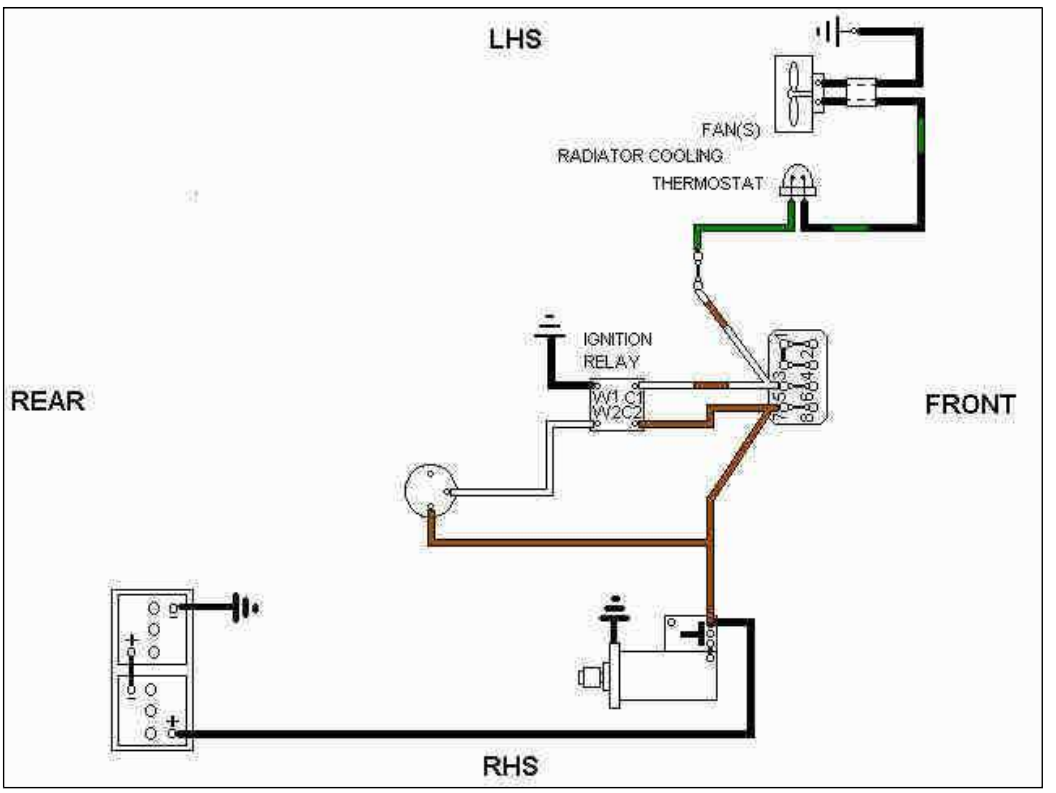
Electric Cooling Fans Schematics

4-cylinder cars 4-cylinder cars with added relay Factory V8 Factory V8 modified

Hover over a wire to confirm the colour

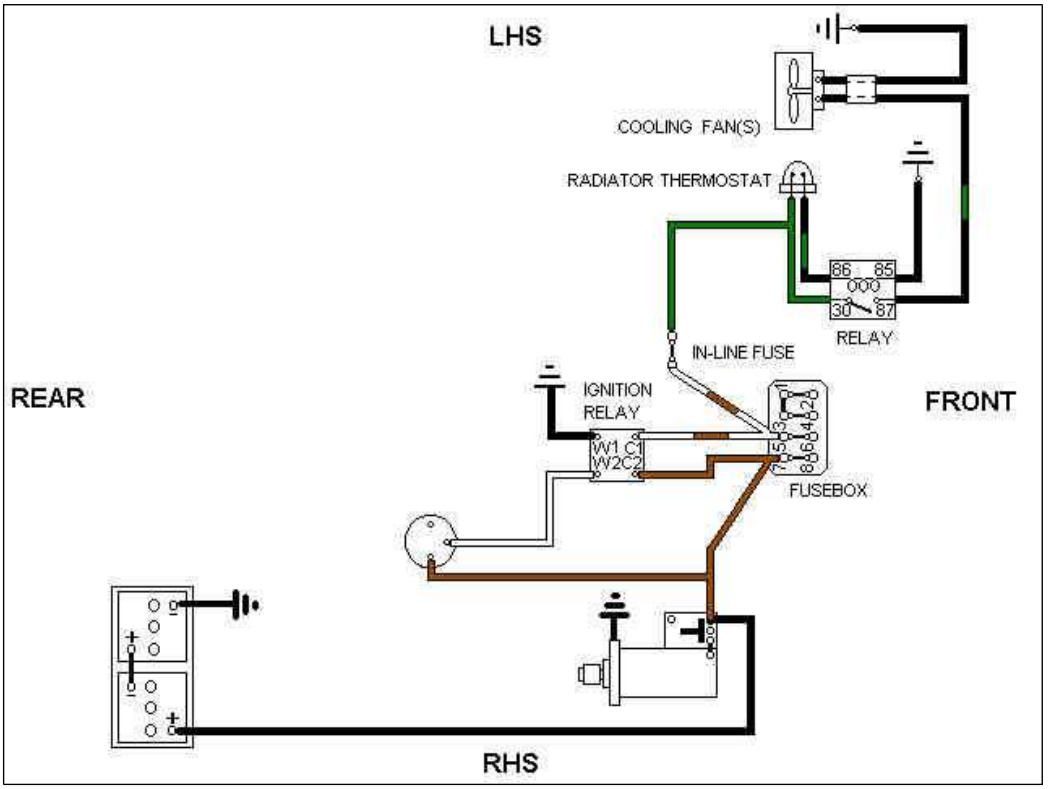
All cars fans share a ground with the headlights so a slightly poor ground connection here may cause the headlights to dim more than usual when the fans switch on. Likewise when the headlights are on it will affect fan speed and hence cooling more than normal.

