutch pedal was occasionally lighter than normal, and I was getting baulking and grinding in reverse. As it was intermittent I reckoned it was the main seal occasionally leaking back, i.e. no fluid loss, and a check showed the level was normal. We completed the trip with no further drama, but I protected the clutch as much as I could by only changing gear when I had to, and if I had to come to a stop I only depressed the clutch pedal and engaged a gear when I was ready to move off.

On return home I investigated repair kits and replacements. The original style metal reservoir type are available again after plastic reservoirs having been the only type available for some years, but as previous master replacements had shown the bores with no visible scoring or corrosion, I decided to try a kit. That took quite a bit of sorting out as there are two types of internals, originally with different external markings, but the later internals are supplied as a kit for the earlier masters. This makes it effectively a conversion kit, but it isn't described as such, and means the original seals are no longer suitable. So with a car of unknown history you have to take out the piston to see what type of seals you have. Various suppliers reference this but I don't think they explain it clearly enough, and note that **the ring-type seal repair kit GRK3004 contains the brake master restrictor valve as the kit is common to both brake and clutch but the restrictor must not be fitted to the clutch**.

Despite being a 1973 model Bee's master does not have the later markings, and even though the clutch master hadn't been tampered with in my ownership of 26 years (and I suspect it was original to the car) I drained the system by opening the bleed nipple and pumping with the pedal and removed the piston and seals before ordering spares so I could check the bore. A long screwdriver is needed to get at the one cover fixing screw tucked down beside the inner wing, but a driver that takes hex bits with a couple of adapters and a 1/4" drive extension reached that OK, the others are easier. Cover twists out across the front of the masters towards the engine, with just the water bottle removed from its cradle to give a bit of slack on the tubing which normally sits over the flange of the cover. Split-pin and clevis pin removed, dust-cover pulled forwards, circlip pliers and a wiggle and pull removes the push-rod. The internal return spring pushes the end of the piston with the secondary seal out, pulled that the rest of the way out with my fingers, leaving the primary seal etc. still in the bore. Extra-long nosed pliers (from my BT days) tip the seal over so it can be gripped and pulled out. Peering into the bore I can see the plastic 'spreader' that sits between the end of the return spring and the fluid face of the seal has half a flange broken away so it had been at an angle on the spring and setting the seal at an angle. I can also see a broken piece of the spreader sitting in the bore. The seal itself it quite distorted, so must have been like that for a considerable time, amazing it kept going as long as it has. Fish the bit out and the spring with the remains of the spreader.

The broken seal spreader that came out (bottom) and a good one from an old cylinder (top):



The distorted seal. The vertical line runs through the centre of the pip that is at the bottom of the cup and sits in the hole in the spreader. That should be central, but is clearly displaced to the right because of the broken spreader.

Wrap some hand-wipe cloth round a chop-stick (!) and use that to wipe round the bore, which looks perfect. Because Bee's biting point has been rather low for as long I can remember, and I did modify the push-rod some years ago to give more 'throw' (which only improved things slightly), I decided to order both kits - the original at Â£4 and the conversion kit at Â£11. New spreaders not available, but having kept the guts of Bee's brake master and both masters off Vee changed some years ago, and out of those three two had the old-style seals with the same spreaders, so I had two spares!

Shiny bore full length and all the way round:

Parts arrived from Moss next morning, and with the low biting point in mind and wondering if I would be able to improve it, I compared the lengths of the five pistons I now had - three previous replacements one with ring seals and the other two with cup, Bee's clutch with cup seal, and the new conversion kit with ring seal. They vary in length quite a bit, except that the new conversion piston is the exactly the same length as the previous replacement that has a ring seal, and Bee's piston is exactly the same as one of the old cup seal pistons. The remaining cup seal piston is slightly longer, and is my first though to fit, but when I check the diameter it is fractionally smaller than Bee's. That must be from the V8 clutch, which has a slightly smaller bore than the 4-cylinder, so not a good idea to use. All the secondary seals are ring-type, but do vary in size.

Unlike the 4-cylinder the V8 clutch master did not change at any time, so it would be reasonable to expect that to have the cup seal as V8 production started before the 4-cylinder seal changed. Why the V8 didn't change in 1973 as Clausager estimates for the 4-cylinder is a bit of a mystery as the V8 still had a couple of years of production left. Maybe the change occurred after the end of V8 production. The other oddity is that of the other two previously removed pistons one is a cup seal the same length as Bee's, and the other is a ring seal the same length as the new conversion piston. One must have come from Vee's brake master, and the other from Bee's brake master, but (purely from an interest point of view) which came from which car? If the cup seal came from Bee, making both pistons and seals identical, then Vee must have had a ring-seal piston in the brake with a cup-type in the clutch. The Parts Catalogue has the same info about a change in brake master to one with two concentric rings as for the clutch, but is similarly vague about the date. And both Vee's brake and clutch masters only have one concentric ring, not two, Bee's having none. The brake master was always the same for the V8 and the equivalent era 4-cylinder. The implication is that one of the brake masters had already been modified with a conversion kit, but before my time. This is all rather by-the-by, and really only leaves me with two options - the new original cup-type seal with Bee's piston, or the new conversion kit, and I go for the former.

A selection of pistons and seals: A is the new piston from the conversion kit; B an identical item from a previously changed cylinder; C is from the V8 clutch; D is probably from the roadster brake master and identical to the one from the clutch master:

The shim (arrowed) that fits between the seal and the piston, on both cup and ring-type seals.

The cup-type seal removed from Bee's clutch (A) significantly longer than a similar seal from another cylinder (B). If the replacement seal is like B, that would explain why the biting point is now lower.

I coat the new secondary (ring-type) seal and the push-rod end of the piston with brake fluid, and ease the seal on easy enough. However there is a thin flange that projects forwards of the main part of the seal and sits flush against the piston body, that flange is partly tucked under the rest of the seal, and needs careful easing forwards with a small blunt screwdriver. After that one of my 'old' seal spreaders is fitted to Bee's spring and inserted into the bore, and the new main seal coated with fluid and manually pushed in. There is a curved thin steel shim that sits between the face of the piston and the back of the seal, which may push the seal away from the piston to open up the three holes in the face of the piston, which are perhaps there to aid fluid flow when bleeding. Insert the shim and the piston, and refit the pushrod with its thick integral washer and circlip. **Note!** If you are fitting a new dust cover to the push-rod do so from the piston end before refitting to the master cylinder, the sharp edges and large size of the clevis pin fork can rip the seal.

For filling and bleeding I decide to try yet another variant of the reverse system I have used with complete success on Vee and a pals car. I connect a tube between the caliper and clutch nipples as before when I used the brake pedal and master to fill an empty clutch system, but this time I connected the Gunson's EeziBleed to the brake master. The same low pressure of about 15psi on the front off-side wheel I had removed to give me better access to the clutch slave, opened the clutch bleed nipple, then the brake, and fluid from the caliper fills the tube and starts going into the clutch system. Peer into the clutch master until I see fluid rising, then close the brake nipple. Test the clutch ... and absolutely no back-pressure at all, and peering underneath only a trace of movement of the push-rod. I'm pretty gobsmacked, as this method of reverse filling had worked perfectly the previous twice I had used it.

I tried operating the pedal slowly, some gurgling, but no change. So I wedged the pedal fully down over lunch, then slowly released it, no change. Someone recently said they pumped the pedal like mad, which also made no difference, except to obviously aerate the fluid in the master and make it milky. Next I wedged the pedal down, then opened the slave nipple, and quite a bit of air came out. Did that several times till no more air. I can feel some pressure now, but only about 3/8" of push-rod movement and it grinds if I try to put it into reverse. More pumping, still no better. So now I put the Gunsons on the clutch master and bleed normally, and loads of air and milky fluid comes out again. More pressure, but it still feels soft at the top and its still grinding. So I leave it wedged down overnight, hoping that the air bubbles coalesce, and can be pulled back into the master when I release it in the morning. That makes the feel much better, it now engages reverse without grinding, although the biting point is very low at probably not much more than 1/4" off the floor.

Although the hydraulic system automatically compensates for all the expected wear at the clutch end i.e. in the release bearing (of which mine is a ball bearing anyway) and push-rod/clevis pin/release arm, I do wonder whether wear in the release arm pivot has allowed the arm to move outwards, so increasing the ratio of the arm, which would need more movement of the slave push-rod to get the correct movement of the release bearing. So I ease the push-rod into the slave a little to take the pressure off the release arm, and test for any wear in and out or up and down, but there is none.

I then start pondering all sorts of ways to get more throw on the pedal. Removing the (pretty thin) carpet from under the pedal makes no difference. So I modify one of my old push-rods to move the clevis pin hole as far as way from the master as possible. This moves the clutch pedal pad up from the brake pedal so does give more throw, but I'm surprised to find there is little change to the biting point. My dander is up now, so I also modify the pedal. I notice that the hole in the clutch pedal is about 1/8" lower than in the brake, so giving it a higher ratio. So as well as moving the clevis pin hole closer to the master, I also move it upwards, to lower the ratio and get more travel that way. I end up with the clutch foot-pad almost an inch higher than the brake, but still no damned improvement in the biting point! But when I check, I find that when the pedal when fully depressed it's about 1/2" off the carpet - because the clevis pin bracket on the push-rod is now pressed hard up against the dust-cover on the cylinder. The clutch is also very stiff, which surprises me as I wouldn't have thought changing the ratio would have affected it that much, but I discover that because I have moved the clevis pin upwards, the push-rod is now angled upwards instead of horizontal, and as the push rod moves in to the cylinder it also moves upwards, and is binding on its spacer behind the circlip in the cylinder. I then realise that the reason the clevis pin is that 1/8" lower on the clutch pedal, is because the clutch master is 1/8" lower in the mounting frame than the brake master is. This must have been done deliberately to get the right amount of movement of the slave push-rod, taking into account the relative dimensions of slave and master bore, without making the pedal pressure too high on the one hand (high ratio) or the pedal movement too long on the other (low ratio).
So that means I have to move the hole back down on the pedal to correct the angle of the push-rod, as well as move it away from the master a bit as there is no point in having the pedal pad so high that the master stops it way before it reaches the floor. But why is my biting point still so low? I take some comparative measurements with the V8, and whilst the V8 has more free play in the clevis pin linkage, it obviously starts to build pressure earlier than Bee. I then look again at the seal I removed from Bee, in conjunction with the older piston and seal, and realise that the seal I have just taken out is a good 1.8" deeper than an older cup seal. I didn't note the depth of the new seal that is now fitted, but if it is shorter than the one I have taken out then the seal will have to move further before it closes off the bypass port from the reservoir, which it has to do before it starts building pressure.

Piston and cup-type seal from Bee's clutch (A) significantly longer than the piston and ring-type seal of the conversion kit.

I could take the piston and seals out again, and perhaps fit the conversion kit, but that is also about 1/8" shorter than a piston with the original seal so isn't going to be any better. And after the problems with bleeding I'm not keen on having to go through it all over again. If I could put a spacer between the push-rod and the piston, then with the pedal fully released the piston would already be part operated, and if I could arrange for that position to be just short of closing the bypass port I would have maximum travel to pressurise the fluid.

There is a ball in the end of the push-rod that sits in a recess on the piston, presumably to avoid sideways forces on the piston as the angle of the push-rod changes slightly through its travel. I could wrap a spacer around the ball, but if that went behind the ball it would prevent the push-rod going fully back - reducing effective travel - as the back of the ball sits in a recess in the large washer. I could build up the ball with weld, but it would need to be carefully shaped back to a ball again, I don't have a Dremel, and I can't spin the push-rod so as to make sure it was circular. Which leaves a spacer disc of some kind that sits between the two halves.

But first I really need to find how far the piston needs to travel before it closes off the bypass hole. If my washer is too thick fluid expansion from heat won't be able to escape into the reservoir as it should, and I won't be able to bleed conventionally. By laying a ruler on top of the clevis pin bracket of the push-rod, and butted up against the open end of the cylinder, I see that the back of the bracket is 4.9mm (from memory) from the cylinder. Then I cut a fine wedge from a piece if hard board and fit it between the front of the pedal and the back of the hole in the bulkhead shelf that it passes through, so I can hold the pedal and hence the piston at various positions into the cylinder. Fully released I can push the slave push-rod and piston into the cylinder easily, and it moves out easily from the effects of its internal spring. 2mm of movement of the piston is the same, but 3mm makes it much harder to push in, and slower to come back out, so at 3mm the seal has partially closed off the bypass port. I settle for a 2mm spacer to allow for piston expansion when that gets hot, and find a washer that is slightly smaller than the cylinder bore, with a small hole in the middle, and a couple of mm thick. Clamping that in a vice between one of the old pistons and push-rods forms it nicely into a shape to fit between ball and socket. A trial fit in the cylinder does raise the biting point a little, not as much as I was hoping, but it seems to be the best I can get. It's effectively loose in the cylinder, so could get dislodged, but I realise that by putting a blob of weld in the hole in the middle of the washer onto the ball of the push-rod, and carefully filing smooth, overcomes the problem of getting the right shape as well as retaining it.

With that fitted the pedal feels much better, very little play at the pedal clevis, and it firms up sooner than before, but although the biting point has improved it is still lower than prior to the seal change. Maybe some air still in the system? I try wedging the pedal partially operated so it just closes the bypass hole, then using a big screwdriver in the release arm hole try to lever it forwards and push the piston into the cylinder but it doesn't budge. So I try another tip which is to push the slave push-rod and piston fully into the cylinder (pedal released now) and tie it there, initially as another way of seeing if there is air in the system, but also prior to another attempt at conventional bleeding. The pedal gets hard very quickly, no sponginess and I can see the release arm trying to move against the restraint of a cable-tie, so very unlikely to be significant air still in there. I reconnect the Gunson's to the clutch master again, open the bleed nipple and maybe a little does come out. Close and try twice more, maybe a couple of tiny bubbles. Once more and nothing. Once more for luck ... and disaster - the Gunson's bottle has emptied and pushed all the fluid out of the reservoir! If it hadn't been for that once more for luck I'd have got away with it. I'm running low on fresh fluid but put what I have in the Gunsons and fill and bleed again, the air bubbles are only reducing slowly, so it's down to Halfords for more supplies, and several more goes - keeping a close eye on the bottle! - before it's bubble free.

Try the clutch in reverse and really it's no better than its best previously. Wedging the pedal fully down and using dial calipers to measure the travel of the push-rod at 0.44", which I would have expected to be enough, especially as some have claimed theirs is only 3/8" (0.375") and fine. However with all the work I have done to increase the throw I would have expected it to be more than 'normal', which does indicate there is still a problem with the master ... or maybe the slave .. or maybe the bleeding. So it's still a mystery. Maybe it's something to do with the release bearing, but unless it is reducing in length as the clutch is disengaged, and I can't really see that happening. Maybe the friction plate is slightly warped, which means the pressure plate has to move further to completely release it. Possible, but I'm never one for engaging the clutch at high revs for a quick getaway, preferring to get it all in as soon as possible at little more than idle then using the torque to accelerate. That's something that will have to wait until the engine comes out, and would still happen even I had more slave piston travel than 'normal'. I could try the conversion kit, but going by the length of the piston from socket to seal lip that will be no better. It could be something to do with wear by the bypass hole meaning the seal has to move further to fully close it off, which would be corrected by a replacement master. For the time being I'm going to run with it, and see if I can live with it or not.

July 2016: Eventually I'm forced by release bearing problems to pull the engine and change the clutch, and after that I find the biting point uncomfortably high, even though the slave push-rod travel is fractionally less than before. I found that because of an alignment issue the release bearing is offset to the cover-plate by a significant amount, which basically means it has been pressing on one side harder than the other, which probably meant that the pressure plate wasn't moving away from the flywheel as much one side as the other, hence had to move further overall (lowering the biting point) to fully release the friction plate. So with the new clutch fitted I have to undo all the work I did to improve the biting point!

Girling Clutch Master by Crispin Allen (*my edits*)

When I tried to bleed the clutch on my MGB, I would open the bleed on the slave, press the pedal down. Result: the fluid comes out, the pedal stays down, so no pumping is possible (I always detach the pedal return spring, during bleeding, as it may give the false impression that the master cylinder piston has returned, where in fact it is just the pedal that has returned) it seems like the return spring inside the master is not strong enough to push back the piston. First thought: has the master return spring failed? No, on removal it is working properly.