4-cylinder cars



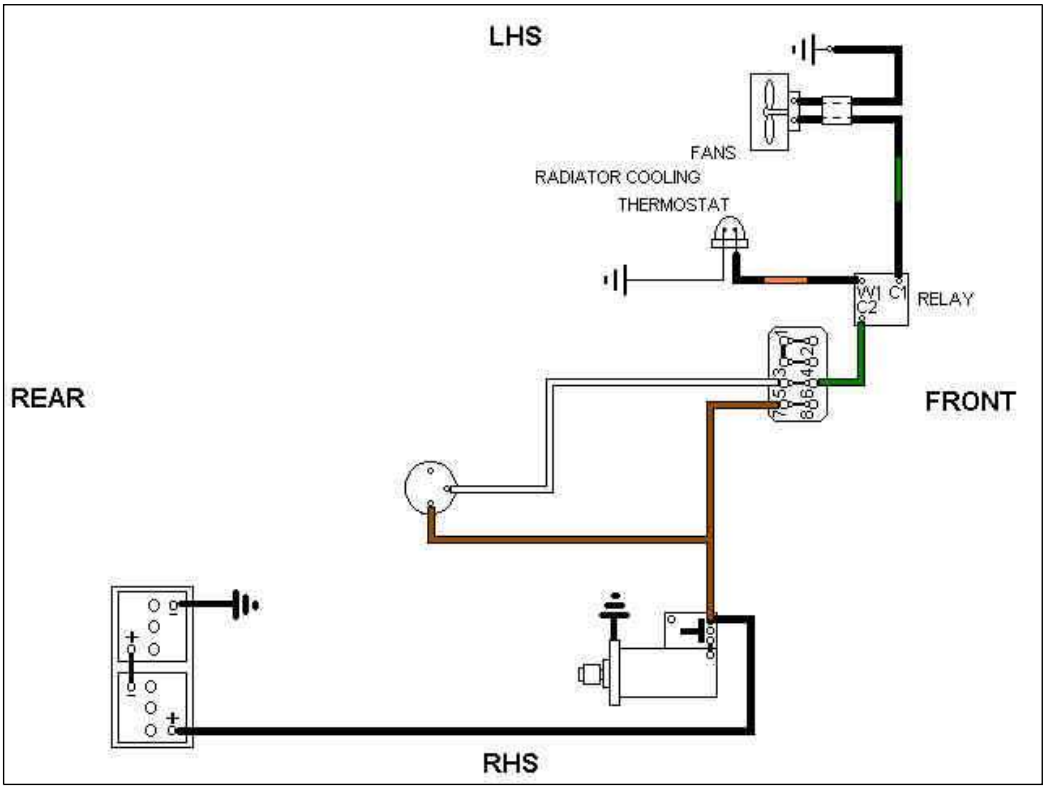
Notes:
1: North American cars had two fans connected in parallel other markets only have a single fan.
2: All 4-cylinder cars have an in-line fuse in the fan circuit. This fuse is fed from the white/brown (ignition relay but see below) circuit then feeds the thermostatic switch with a green wire. Be aware that this green wire is nothing to do with the main green circuit that is fused from the 2nd fuse up in the 4-way fuse block.
3: It seems that early cars with electric fans may have had a fan relay before they got an ignition relay and when they got the ignition relay the fan relay was deleted. The Parts Catalogue shows a 3-terminal relay the same as for the V8s but in order to use this the sensor switch would have to be wired differnetly probably he same as for the V8s.
4: Some owners have moved the white/brown wire for the fans from its usual position on the 4-way fuse block to a spare brown spade. This results in the fans continuing to run when the ignition has been turned off or indeed starting to run after you have left the car. Nothing earth-shattering in doing so - except that a fault could cause the fans to flatten the battery or in the worst case start a loom fire.