> *The mechanical linkage between the pedal and the master cylinder piston means that the pedal return spring is helping to pull the piston back during pedal bleeding as well as confirming that it has pulled back. To remove the pedal return spring is counter-productive.*

I had spent several hours trying to bleed the clutch without success, so I looked on the internet and was comforted to see that it is a nightmare job for everyone including professional garages. While planning my next attempt, I thought I would bleed the clutch on my Triumph GT6. I filled up the master cylinder, opened the bleed. Fluid came out, pumped the pedal a few times, checked for bubbles, tightened bleed. Job completed in about 10 minutes.

Why were the two tasks so different?

This bit of information found at: mgparts.co.nz: The lack of a return valve means the air in the pipe and slave cylinder is not isolated from the master cylinder so the suction generated by the master cylinder piston stroke, is dissipated right through the system rather than confined to the master cylinder. The amount of suction remaining is not enough to draw new fluid in.

> *There is no 'return valve' in the Lockheed clutch master cylinder, although there is in the brake master which delays the return of fluid to allow 'pumping up' in the event of a long pedal. If there was one in the clutch m/c in either brand it would delay engagement of the clutch after the pedal was released, which seems very unlikely. When the pedal returns during pedal bleeding then the m/c piston has also returned from the action of the internal spring if nothing else. If the bleed nipple has been closed for the return stroke (as it has to be otherwise fluid and air would simply go back and fore) the lowering of pressure that occurs in the m/c bore sucks fresh fluid from behind the pressure seal and the reservoir to replace the fluid and air that has been expelled from the bleed nipple on the down-stroke of the pedal. This is how pedal bleeding works. The ease of bleeding for the Girling must be down to differences in the design of the bores and pistons.*

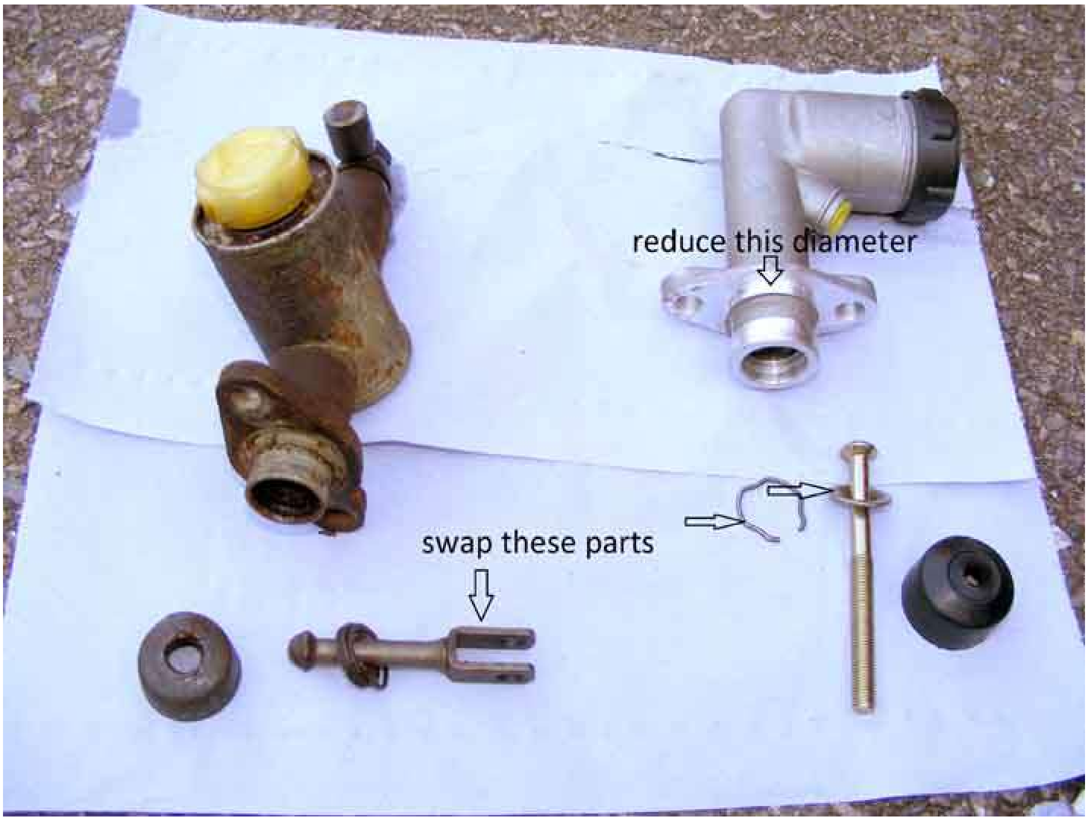
Clearly the problem lies with the master cylinder design. Taking a close look at the master cylinders in the early MGBs, there is very little room in the pedal box, the brake master cylinder takes up most of the room. It looks like MG had to use the thinnest reservoir clutch master available, and even then, they couldn't mount it straight (see the slanted mounting flange). On later cars with servo there is more room, but they kept with the Lockheed cylinder.

> *The canted-over clutch master was rendered necessary by the North American Mk2 dual brake master, and fitted to all cars for simplicity. Before that they were upright.*

MGBs with the brake servo, have more room to install a different master cylinder. As the Girling Master cylinder works well on a Triumph, why not try that?

The Girling master cylinder was installed in most Triumphs, Land Rovers and the MGC. There are various bores available including 3/4inch (0.75") the same bore as the MGB. The pedal box mounting bolt holes match up perfectly, but unfortunately the centre hole is a few mm too small, but a few minutes with a hand file on the master cylinder solves this:

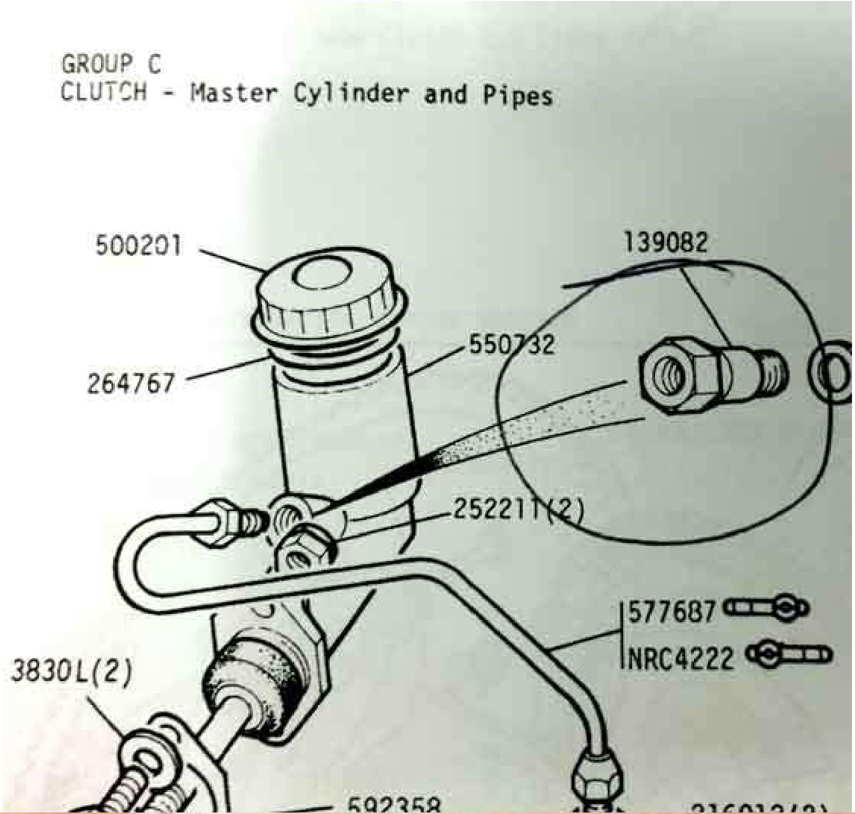
Just swap the push rod, circlip and the retaining washer (this needs to have a notch cut out to be fitted onto the push rod):



The MGB uses a larger diameter solid pipe, so the adaptor, (as used on Land Rovers) is required to convert 3/8 to 7/16:

I had considered replacing the whole solid pipe with smaller diameter pipe, however the slave cylinder are also the larger 7/16 union.

Gently bend the solid pipe to attach to the adaptor and master cylinder. Reconnect clevis pin etc.:



Bleed clutch in normal way (as you would do the brakes) now takes about 10 minutes instead of several days.

Land Rover Master cylinder: STC500100 & Adaptor: 139082

March 2021:

> Chris Silk is unable to completely remove the cap even though he has the same dual-circuit frame and plastic cap as Crispin. Nevertheless Chris had enough room the fill the reservoir with the cap just tilted back, and although during bleeding he inadvertently emptied the reservoir twice he still completed the bleeding in 20 minutes.
>
> This Girling clutch master is original equipment on the MGC, which has a completely different pedal frame again, and this picture shows masses of clearance for the clutch - which is just as well given the height of the brake master. I'm wondering if the MGC frame positions the master cylinder mounting face forwards of both MGB positions, or is just lower:

Ray Leborgne's RHD installation, alongside the original single-circuit brake master. The clutch cap is pretty close to the brake master but otherwise clearance looks OK. Ray is contemplating using a Girling brake master as well, but as can be seen from the MGC installation above the MGC brake master almost certainly won't fit in an MGB pedal frame. That's maybe why a second clutch master has been mentioned as an alternative, but with significantly reduced fluid capacity:

The 'ink' is hardly dry on the above and Ray has fitted a Girling brake master:

He writes:

> It does have a few drawbacks.
>
> The top unscrews to fill it up, however the top cannot be removed, and it can only slide back. It just means I cannot use my Eezibleed, not the end of the world.
>
> Although I used the old push rod from the old MC (as the clutch instructions) what I did not see (until it was too late) was that the overall length from the pedal box to the pedal was very slightly longer, thus it locked the brakes on. This was overcome by grinding down the edge of the pedal and inserting spacers on the MC.
>
> It may work better with a Mk1 pedal box as this looks like the MC fixings a lower which means more space between the cap and bulkhead.

I was hoping to replace the plastic cap of the clutch MC for the metal version, I purchased a cap which was stated as 44mm (the ID of the Girling MC) but alas it was too big, I suppose that what you get with aftermarket. So I'm reluctant to keep trying, the plastic will stay.

Subsequently Ray had further problems with the push-rod causing the brakes to lock on:

The problem that I did encounter was the brakes were locking on (again) but this time the problem was with the push rod.

I transferred the old push rod from the Lockheed (as per the clutch) and used the retaining washer from the Girling. But what was happening was as the pedal was on its return stroke the push rod was catching the retaining washer and not fully returning thus locking the brakes.

The reason (in my view) is twofold, the shape of the old push rod and the size of the hole in the retaining washer.

The Girling is on the left, Lockheed on the right. As the Lockheed is more pointed it would move around on the end of the cylinder's piston and because the retaining washer had a large hole the push rod would move to one side and catch the retaining washer on its return stroke. It's done this a number of times when driving, just flick the brake pedal and they would unlock.

So went back to the Girling push rod, made a new retaining washer (smaller hole) and adapted the old Clevis (drilled and tapped) to fit on the Girling push rod with locking nut. Having a locking nut (half nut) does not interfere with the overall travel of the push rod.

Converted the clutch to match.

Going by this picture of Mk1 and Mk2 single-circuit pedal boxes side by side from Dave O'Neil the Mk1 does seem to position the master cylinders lower. The covers also changed which tends to support that:

Note that the pedals also changed from Mk1 to single-circuit Mk2 and matching items may be necessary to maintain the geometry of the pedal, push-rod and master cylinder. The box (and cover) changed again for single-circuit rubber bumper, but the pedals didn't.

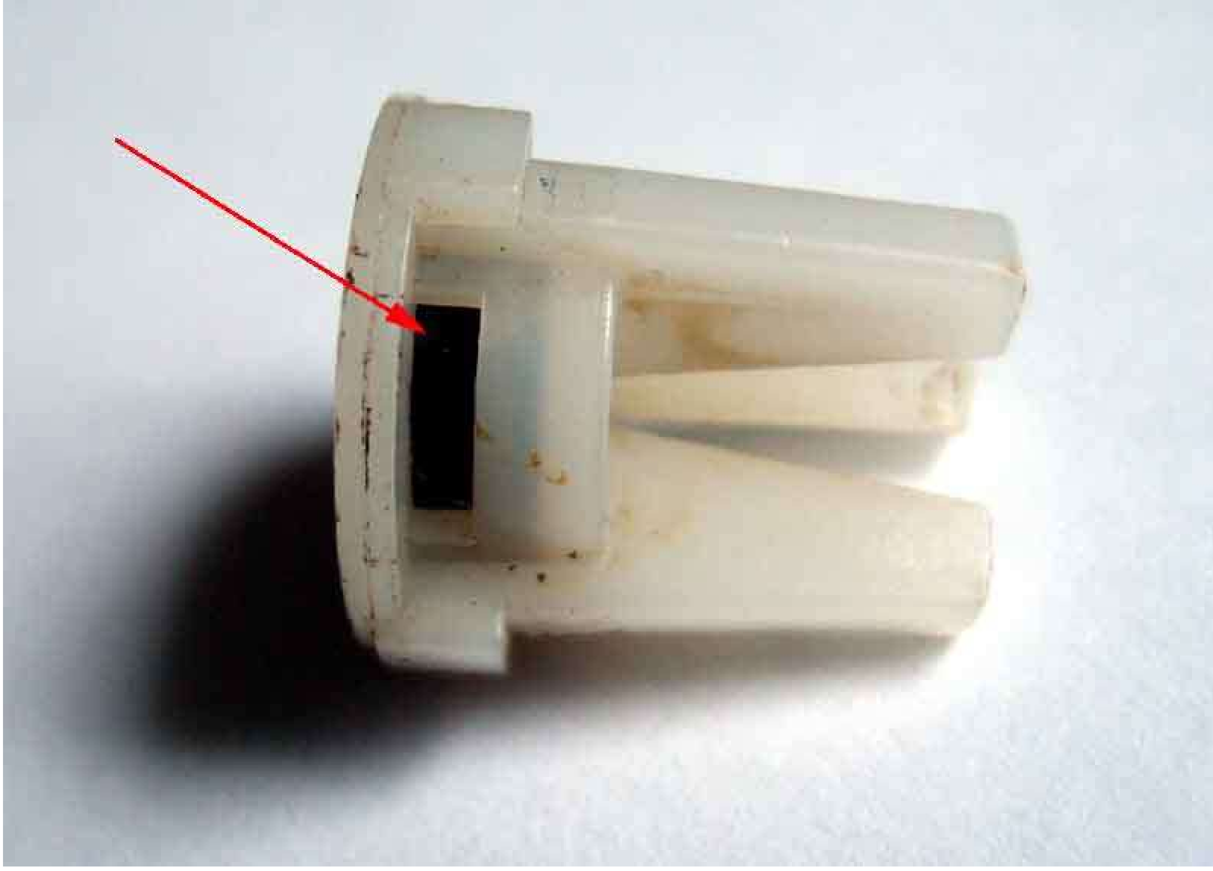
Mk2 Lockheed master cylinders for comparison:

Brake master Restrictor

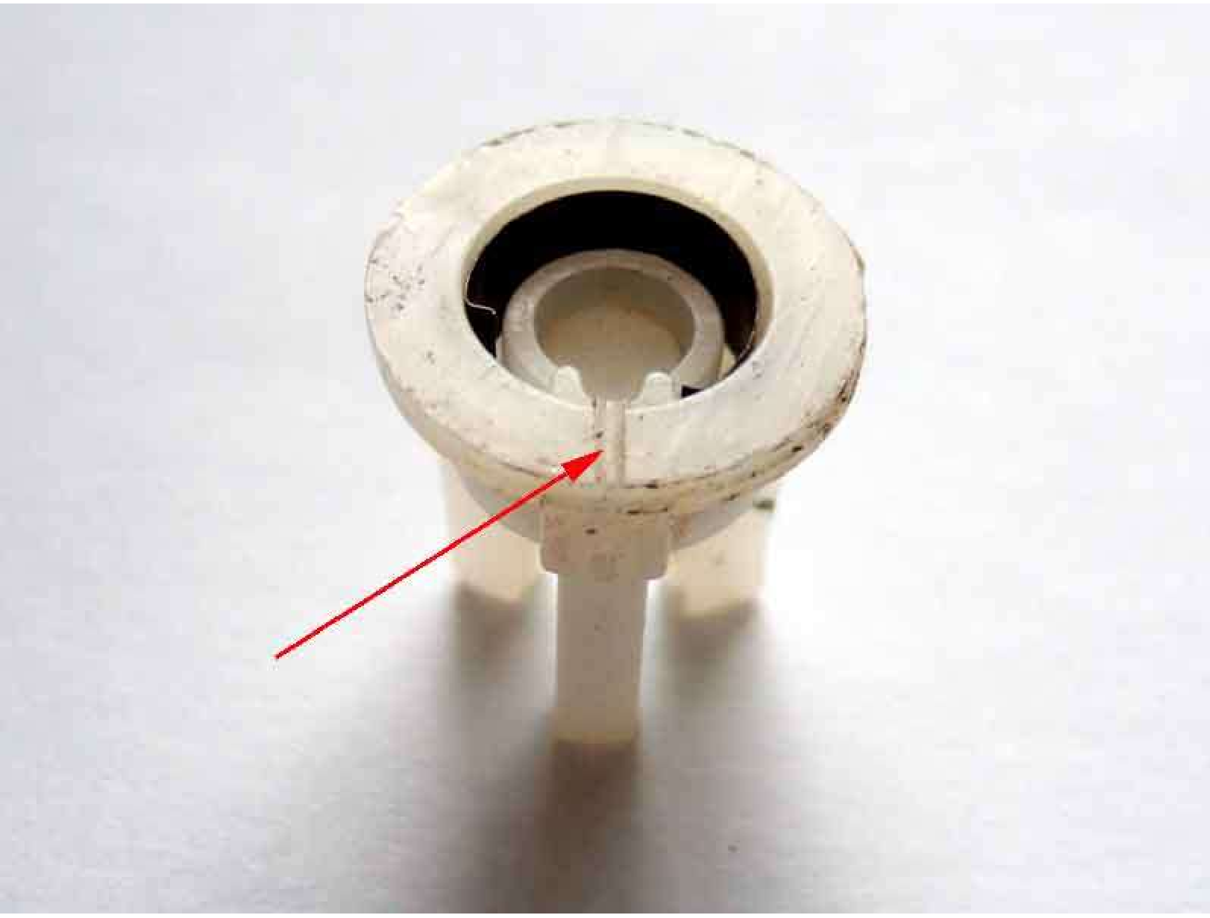
Brake Master Cylinder 'Slow-return' Valve

A general view of the single-circuit master valve, which comes as part of the seal replacement kit, but is not shown in the Parts Catalogue. The three 'legs' go in the end of the piston return spring, and the flat face against the end of the cylinder over the outlet port.

The slot in the side of the valve, normally covered by a brass spring. When you depress the brake pedal fluid pushes this brass spring out of the way and flows freely into the brake system.



On the opposite side from the slot and the brass spring there is a small groove cut into the flat face of the valve. When the pedal is released the brass spring returns and closes the slot, so the only exit for fluid pressure is the small groove, which delays the return of the fluid. However all the fluid pressure **is** eventually dissipated back into the master, it does not maintain any residual pressure. It's this valve that allows you to 'pump up' the brakes with several quick presses when you have air in the system or the rear shoes or handbrake are very poorly adjusted.

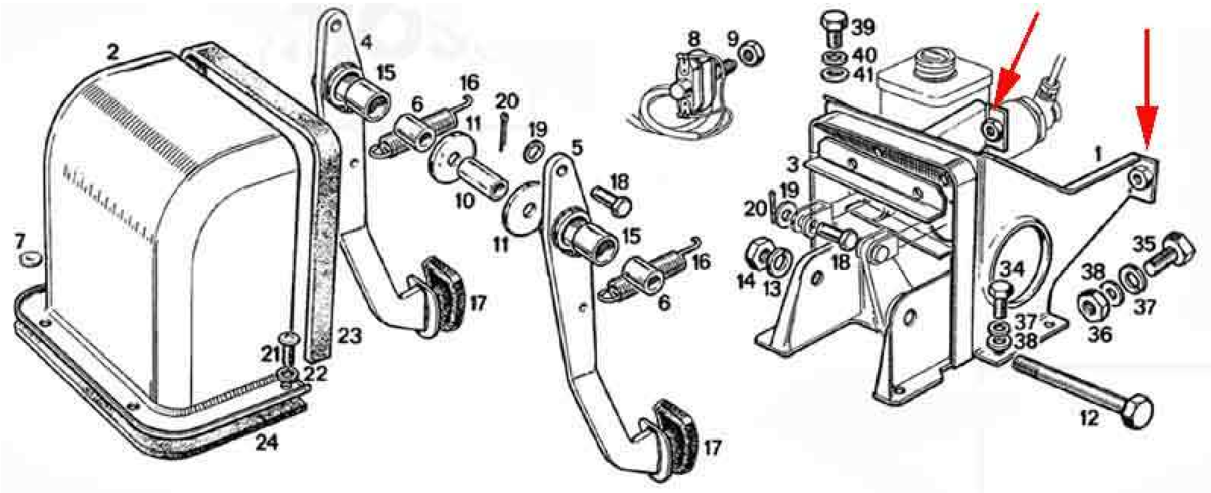


The early dual master seems to have just one of these valves (although two are shown for other applications of the same master), referred to as 'body-trap valve' 27H8453.

Pedal Box

The pedal box on cars prior to the boosted dual circuit system: AHH6065 for Mk1 cars, AHH8421 for single-circuit Mk2 cars with an over-size hole for the brake master and no lower reinforcing to accept the unboosted dual circuit master, although they were fitted to all cars until they gained the boosted dual circuit system. These also have the clutch master canted over a bit to clear the dual-circuit master reservoir cap, but that may be in the construction of the master itself and not the position of the holes in the box. This picture from Dave O'Neill - Mk1 on the left, Mk2 on the right:

Item 15 'bush, pedal' AAA4129 is for both pedals (was NLA in October 2016, shown as available from several suppliers in January 2017). Item 6 'bearing tube' is the pivot bush AHH7201, again the same for both pedals. 11 is the two spacer washers PWZ206, and 10 the distance tube AHH6063 that fits between the two spacer washers. The pivot bolt bushes are slightly wider than the pedals, so that when the bolt and nut are tightened the two pivot bolt bushes, spacer washers and distance tube are clamped up between the sides of the pedal box, which leaves the pedals free to rotate on the pivot bolt bushes with minimal sideways movement and 'wobble': (*Moss Europe)*



October 20918: However there is an oddity in the screws that attach the pedal box to the heater shelf. The Parts Catalogue doesn't explicitly identify these, but under item 8 - 'AHH 8421 (for example), Box - master cylinder there are six HZS405 (1/4" x 5/8" UNF, 7/16" head, item 37 below), one HZS407 (1.4" x 7/8" UNF), seven PWZ104 (1/4" plain washers) and seven LWZ204 (1/4" spring washers). You could be forgiven for thinking that the six HZS405 would be for the pedal box, but you are wrong. The middle one on the brake pedal side is actually 5/16" x 5/8" UNF (1/2" head, item 38 below), which is listed next in the Parts Catalogue i.e. HZS505 together with 5/16" plain and spring washers. I discovered this on the roadster when looking underneath the shelf for an attachment point for a mechanical brake light switch, and noticed this welded nut is noticeably larger than the other five. Wondering if it was a one-off I checked the V8 and it is the same. The only thing I can think of is that they opted for a bigger screw beside the brake pedal, as there is going to be a lot more force applied to that pedal than the clutch pedal. Still odd they didn't do it both sides though. Along the way I discovered that one was not fitted to the V8, I must have tried to use a 1/4" when putting things back after the repaint in 2017, discovered it wouldn't fit, and somehow it got left. As I need to fit a longer one to the roadster for said brake light switch bracket I transferred that one over. Initially I thought I would have to remove the pedal cover, but there is just enough room between that and the wing flange to get a 3/8" drive socket and extension bar in.

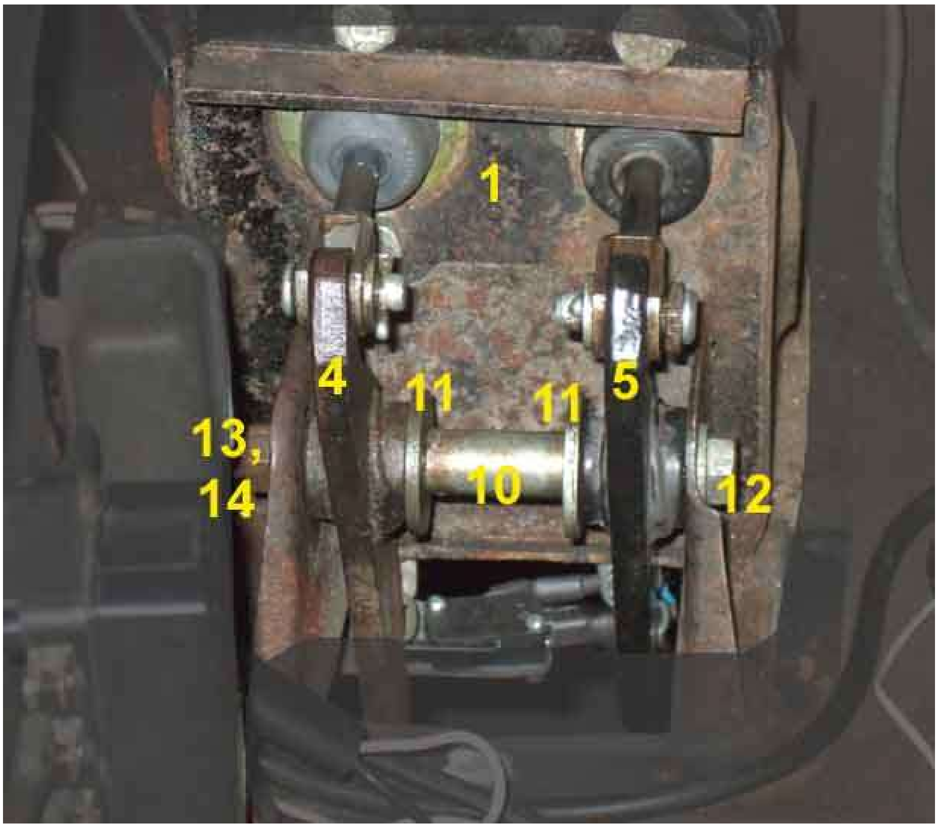
Incidentally the upper pedal box securing bolts (arrowed in red above and below) are a pig to remove as the bolts go through from the cabin side, and you have to go up behind the dash behind all the wiring to get at them. The inboard one is even worse as it has the steering column supports (later column as on Vee at least) below it as well. Removing it for Vee's (75 V8) repaint I got to the outboard one with two 3/8" drive wobble extensions, but the inboard could only be accessed with a ratchet-ring spanner. Initially I only had three very fine clicks of movement, which would have taken forever (even when loose I couldn't get my slim fingers to it) but by removing the relays and voltage stabiliser, and the indicator flasher and its clip, I got about 15 degrees of swing. Still took patience though.

July 2022: Steve Long has a 74 UK roadster and writes:

> "To get to the left one simply pull the wiring loom towards the steering wheel and use a 1/4" drive 7/16" socket - I got about 100 degrees movement. The right hand screw is behind the windscreen wiper motor; undo the two 7/16" screws holding the wiper motor in place and it will hang on its track leaving plenty of clearance to get to the hidden screw. Undoing the pipes from the back of the master cylinders is a whole different story!"

I have changed master cylinders on both cars and can concur with Steve's final sentence, but on Vee I was stripping the engine-bay so removed the pedal box complete with cylinders and pipes, and refitted pre-assembled, so was able to avoid that. The harness arrangement is completely different for 4-cylinder of that era and V8, I'm sure I would have done everything I could think of to get better access to that bolt.

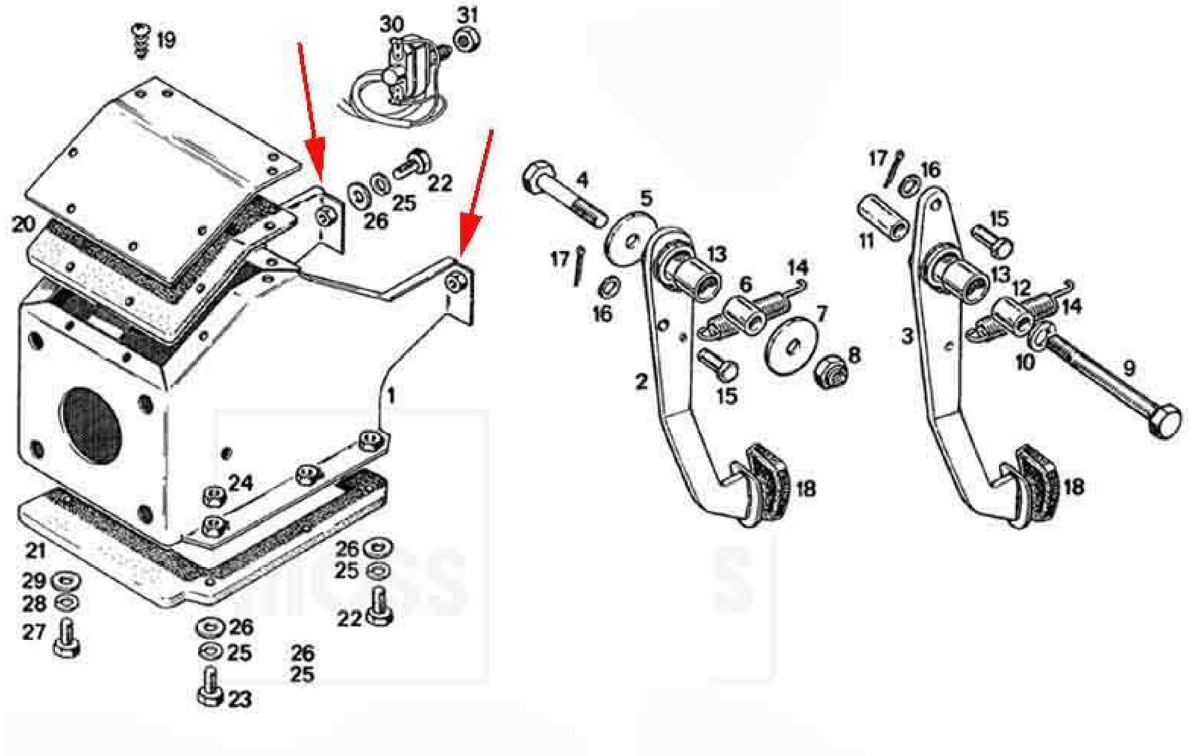
The pedal arrangement labelled with the item numbers in the above drawing, only the pedal (15) and pivot (6) bushes are hidden. With this arrangement everything except the pedal and its bush (for obvious reasons) should be clamped up tight:



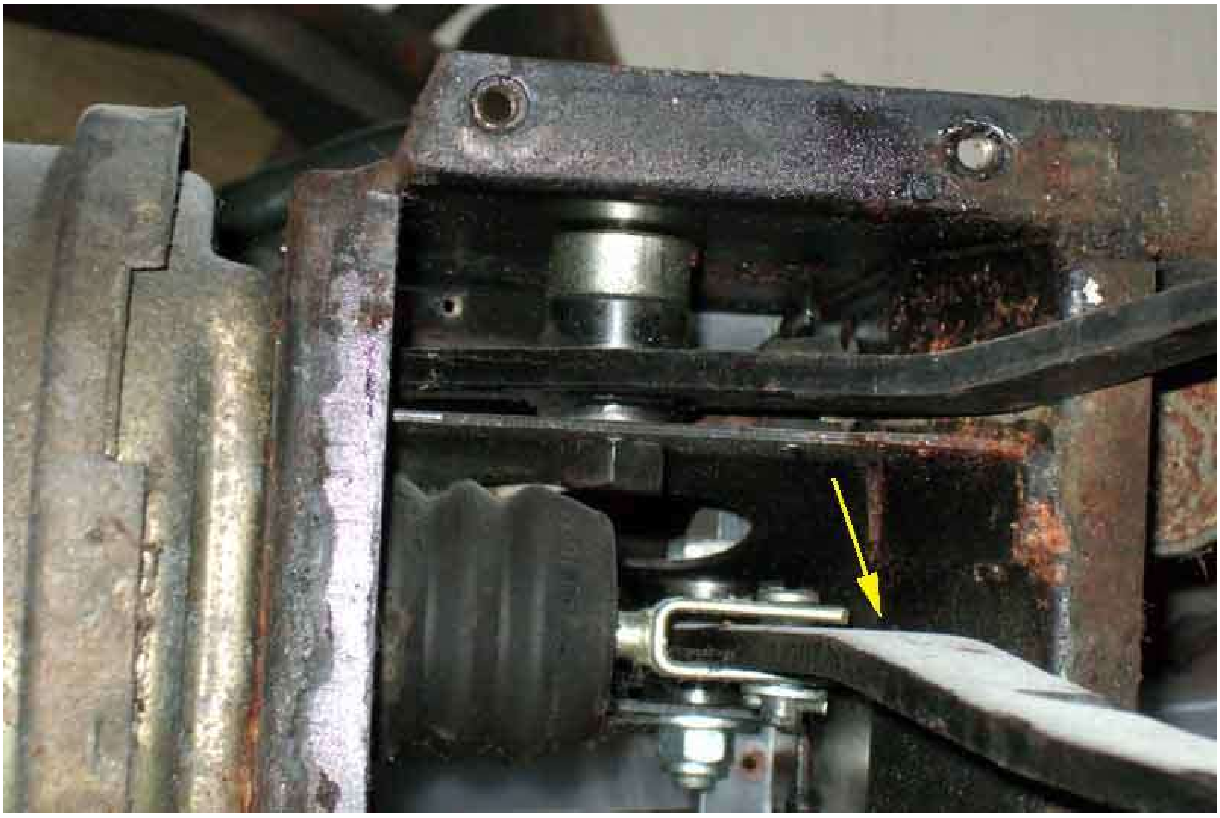
When gripping the distance tube 10 you should NOT be able to rotate it ...