4-cylinder cars with added relay



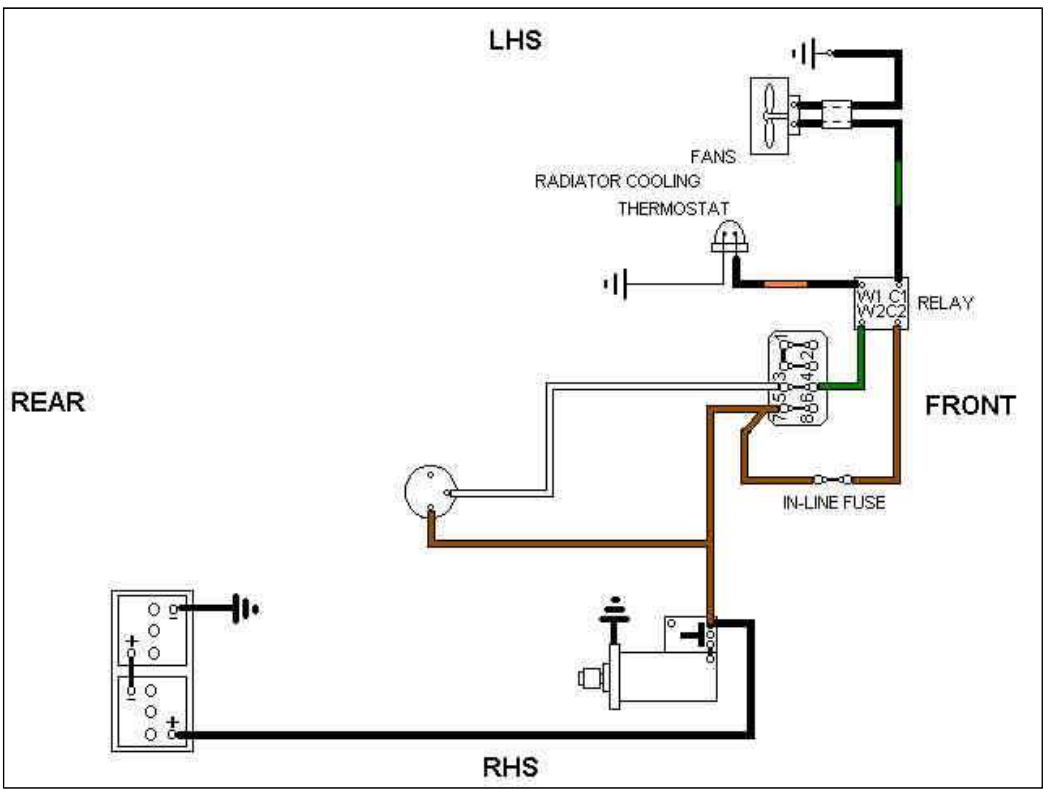
Notes:
1. In this circuit the fan wire is moved from the thermo switch contact to a relay contact. When the thermo switch closes it extends 12v from the green through to the relay which operates to a ground. The green on the thermo switch contact is extended to the other relay contact which when it closes powers the fans. Thus the same green feed is used to power both the relay and the fans but the thermo switch only carries the light current of the relay the relay carries the heavy current of the fans.
2. You should not need to add a relay to 4-cylinder cars with standard fans even two as the standard switch seems more than man enough for the job. However if replacement radiator switches fail quickly they may like replacement brake light switches be of poorer quality than the originals in which case a relay may be beneficial.
3. The relay contact number given are for current after-market relays. If using a standard Lucas relay use W1 for 85 W2 for 86 C1 for 30 and C2 for 87.

Factory V8



Notes:
1. Factory V8s have two fans wired in parallel.
2. The original relay is an unsual 3-terminal design in which the green supply from the fusebox is used to operate the relay in series with the sensor switch to ground as well as being extended through the contact to power the fans. This puts a heavy additional load on the green circuit - about 10 amps in my case - fusebox and ignition switch. The heated rear window also a high current item does the same thing. Not a good idea with 30 year-old electrics and a significant contributor to non-flashing indicators.

Factory V8 modified



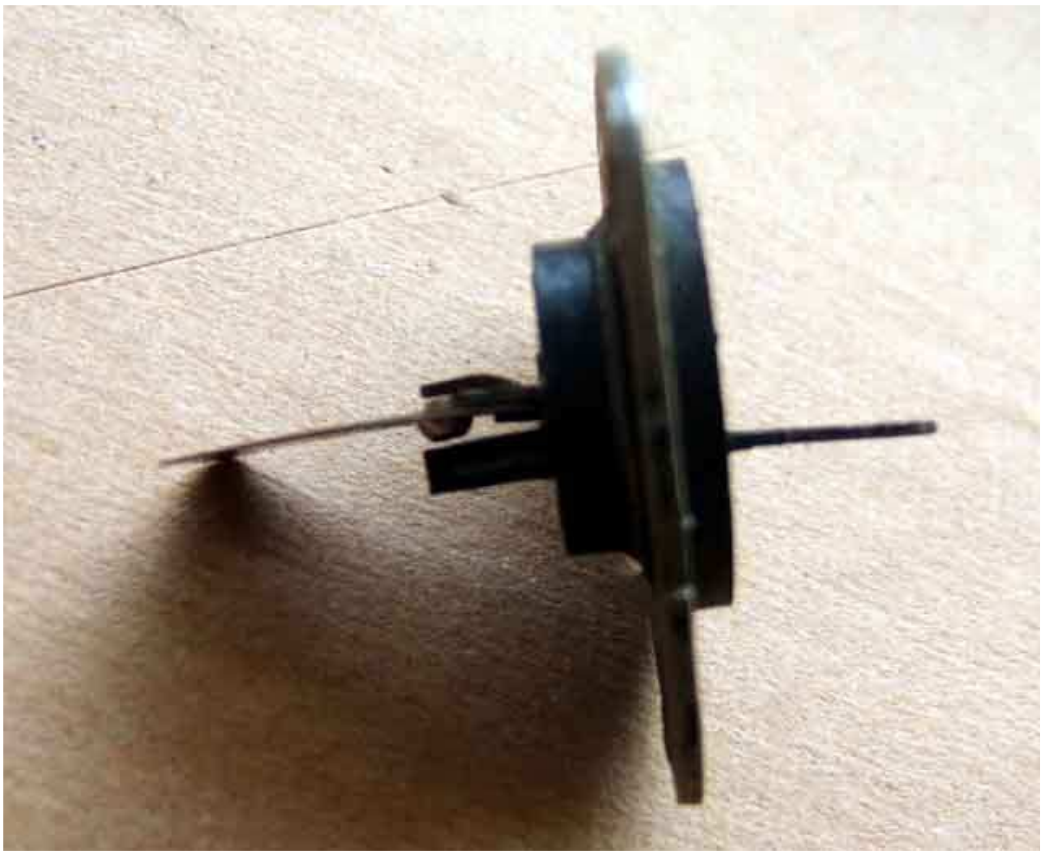
Notes:
1. Originally I though the V8 diagram was a misprint as mine has a four terminal relay with a connection from the brown circuit at the fusebox to the contact and hence the fans themselves meaning that only the load of the relay winding is on the green circuit. A useful modification but it should really be fused for safety either as shown with an in-line fuse in the wire to the brown circuit at the fusebox or an aftermarket fused relay.
2. Even with this brown feed instead of the green there is significant volt-drop in the fan grounds which share a relatively small-gauge wire with each other and the headlights right back to a grounding point by the fusebox. I provided an additional heavy gauge ground connection to a lug under one of the mounting bolts to the bonnet slam-panel for each motor. As my alternator has a spare large output spade and a spare input spade on the relay I provided a heavy gauge brown wire between them to increase current still further. These changes supplied an extra 25% or so voltage to the motors which gives a very noticeable increase in fan speed and hence cooling. In this case you either need an in-line fuse in each brown feed join the two browns together and then via a single in-line fuse to the relay or a single in-line fuse from the relay contact to the black/green fan wire.
3. Thanks to Graham Cornford for pointing out the error in the relay terminal naming. 4. If using a modern relay the terminal numbering would be W1 = 85 or 86, W2 = 86 or 85, C1 = 87, C2 = 30.

V8 'Otter' Cooling Fan Switch

General view (note the tabs have been bent back for opening up)

The switch uses a bi-metal strip to 'ping' a contact open and shut to get a clean electrical make and break.

The contact resting on its back-stop with clearance to the internal part of the spade connection. When I opened up mine it was pinging back and fore OK but not always making a good contact, even the low current of the relay is enough to cause some arcing at the contacts due to the relay inductance and back-emf. I tried cleaning the contact surfaces, but there is very little room, and by the time I had finished it was no longer pinging back and fore. I'd already bought and fitted the Burlen replacement by this time, this exercise was just out of interest.