... nor the spacer washers 11. If you can it's not clamped up as it should be. If clamping it prevents the pedals moving then either the pedal bush (15) is too wide or the pivot bush (6) is too narrow. If 10 and 11 are clamped up tight but the pedal still wobbles excessively then either or both of the pedal or pivot bushes are worn where they contact each other.

The boosted dual-circuit pedal box: Item 13 'Bush, pedal' BHH1101 for both pedals, not available as of January 2017. Item 12 'Distance Tube' BHH1099 is the pivot bush and item and 11 'spacer' BHH1098 for the clutch pedal, neither are available. However the drawings are not to scale as will be seen in the photos below. The pivot bush is much wider than the pedal bush, and the spacer is short and fat and fits over the pivot bush with the pedal. Item 6 'Distance tube' BHH1097 is the pivot bush for the brake pedal and is available. Note that as the pedal bushes are the same item, two of the shorter brake pivot bushes could be used for the clutch pedal bush (one cut down to give the correct overall length). Items 5 and 7 are conventional washers and used under the bolt head and nut i.e. their thickness is not critical, unlike the spacer washers used in the earlier assembly: (*Moss Europe)*



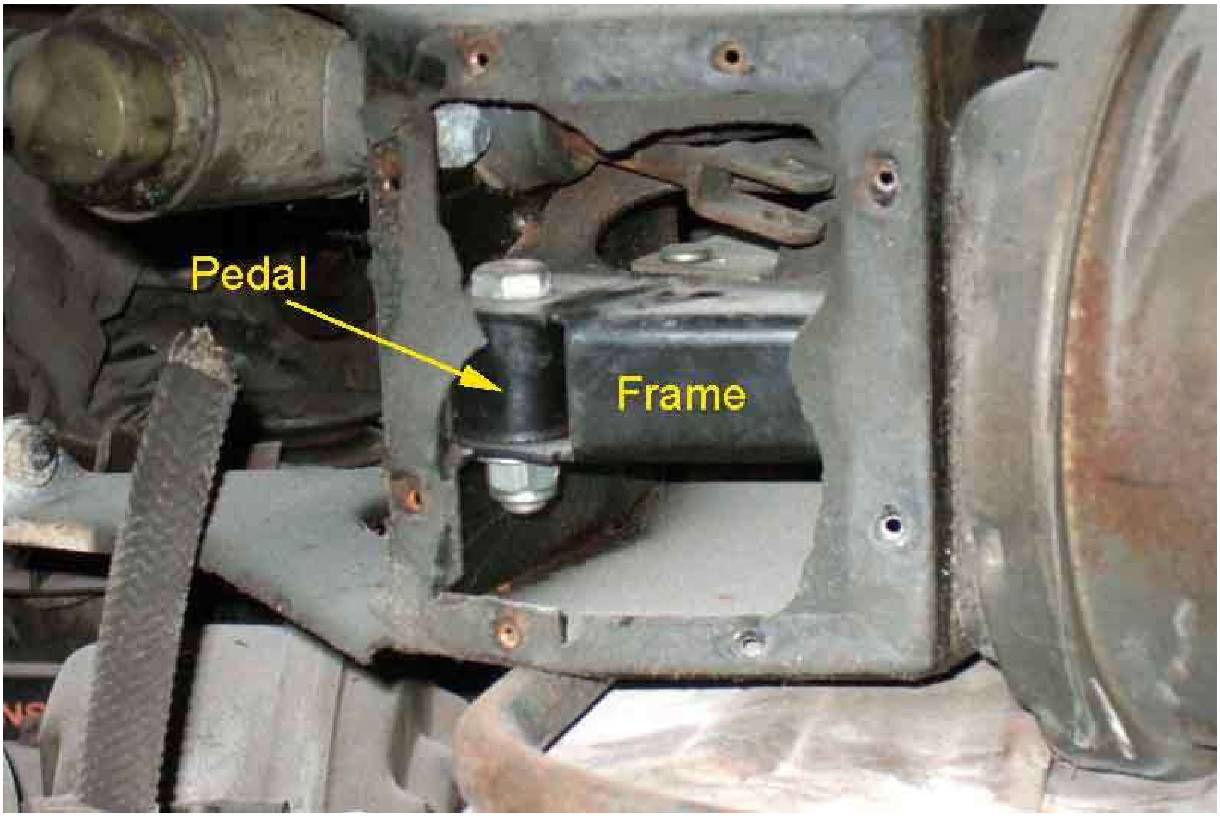
Showing the clutch pedal (at the top, brake pedal below) with spacer. What appears to be penny-washers under the pedal and above the spacer are reflections. The arrow indicates where the hole for the brake light switch must be on this pedal box, behind the brake pedal, which moves forwards (to the left in this image) and away from the switch as the pedal is operated.



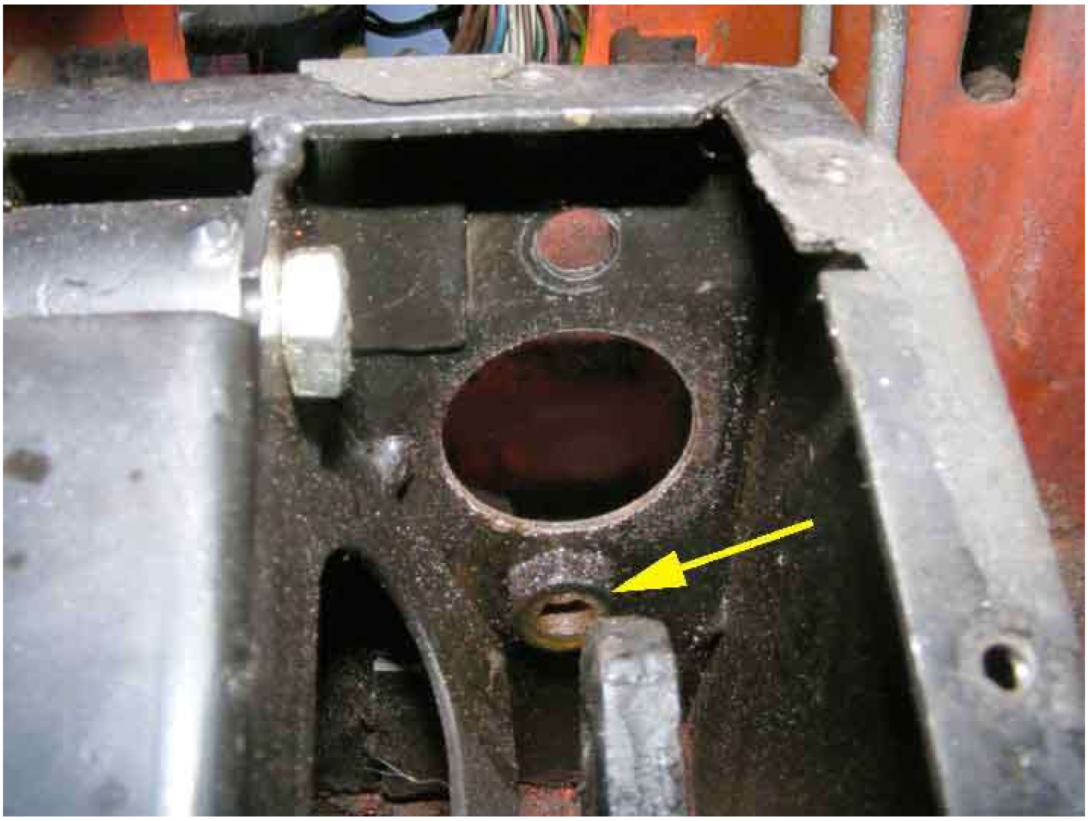
Clutch pedal with the distance tube (pivot bolt bush) flush with the pedal on the left, protruding on the right. The spacer sits on the distance tube with the pedal. The bolt head has a spring-washer. These original bolts do have a plain section below the head, which current replacements may not have, and the distance tube is initially a sloppy fit on the threads. However the distance tube is slightly wider than the pedal plus the spacer, so once the bolt is tightened the distance tube is clamped between the sides of the box, so the clearance between it and the pivot bolt threads is irrelevant.

The nut (arrowed) is welded to the box. Tightening the bolt clamps the distance tube (pivot bolt bush) into the box leaving the pedal and this spacer (note) free to rotate but with minimal sideways movement and 'wobble'.

The brake pedal pivot is even simpler. The distance tube is fractionally wider than the pedal and its bush, and is clamped into the box by the bolt and nut, leaving the pedal free to pivot with minimal sideways movement and 'wobble'. There should be a penny-washer under the bolt head as well as under the stiff-nut.



This view shows that the lower clutch master cylinder nut (arrowed) is welded to the inside of the frame, and therefore that the bolt goes in from the back of the master: (*Crispin Allen*)

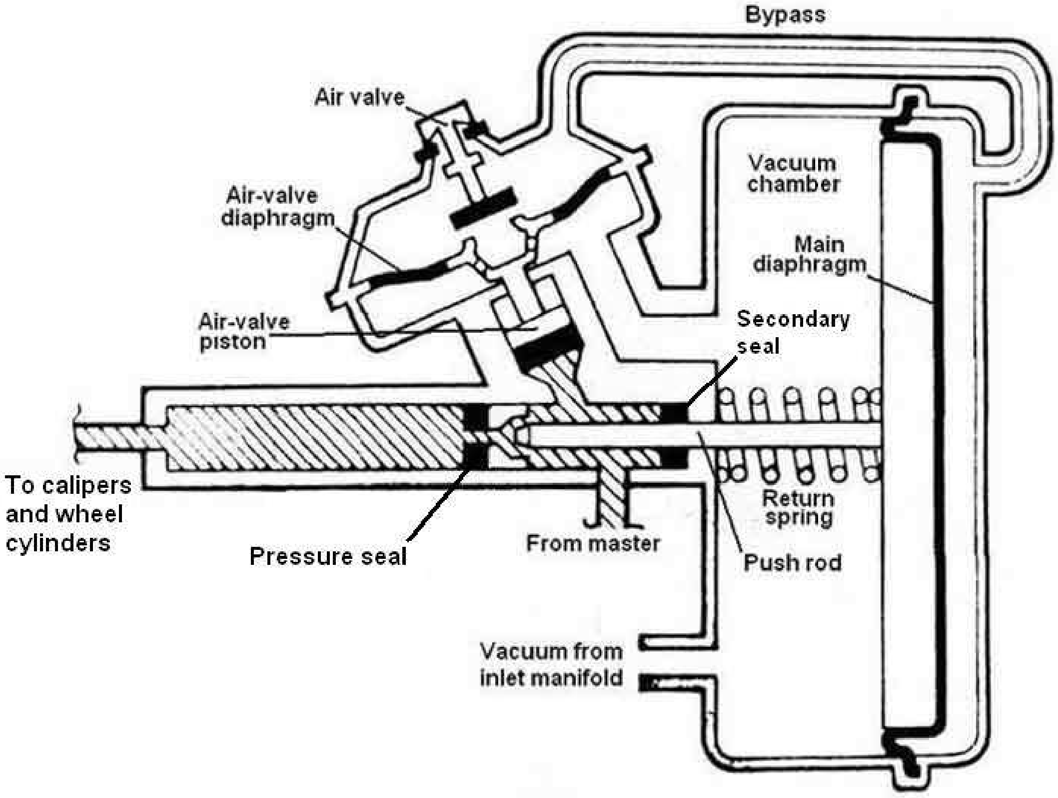


Remote Brake Servo

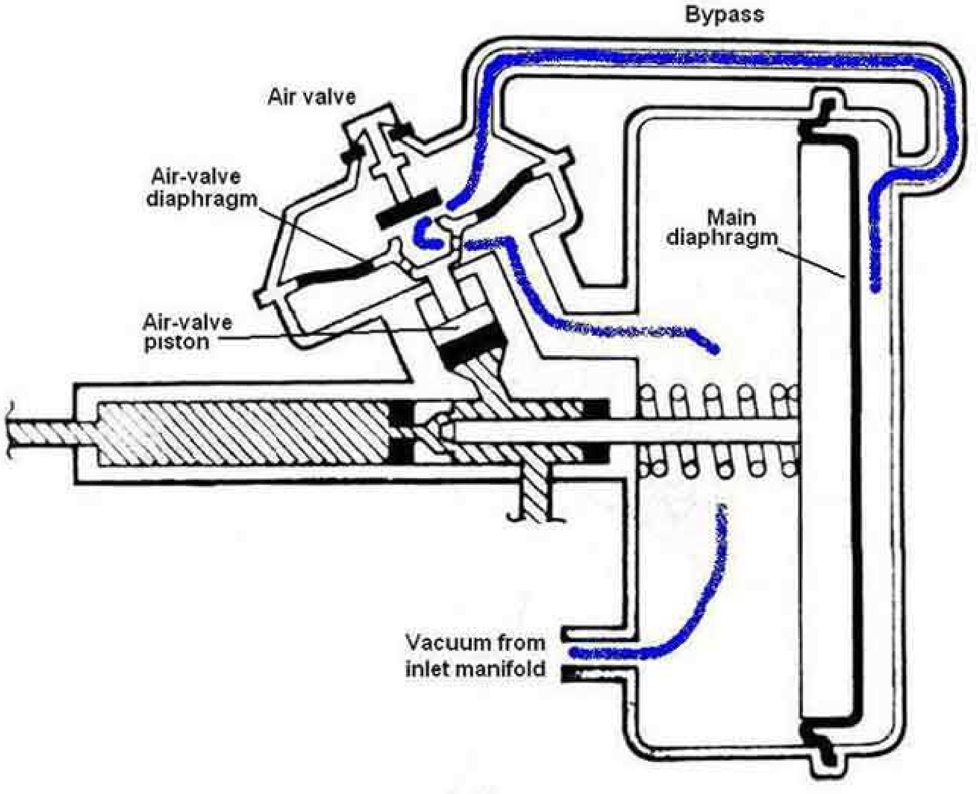
Operation Mounting Rebuild

Operation:

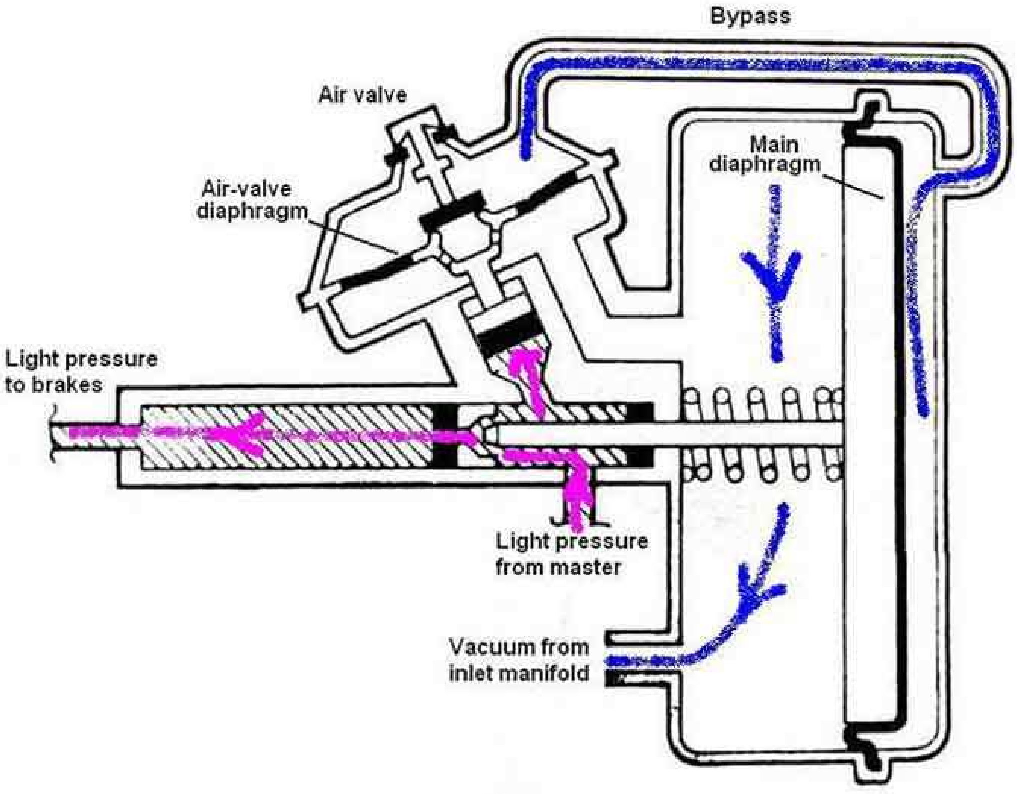
The main component parts



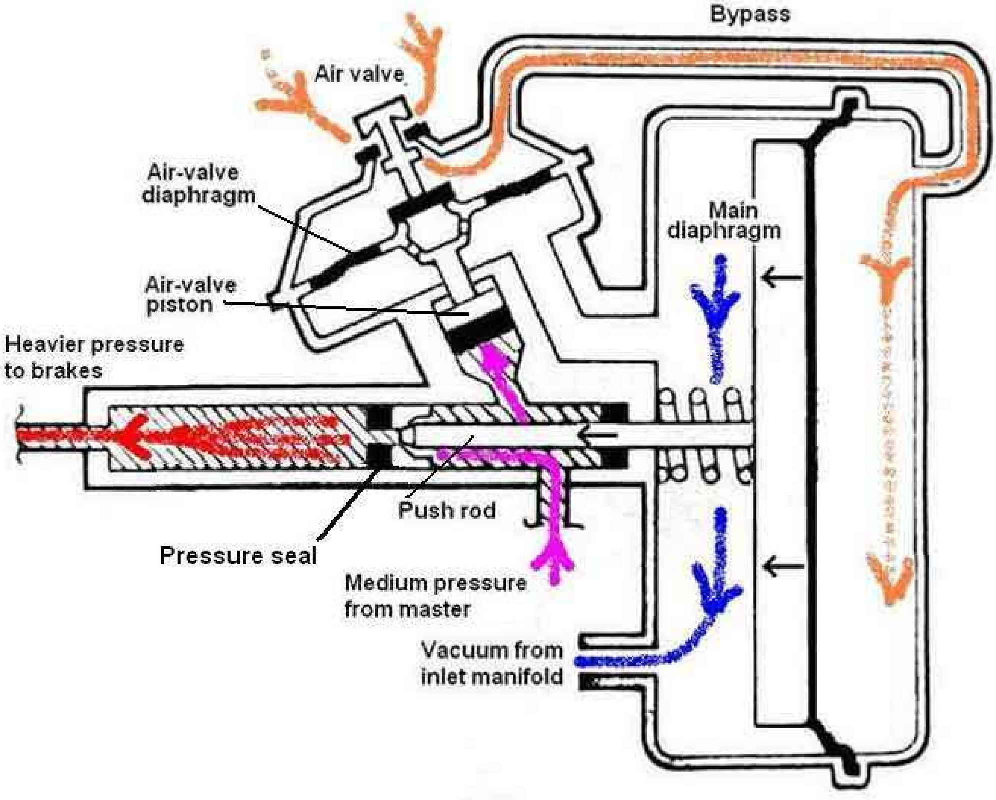
Engine running, brakes not applied. Vacuum from the inlet manifold is applied to the front of the main diaphragm, but also though the passage in the air-valve diaphragm, gap between the diaphragm and the air valve, the bypass pipe, to the back of the diaphragm. Thus the diaphragm has the same air pressure both sides and the return spring keeps it pressed to the back of the vacuum chamber.



Brakes applied lightly. Light fluid pressure from the master is applied to the bottom of the air-valve diaphragm, and also through the space between the push-rod and the slave cylinder and onward to the brakes. Light pressure on the air-valve piston (called the reaction valve in AP/Lockheed documents) pushes the air-valve diaphragm up to the air valve, closing off the gap between the two, but not yet lifting the air-valve off its seat. Thus there is still the same air pressure both sides of the diaphragm and it remains pressed to the back of the vacuum chamber. This lack of assistance on light pedal pressure prevents the brakes coming on harder and more suddenly than one might wish.

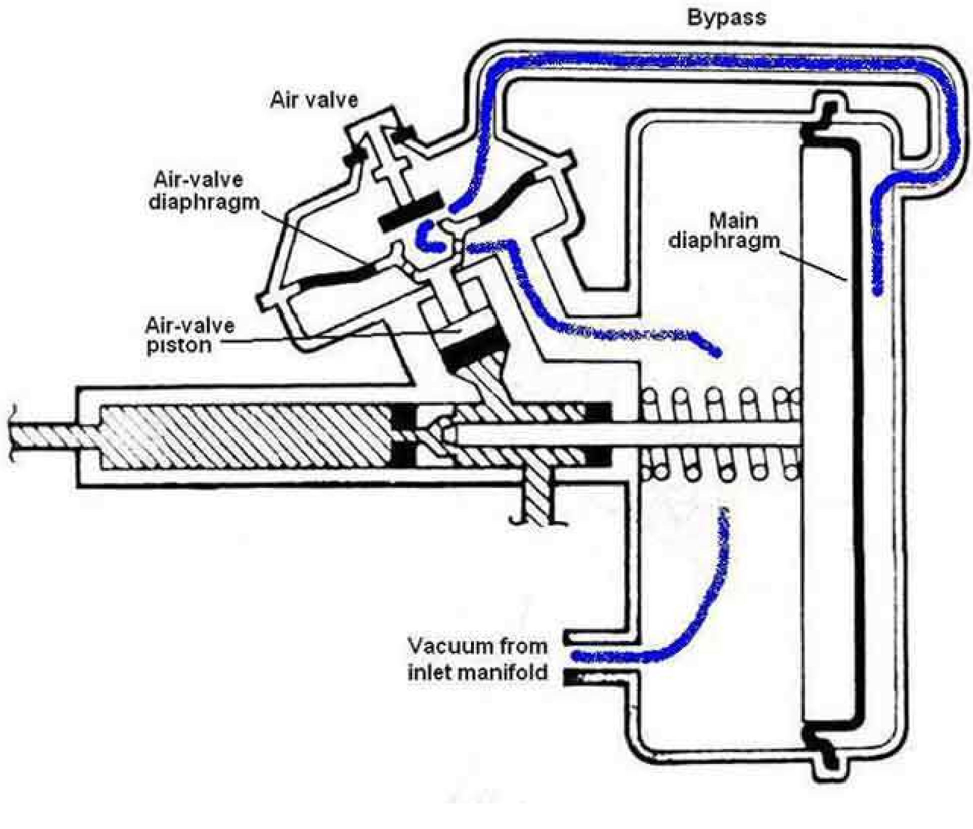


Heavier pressure on brake pedal. Heavier fluid pressure pushes the air-valve piston and its diaphragm further, which lifts the air-valve off its seat. This opens the air-valve allowing air at atmospheric pressure through the bypass pipe to the back of the diaphragm. With a depression on the other side the diaphragm is pulled forward, together with the push-rod, which closes off the gap between it and the slave piston, and pushes the slave piston along the bore to give a higher pressure at the outlet to the brakes than there is on the inlet from the master cylinder, which gives the 'boost' effect.



When the brake pedal is released, pressure on the air-valve piston is removed, it drops back, allowing its diaphragm and air valve to drop back also, and the latter closes the opening to the atmosphere. When the air-valve diaphragm moves away from the air valve the gap between them is opened up also, and manifold vacuum can now be applied via the bypass pipe to the back of the diaphragm again. This moves back to the rear of the chamber, pulling the push-rod back. The push-rod is connected to the slave piston with a loose connection (not shown in the diagram) so as well as opening up the gap between the two and releasing pressure from the brakes, it also pulls the slave piston back.

Note that as the servo releases a small amount of air passes from the back of the diaphragm into the inlet manifold. Some report that, with rapid and repeated presses of the brake pedal, the idle revs will rise. I don't get that, instead I will get a slight **drop** in idle speed during warm-up, which takes more and more presses as it warms up, until eventually it doesn't alter the revs at all at full operating temperature. **Note also that if the revs rise and stay risen while the brake pedal is held down, that does indicate a servo fault, whereby the air-valve is opening but the bypass isn't being closed off.**

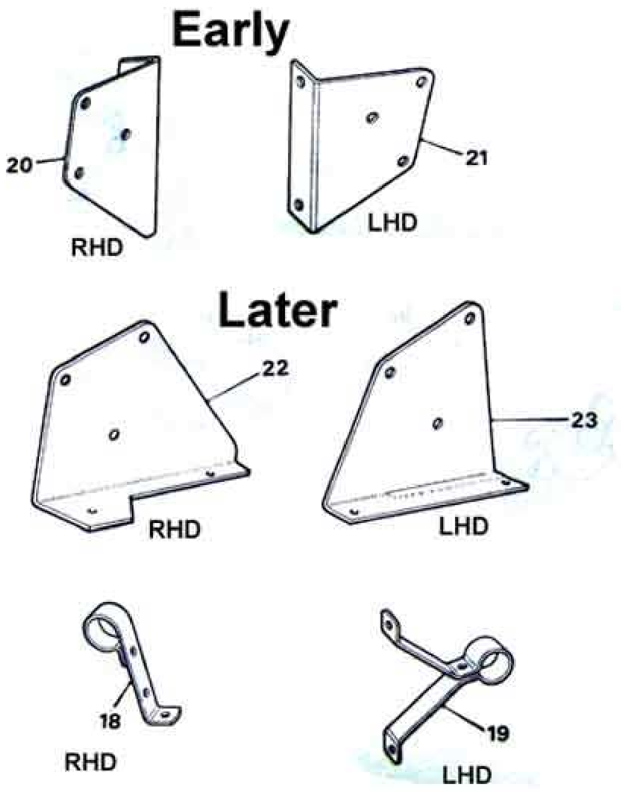


Note that if the secondary seal should leak fluid will escape into the vacuum reservoir, possibly being burnt in the engine, but in any case it can empty the master cylinder leaving you with no brakes. For that reason you may decide to fit a fluid level warning system. Commercial systems are available, but I decided to have a go at making my own. It works well, when I had a problem with the clutch causing the fluid level to drop immediately before a 3-day trip I was able to swap the two caps over and use the warning to top-up the clutch master before the level dropped too far and would need bleeding.

There is a one-way valve where the vacuum hose attaches to the servo, which ensures vacuum remains in the servo if the engine should stop while the vehicle is in motion - note that if the momentum of the car is still spinning the engine vacuum will still be maintained in the inlet manifold and hence the servo. However this will NOT occur if the throttle is held wide open, even if the engine is still spinning. While there is vacuum remaining in the servo the brakes will function normally i.e. with the usual amount of assistance, and it will take two or three presses of the pedal to 'empty' that vacuum. So another thing to remember is not to pump the brakes if the engine stops while moving ... to be counter-balanced by the possible need for cadence braking if the front wheels should lock!

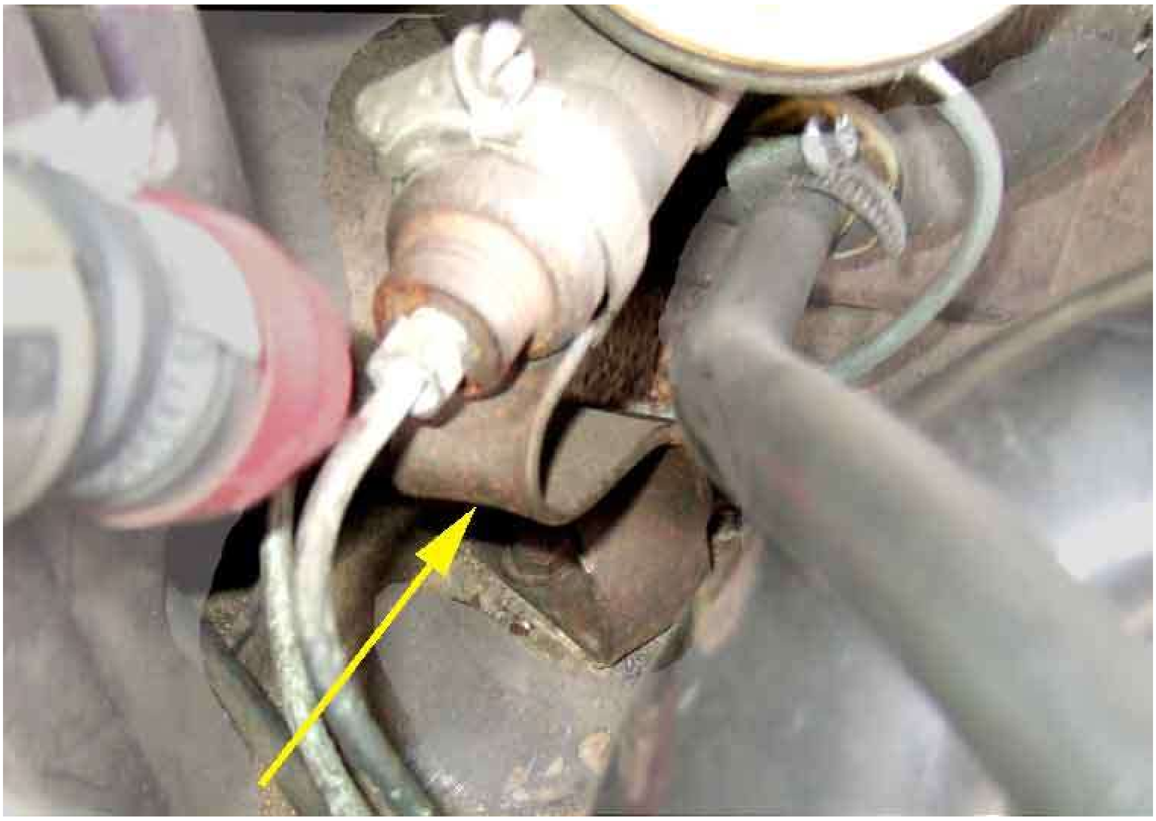
Mounting:

Parts Catalogue images for prior to the 1974 model year, note the 'fixed' cylinder supports 18 and 19 which don't allow the servo to be anything other than horizontal:



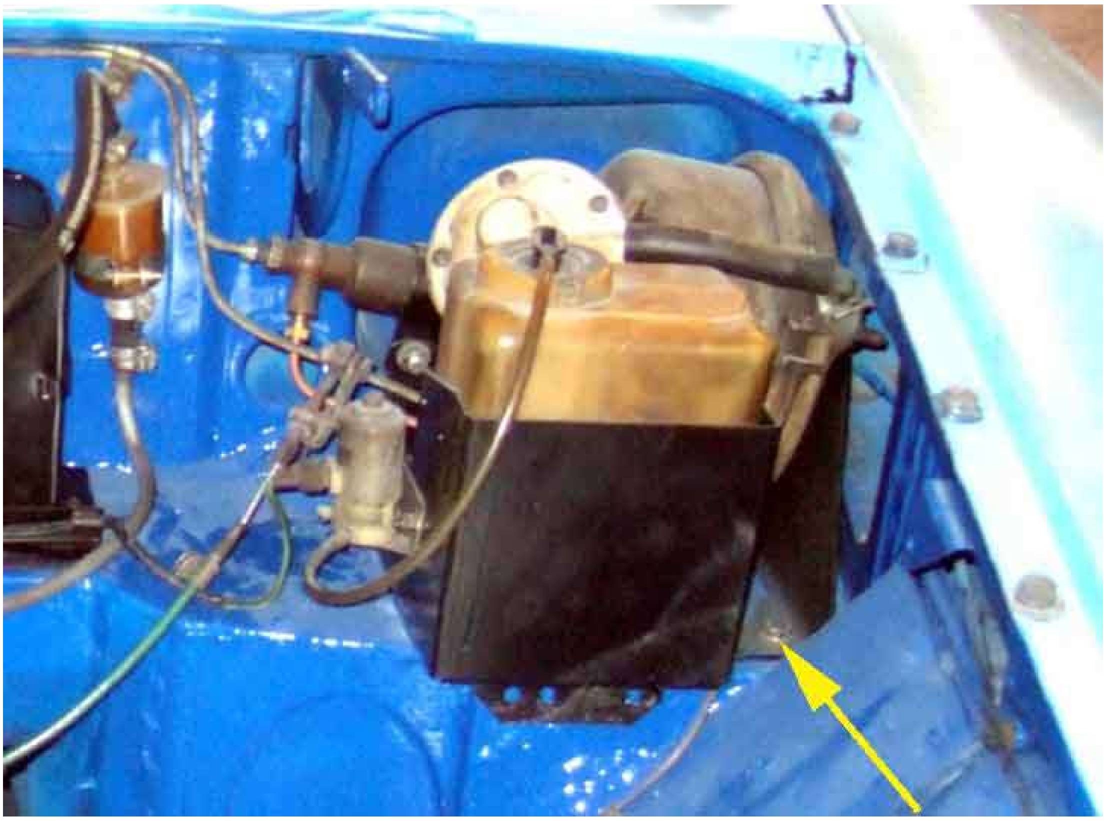
My 73 roadster - fixing bolt arrowed utilising the rear outer mounting point for the LHD pedal blanking plate, possibly another one further back, flattening part of the flange on the LHD pedal blanking plate:

Cylinder support - a crude 'S'-shape secured to the servo with a Jubilee clip:



This has to be a PO retrofit as the servo didn't become standard on UK cars until more than a year after Bee was built and it's not listed under optional extras on the Heritage certificate.

75 V8, fixing bolt arrowed, a bracket stud further back, positions the servo at a slight upward angle, but nothing like the AP/Lockheed drawing below. A much neater installation with the same positioning of air valve and cylinder as shown in the factory brochure:



Partially concealed behind other components, 'A' - mounting bracket, 'B' - cylinder support allowing the servo to be angled, used on all V8s and 4-cylinder cars for the 1974 model year on. The feet of bracket 'A' must be angled slightly to tilt the servo on the shelf, but it isn't apparent here:

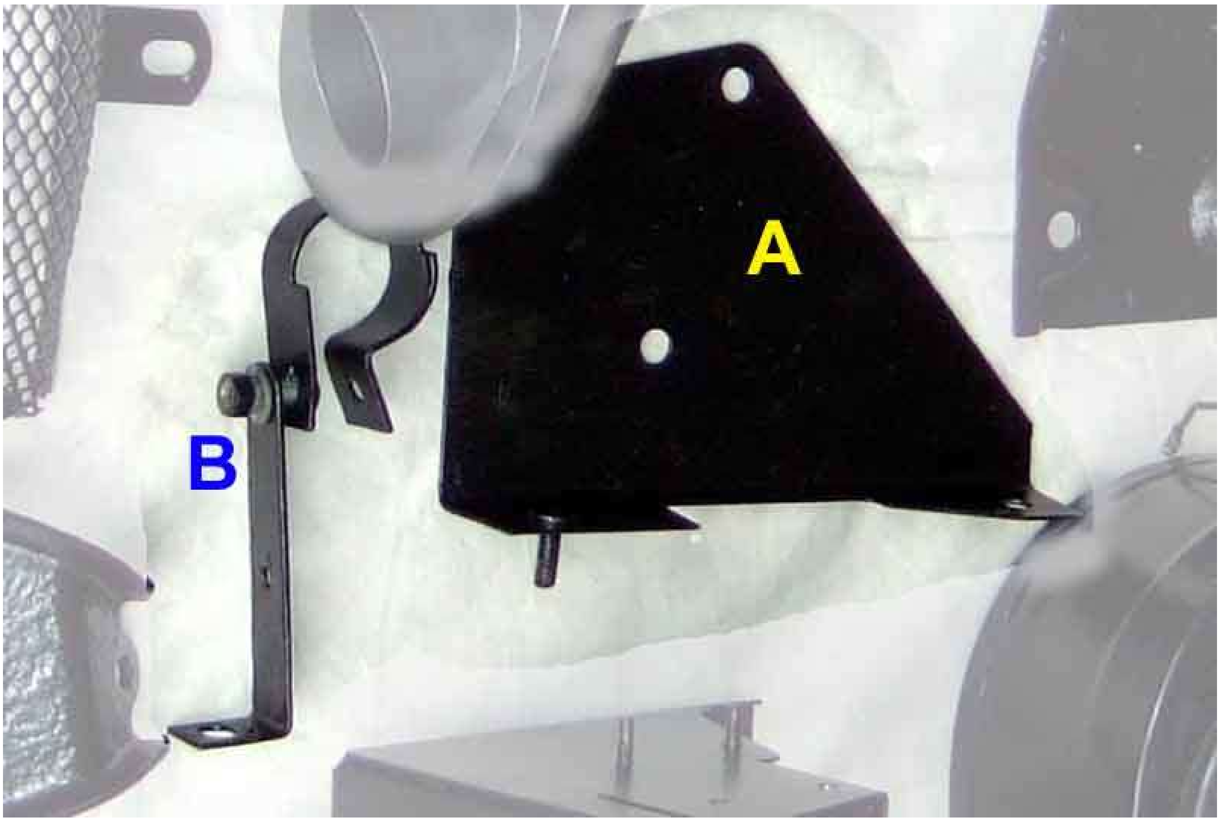
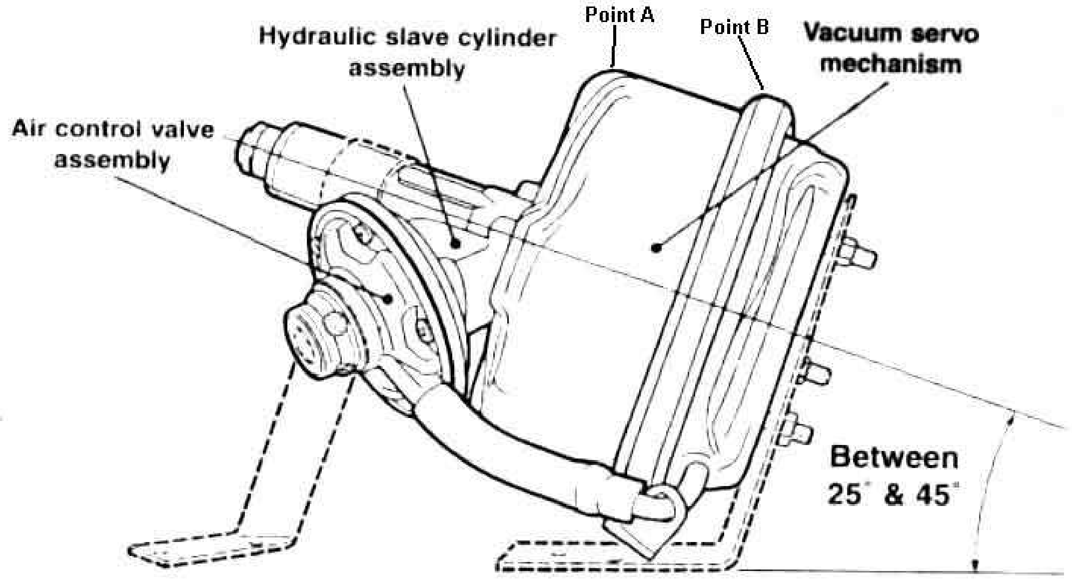


Image from AP/Lockheed fitting instructions [(this link downloads a PDF)]() found on a [Lotus Elan forum]() showing a pronounced upward angle of the cylinder, and the air-valve assembly pointing downwards, both of which will reduce the amount of air that can be trapped in the servo. But whether there is enough room to tilt the servo in an MGB by 45 degrees, or even 25 degrees, I don't know, as it is already pretty-well sandwiched between the bonnet and the shelf as it is. It could be tilted by about 10 degrees before point A rises above point B and so needs more vertical space, and once you start tilting it there is scope to move the whole servo down on the main bracket, so reducing the vertical space required.



LHD single-circuit with servo: This picture of an LHD V8 clearly shows the servo pointing forwards. A number of LHD V8s were built for testing in North America, so this appears to be a factory installation. They were returned to the UK then sold into private hands in Europe. This appeared in an advert in Holland sent to me by Hans, presumably for one of those cars. There was one in Damask Red, which this appears to be:

Rebuild:

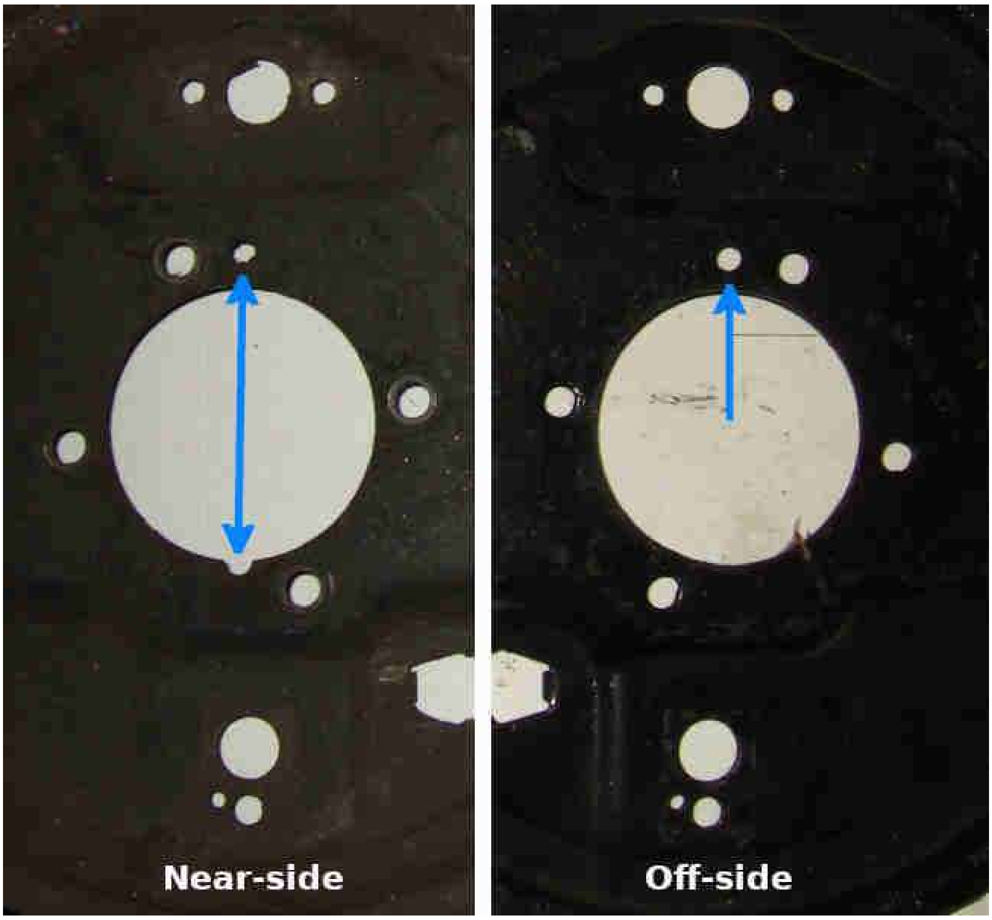
See this from The Landcrab Forum.

Wheel Cylinders

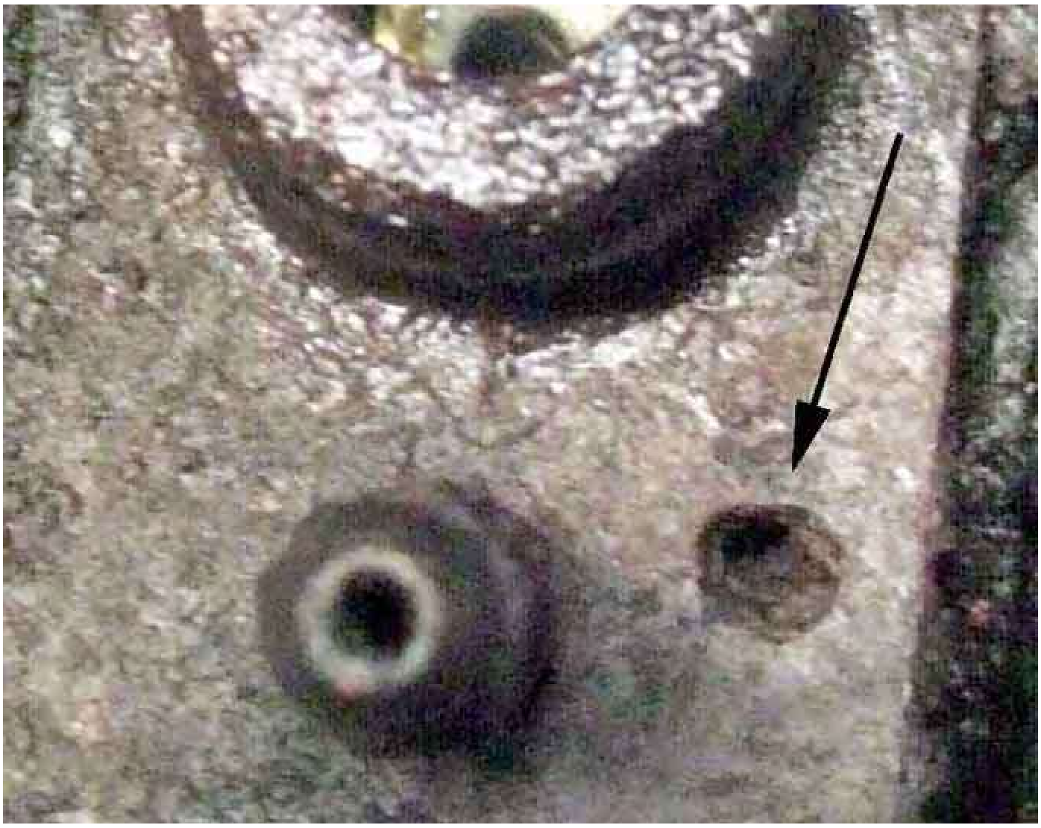
Later GT (not V8) cylinder showing the locating peg further away from the fluid port ...