Cooling Fans - Mechanical

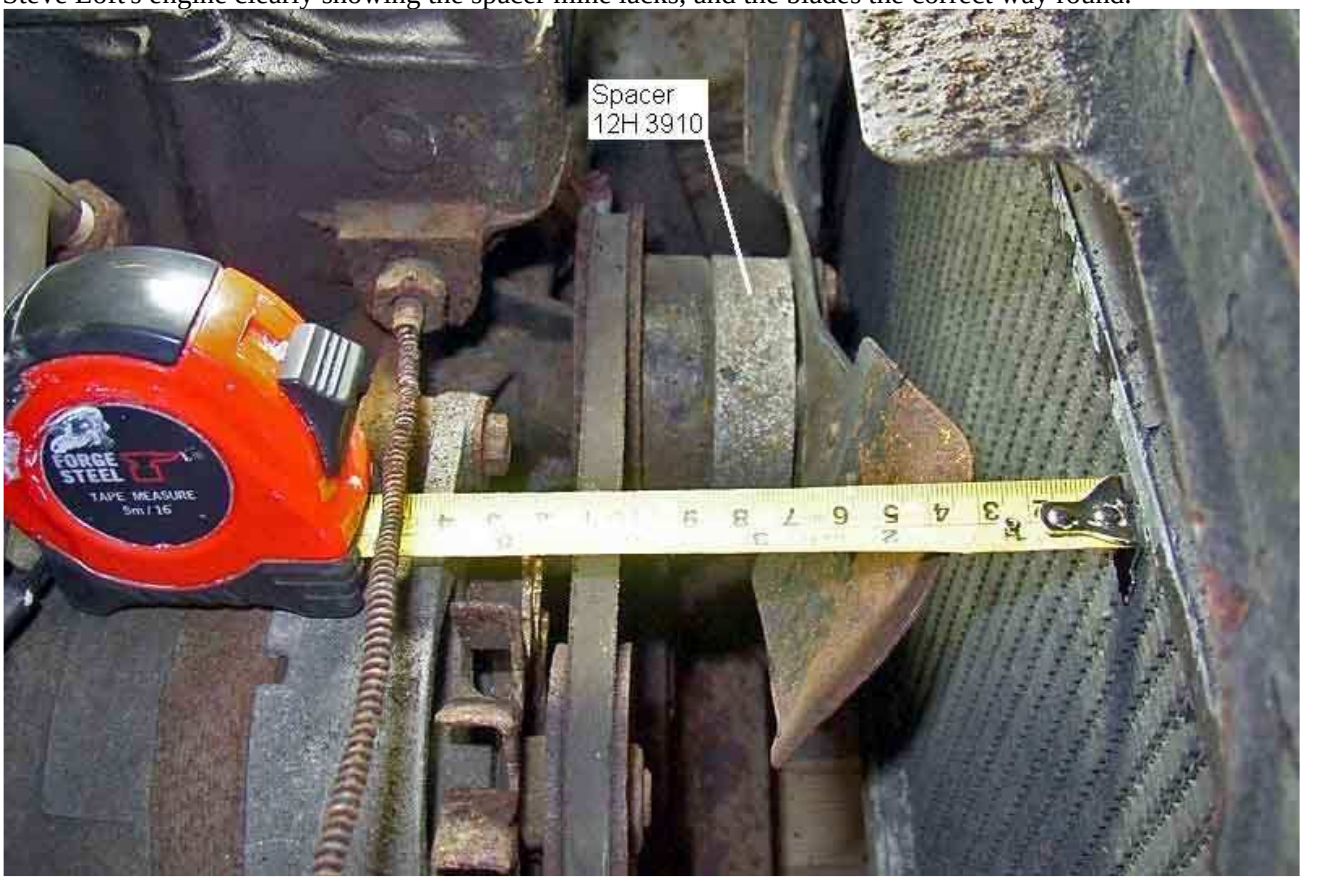
A general view of the fan, the wrong way round, in relation to the pump, alternator and radiator. The free end

of the measure is against the back of the radiator core.

Logically this should be the side of the fan that faces the engine, with the concave and smoothest surface best able to push the air towards the engine i.e. pull it through the radiator.

This should be the side that faces the radiator. Note how much higher the central boss is off the ground, which alters the relative distances between blades, engine and radiator according to which way round the fan is mounted.

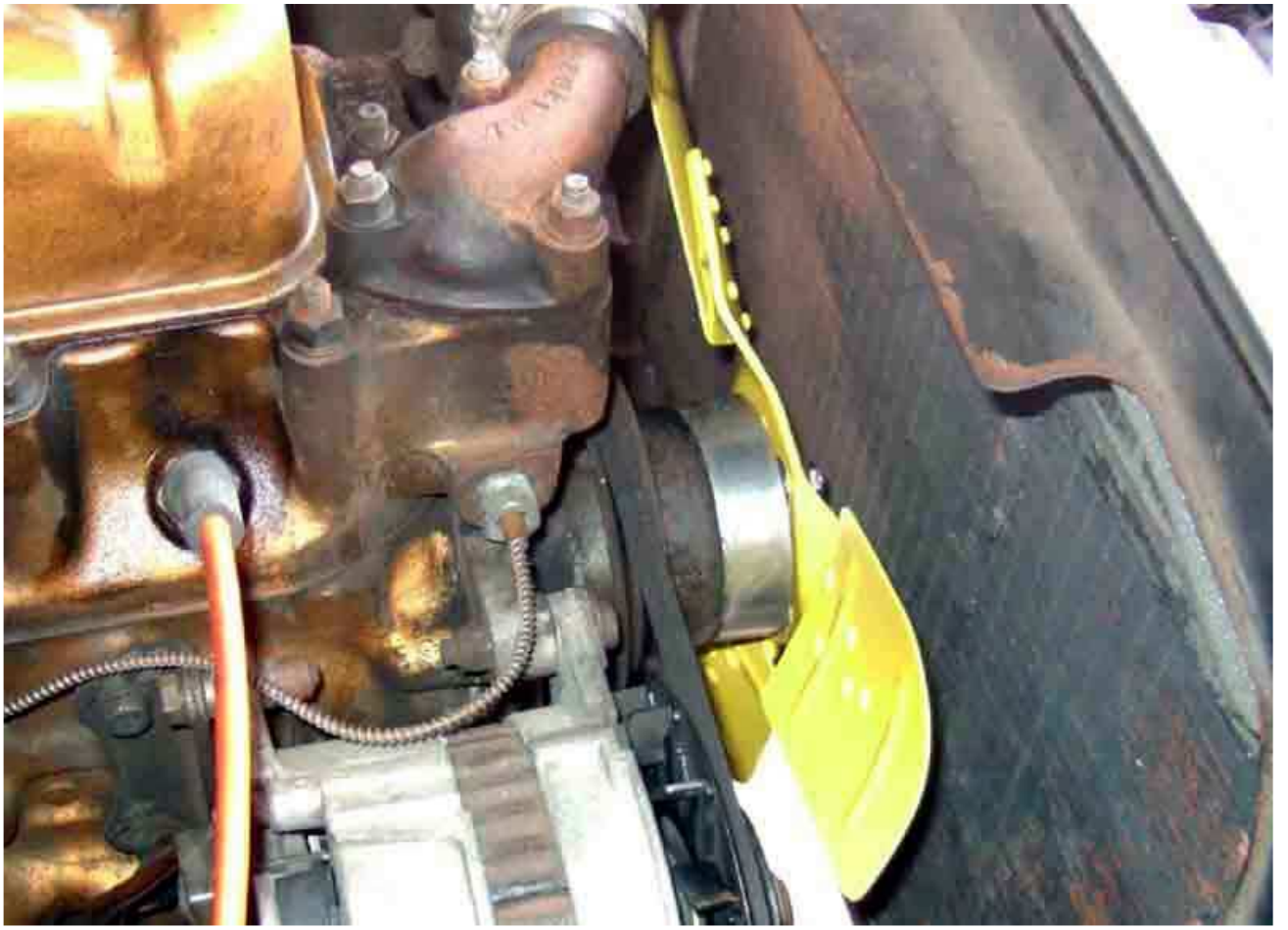
Steve Loft's engine clearly showing the spacer mine lacks, and the blades the correct way round.



2nd-hand spacer. Not pretty but serviceable.

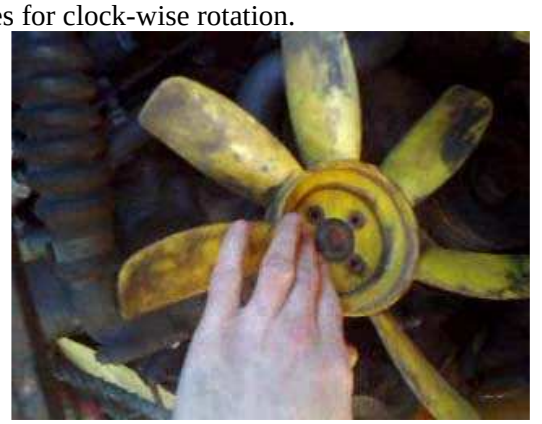
It is 7/8" thick, and has tapered sides being 3 1/8" across the flat face and 3 1/16" across the recessed face. Presumably it will be obvious which way round it goes from the relative diameters of the pulley and fan faces, but in the Parts Catalogue it is shown with the flat (wider) face forwards.

Spacer cleaned up, fan repainted, and now the right way round.



David Bolton's 6-blade fan on a UK 72 shown for comparison. Note the long-nose pump and pulley, and hence no spacer and short bolts (however it could be a short-nosed pump with the spacer **inside** the deep pulley). Note all these fans rotate clockwise when viewed from the front of the car.

7-blade plastic fan correctly orientated, with the deep dish facing away from the engine, and the slightly curved leading edge of the blades for clock-wise rotation.