... than the roadster, early GT and V8:

Bee's old backplates showing both notch and hole in one and just the hole on the other:



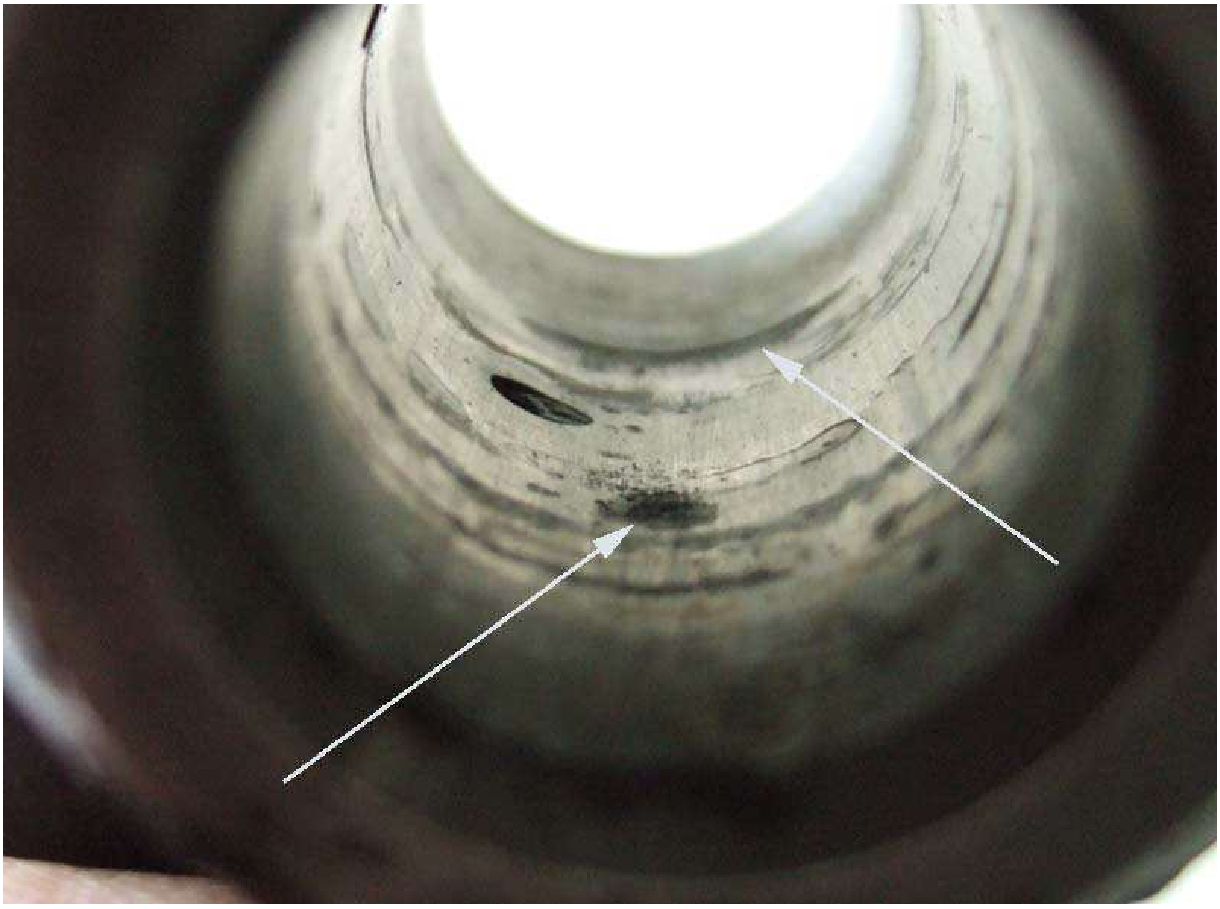
Vee's offside cylinder with the location roll-pin eroded away



Bee's right-hand cylinder which had just started leaking during a service. This image makes the outside look very rough and rusty, but in fact it is shiny metal, just a rough casting.

Right-hand end (the lower end when installed) containing rusty fluid in the boot and the bore with roughness, the other end was fine.

However with the pistons removed and the bore cleaned it was largely polished and shiny, but with several very localised areas that had been significantly eroded away, two of them arrowed here (the oval area between them is the bleed port). Was this very poor casting that the boring process failed to clear? Or porous metal in that area that rusted much quicker than the surrounding metal? They are both at the lowest part of the bore when fitted, so it probably **is** something to do with water in the fluid.



Something else I noticed was how easy the pistons pushed back into the bore, even with dry seals. I can remember in the past when I've changed seals having a helluva job getting them back in even with hydraulic fluid as a lubricant, because the seals stuck out so far. These stick out hardly any further than the pistons, and when you take the clearance between piston and bore into account will hardly be pressing on the bore at all.

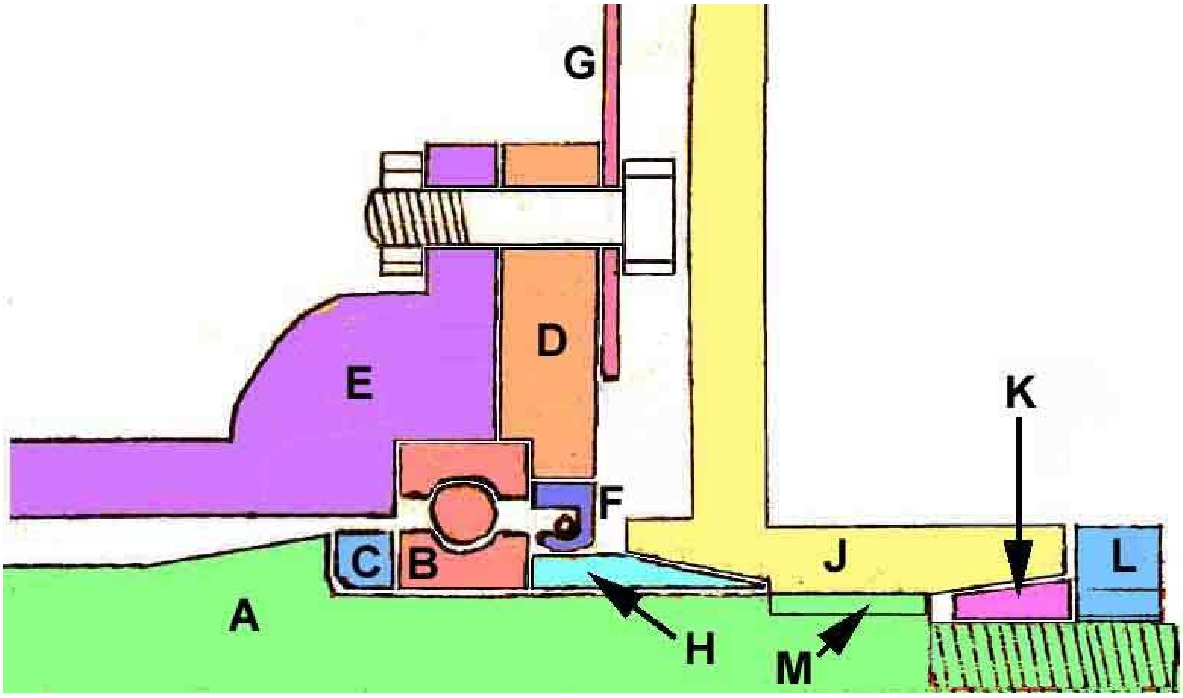
2021 and Vee's off-side wheel cylinder. Outside shiny metal but very rusty under the cover, as are the piston and bore outside the seals:

Clean bore where the seals run:

Hub Assembly

Salisbury:

Representative sketch only, not to scale

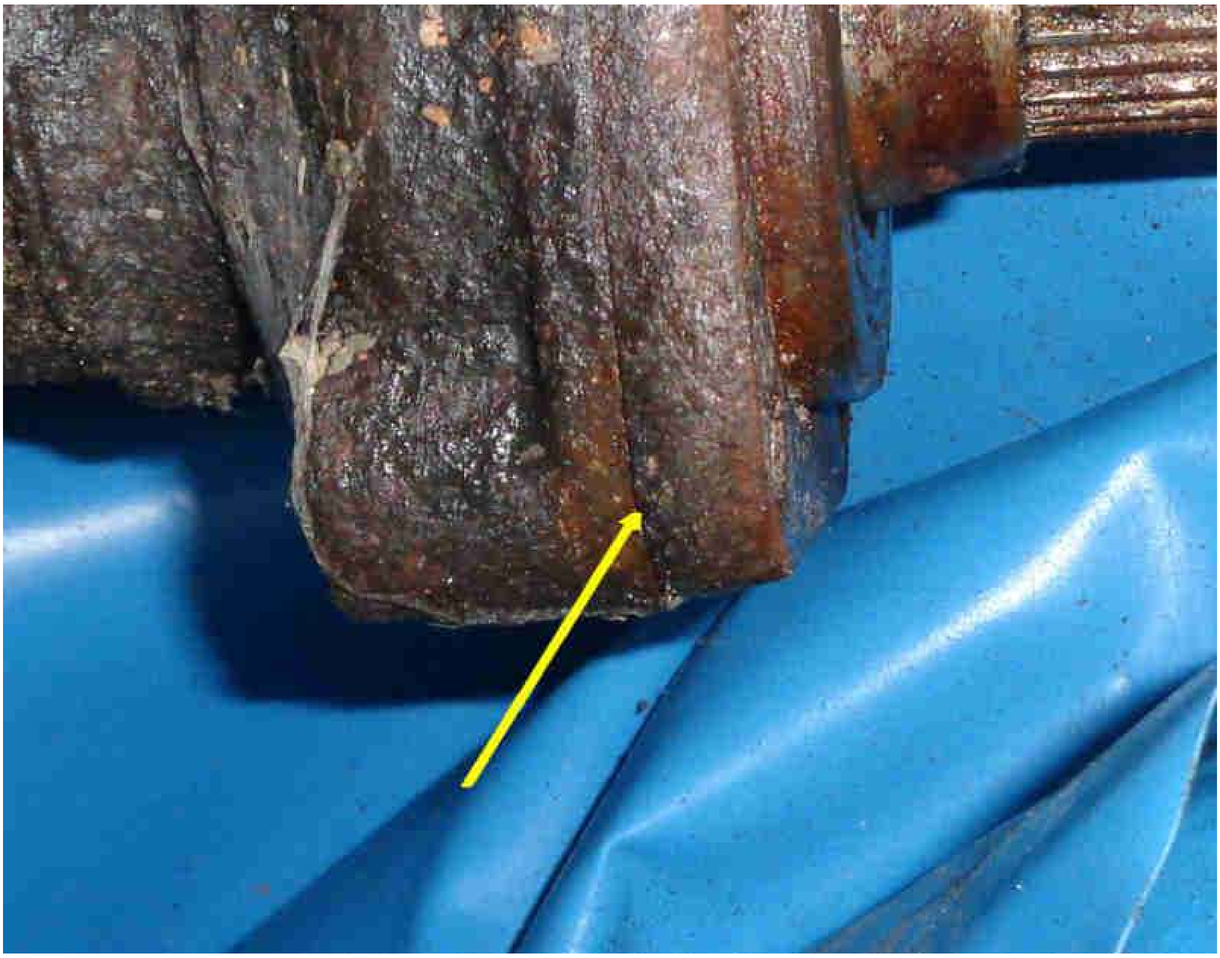


A - Half-shaft	B - Bearing	C - Bearing spacer	D - Bearing cap
E - Axle casing	F - Oil seal	G - Back-plate	H - oil seal collar
J - Hub	K - outer collar	L - Hub nut	M - Splines

Note the orientation of 'C': The chamfered corner must go up against the corner on the half-shaft. If fitted the other way round the half-shaft and hub will be pushed closer to the centre of the car. Probably not enough to cause a problem, but even so.

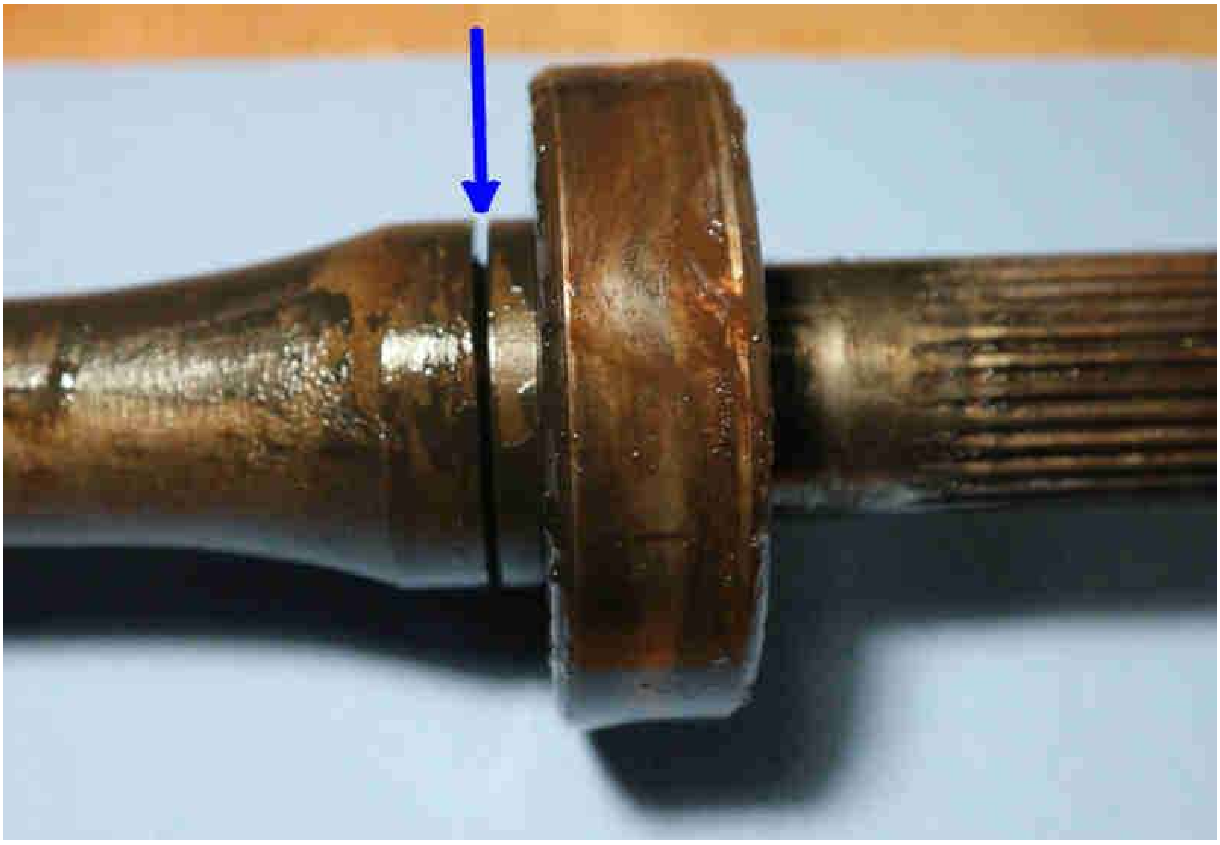
Axle with bearing cap. The join between the two can be difficult to see as the two halves are rough cast on the outside and the same size and shape:

But should be visible somewhere:

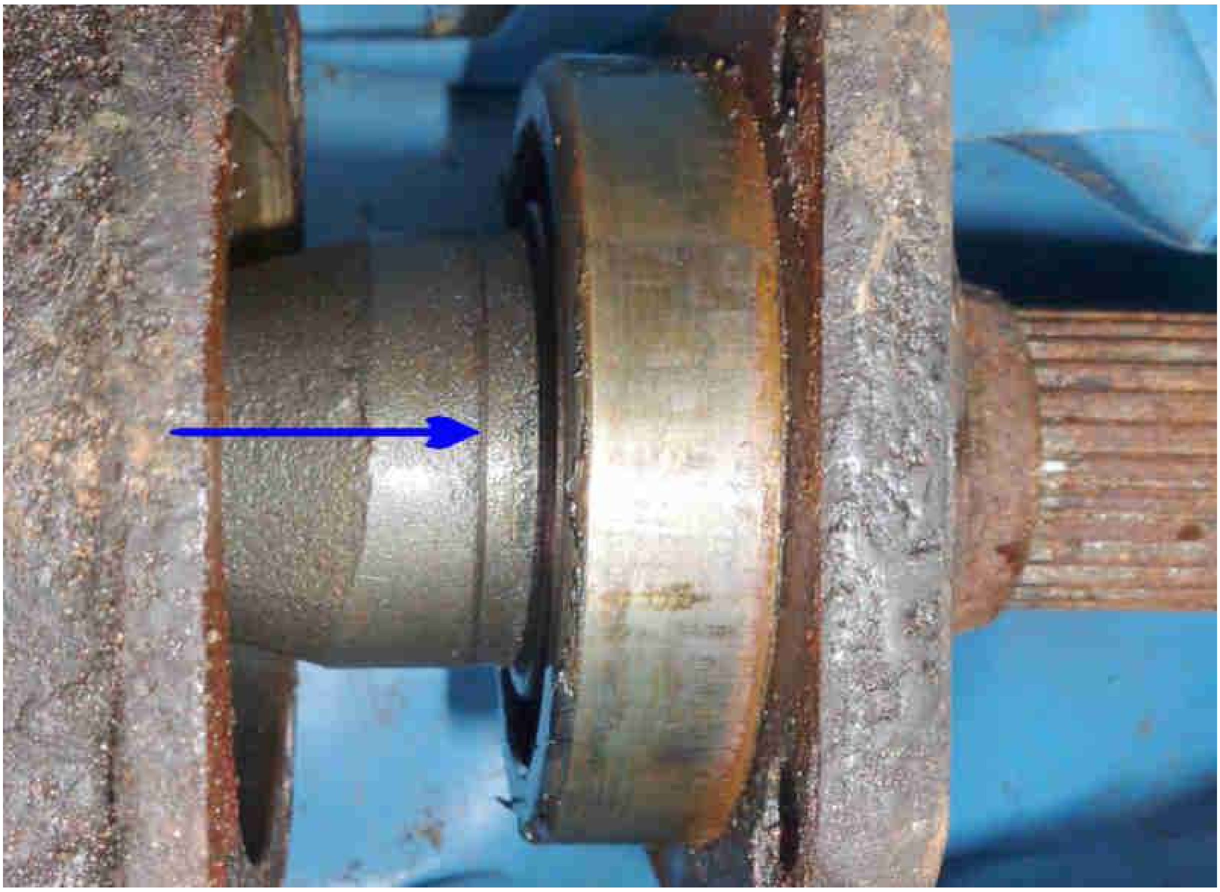


If struggling to part them try tapping the cap round with a hammer and drift above one of the holes, then a soft drift round the back of the cap on the now exposed parts should release it:

Father Ted's half-shaft with a clear gap between spacer and shaft shoulder:

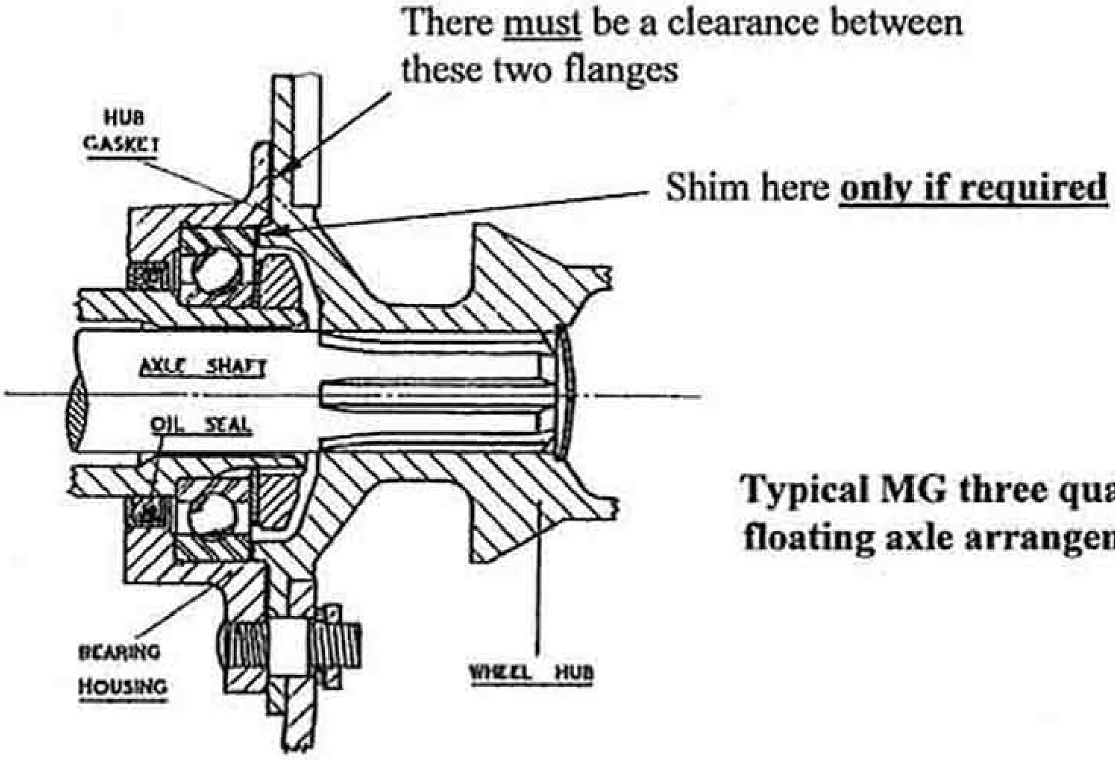


Which should not be there:



Typical MG Banjo:

From [Totally T-Type 2]



Typical MG three quarter floating axle arrangement

Fitting rear brake cylinder E-clips

The tool I put together:

Looking at the clip it consists of a ring with a section cut out and three tongues pointing inwards. It isn't flat but slightly twisted such that the middle tongue is bent one way and the other two the other which makes it 'handed'. Whilst it can be fitted either way I found that if fitted with the two end tongues pointing towards the backplate held the cylinder in place, it was a bit sloppy, but fitting the clip the other way up results in the 'spring' in the clip holding the cylinder firmly. It seemed to me that by pressing down evenly on the outer part of the ring you could get the tongues to ride over the edge and slide down the sides of the boss on the cylinder at least part of the way. Then it should be a relatively easy matter of pressing the tongues down to drop into the groove of the boss. Both the commercially available tools use a bolt screwed into the pipe fitting of the cylinder, and a nut on the bolt to apply the force which seemed reasonable, and a 3/8" UNF bolt and nut satisfy that requirement.

I found a brass pipe fitting in a box of bits where the outer circumference of the fitting was just slightly bigger than the clip as shown above (note that this picture shows the clip the 'wrong' way up).

The next requirement is to be able to position the clip correctly and firmly before applying the pressure. The fitting above has a large hole in the centre which allows far too much lateral movement, but I found that the Outside Diameter (OD) of a nut off a 1/2" compression fitting was just slightly bigger than the Inside Diameter (ID) of the larger fitting, and with a little filing down of the angles of the spanner flats allowed it to be pressed into the larger fitting. This still left quite a bit of free play, but I found a wheel nut (off a Metro, or possibly dating back to when I had a Mini around 1970) again with a little filing could be pressed into the inner fitting. This was the same 3/8" thread as the bolt, so drilling a clearance hole allows it to slide up and down the bolt while giving very good lateral location. This left the tapered section of the wheel nut standing proud, which I cut off.

This still allowed the clip to move around under the 'tool', but I found an old copper U-bend a short length of which snugly fitted over the circular portion of the larger fitting to hold the clip in exactly the right position. To clear the bleeder valve and locating peg I shaped the brass fitting and copper sleeve as shown. A later refinement (right-hand picture) was to chamfer the ID of the outer fitting to make it easier for the tongues of the clip to be eased over the end of the cylinder boss. Note that in the left-hand picture the clip is in the correct orientation for fitting.

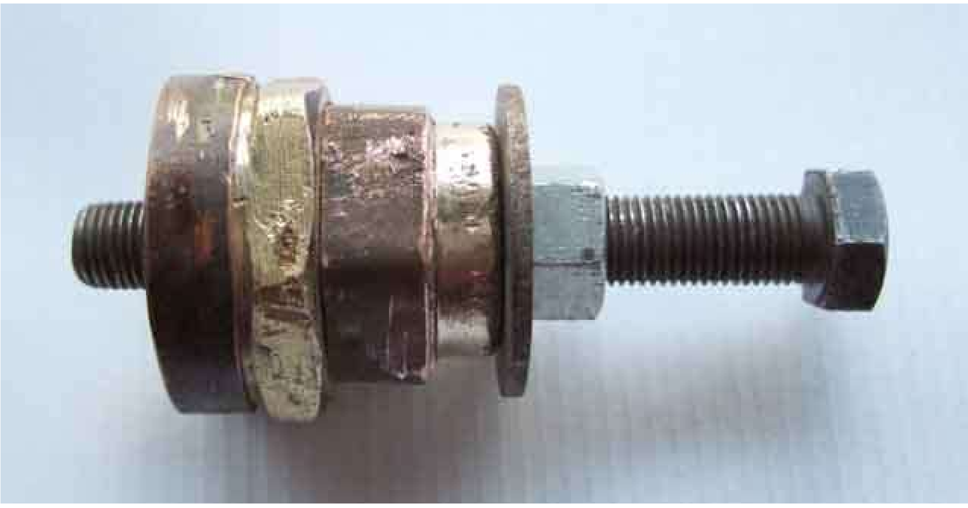
In use you just 'hang' the clip off the boss by its middle tongue ...

... then fit the tool over the clip while you screw the bolt into the pipe fitting. Gently turn the nut, there is a little resistance then a 'click' and the nut becomes much easier to turn ...

... as the clip slips onto the boss, although the tongues are not yet located in the groove. At this point you could press the tongues of the clip into the groove one-by-one with a screwdriver with no chance of it pinging off but I wanted to go a bit further. I had noticed that the ID of the 1/2" compression fitting nut I had used was just slightly smaller than the OD of the slave cylinder boss. I found another nut and a bit of work with a file opened it out so it just slides over the boss. This then can be used with the bolt and nut as before and a suitably sized washer to press all three tongues into place in one go. I felt it would be nicer to have both parts of the tool attached together and found another piece of copper pipe of smaller diameter than the first which with a bit of shaping was an interference fit over the spanner flats of the two 1/2" compression fitting nuts so holding them together. They could be brazed but I don't have the facilities.

So now I just install the clip over the boss with the tool one way round, remove it and refit it the other way round as above, and with a couple of turns of the spanner you can hear the tongues clip into place in the groove.

So there it is, a few hours fun in the garage saving some aggro under the car.



But one year I was not able to use the tool so came up with using a pair of outside circlip pliers to fit the clip. The pins on the pliers naturally gravitate to beside the end tabs, so just squeezing the handles opens up the clip:

In practice the U-bolts get in the way of straight pliers, which have to be angled upwards, angled pliers would almost certainly be easier. But even so a hand around the edge of the back-plate with a thumb pressing the slave onto the back-plate, and a finger tip gently pressing the top of the E-clip so make it square with the boss on the slave, a squeeze of the handles, and Robert is your mother's brother.

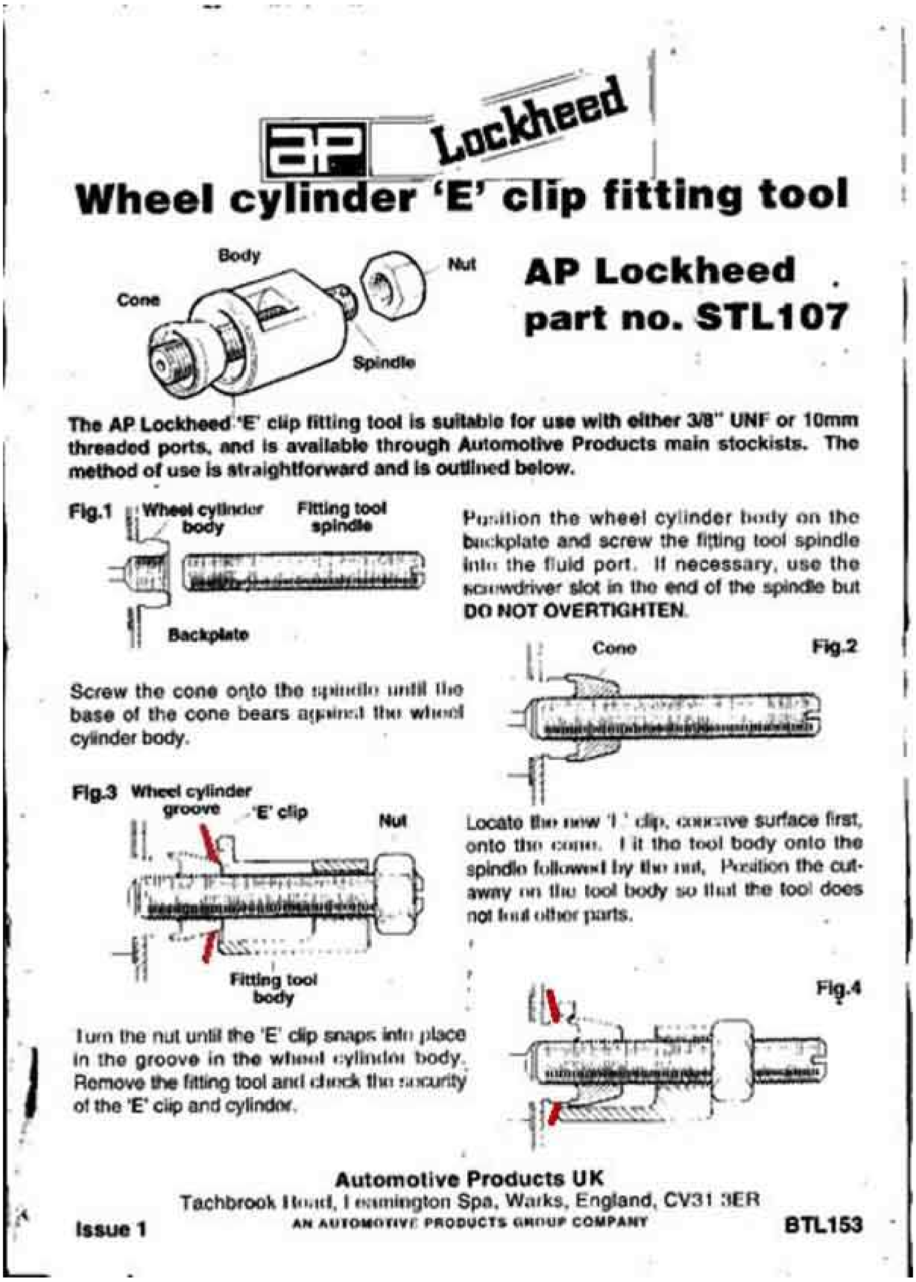
August 2015: A while ago someone on one of the fora got rather exercised about my orientation of these eclips insisting quite vociferously that my way was wrong. A couple of other people saying their known-history cars were as I describe from the from the factory made no difference, and this from the sectioned MGB at Gaydon looks the same to me.

With the convex face of the clip towards the back-plate the curved part is pressed against it:

All three tabs snap into the slot on the cylinder:

Whereas fitted the other way the corners of the clip are digging-in to the back-plate, the outer tabs do not snap into the slot, and pop out again all too easily:

In September 2020 Dave O'Neil came up with this document that does say it should be fitted with the concave face against the back-plate, not the convex:



AP Lockheed

Wheel cylinder 'E' clip fitting tool

Body / Nut / Cone / Spindle

AP Lockheed part no. STL107

The AP Lockheed 'E' clip fitting tool is suitable for use with either 3/8" UNF or 10mm threaded ports, and is available through Automotive Products main stockists. The method of use is straightforward and is outlined below.

Fig.1 Wheel cylinder body / Fitting tool spindle / Backplate

Position the wheel cylinder body on the backplate and screw the fitting tool spindle into the fluid port. If necessary, use the screwdriver slot in the end of the spindle but **DO NOT OVERTIGHTEN**.

Fig.2 Cone

Screw the cone onto the spindle until the base of the cone bears against the wheel cylinder body.

Fig.3 Wheel cylinder groove / 'E' clip / Nut / Fitting tool body

Locate the new 'E' clip, concave surface first, onto the cone. Fit the tool body onto the spindle followed by the nut. Position the cut-away on the tool body so that the tool does not foul other parts.

Fig.4

Turn the nut until the 'E' clip snaps into place in the groove in the wheel cylinder body. Remove the fitting tool and check the security of the 'E' clip and cylinder.

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Nigel Atkins (who applied the red highlighting to the document to emphasise the edges of the tabs) said he had used a similar tool and that way round the clip did slide on easier. There is also a YouTube video out there that shows the tool being used to fit the clip my way round, but someone has posted a comment that the clip just digs into the cone. So if using the tool you may have to do it that way, but using the circlip pliers I'll stick to my way.