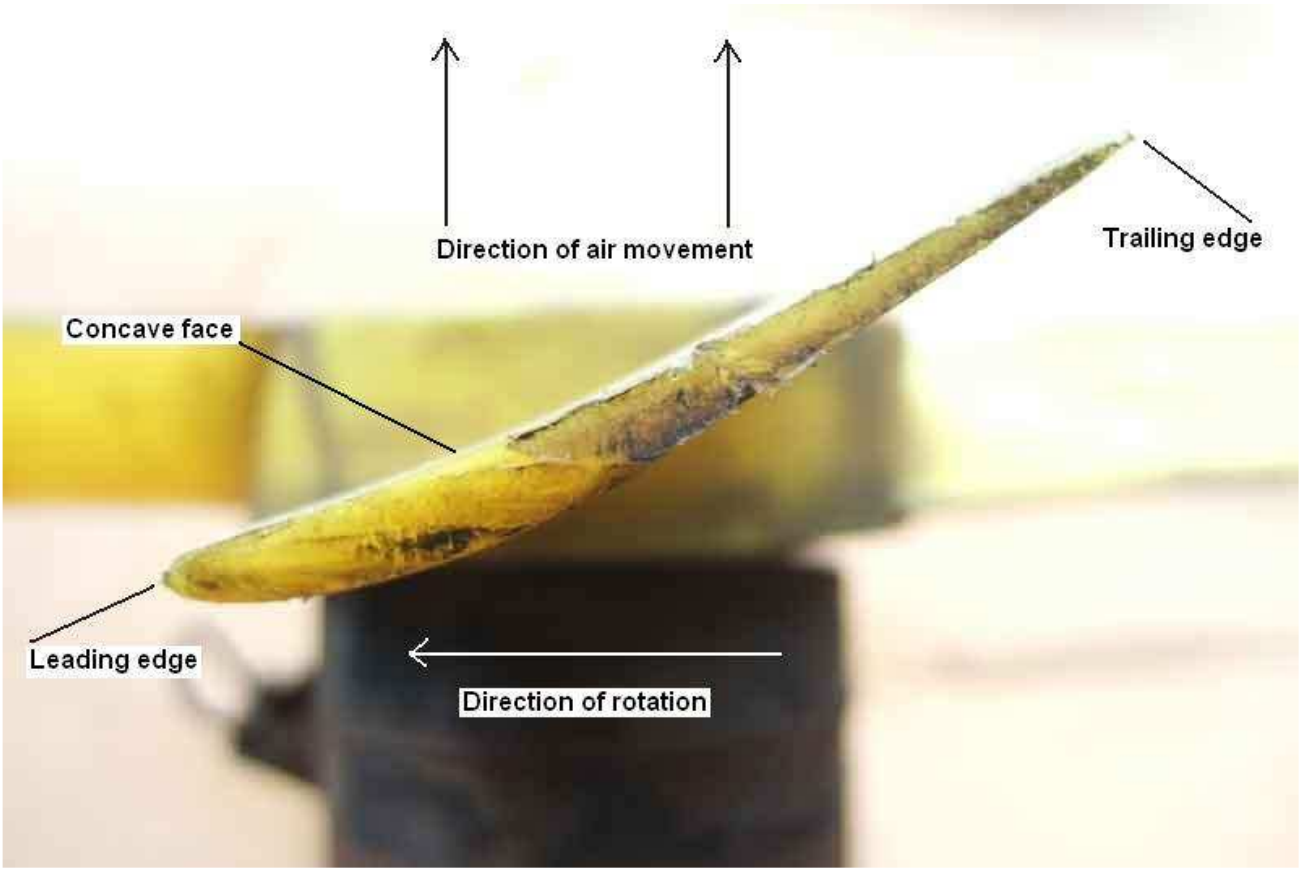
Correctly fitted, blades well clear of thermostat housing, alternator etc.

Fan the wrong way round, blades fouling engine parts.

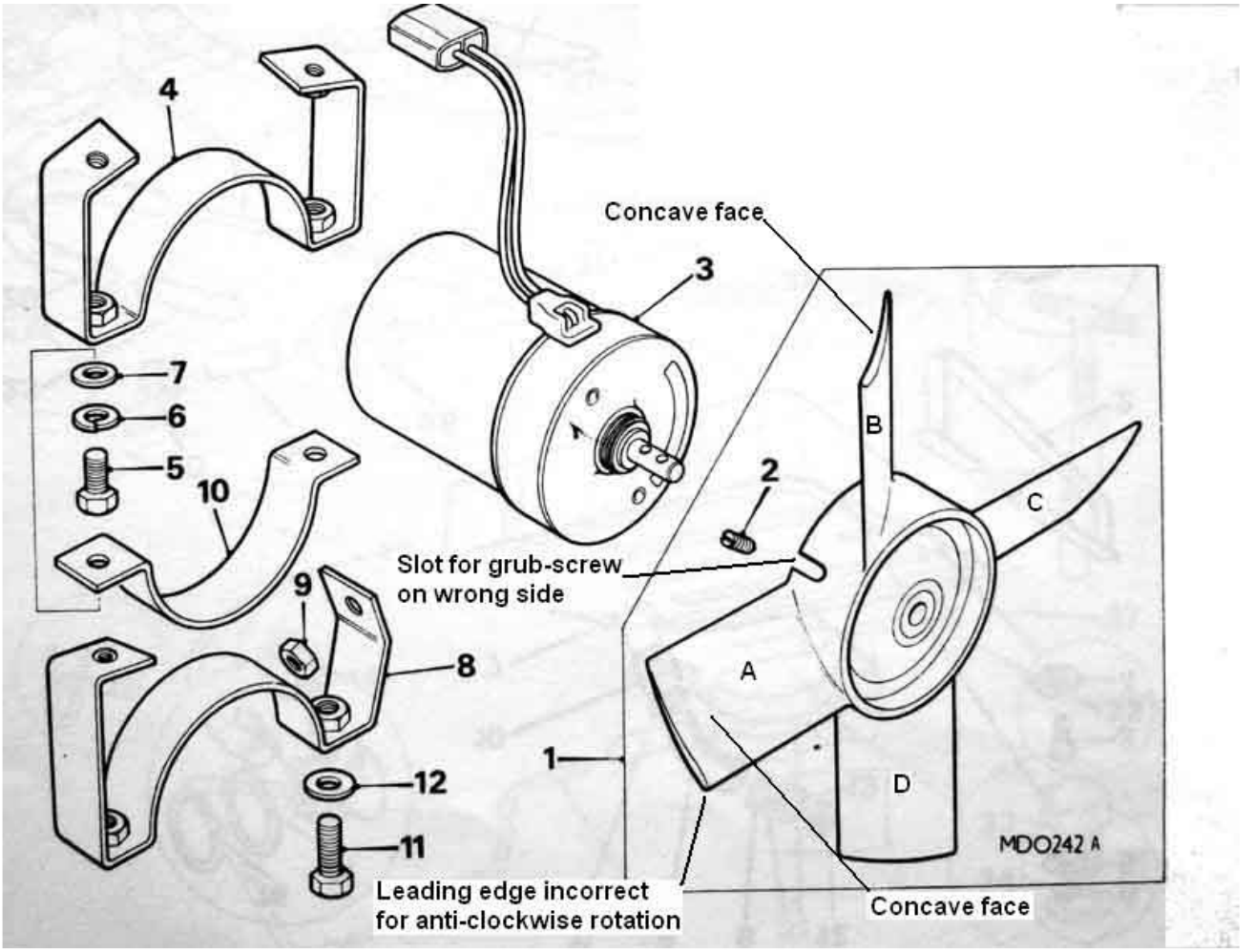
Cooling Fans - Electric

Arrow showing direction of rotation, anti-clockwise when viewed from the front of the car.

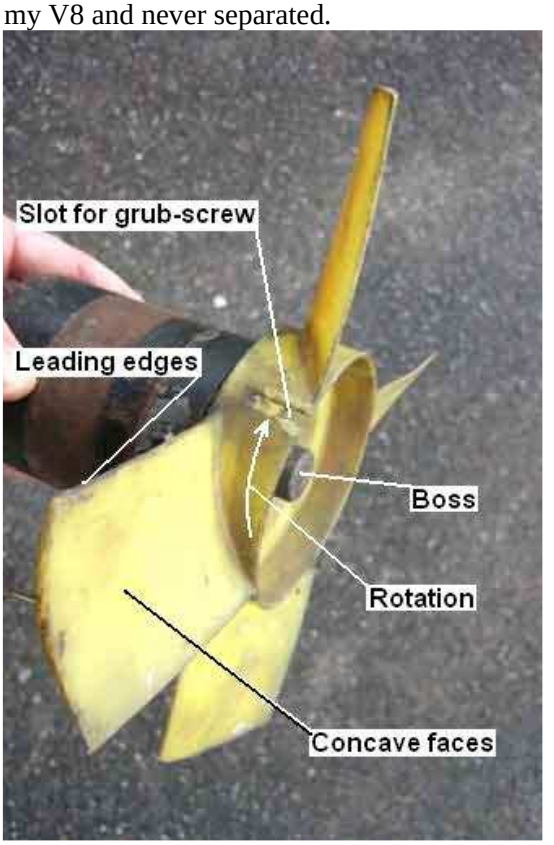
Showing clearly defined blunt leading and tapered trailing edges.



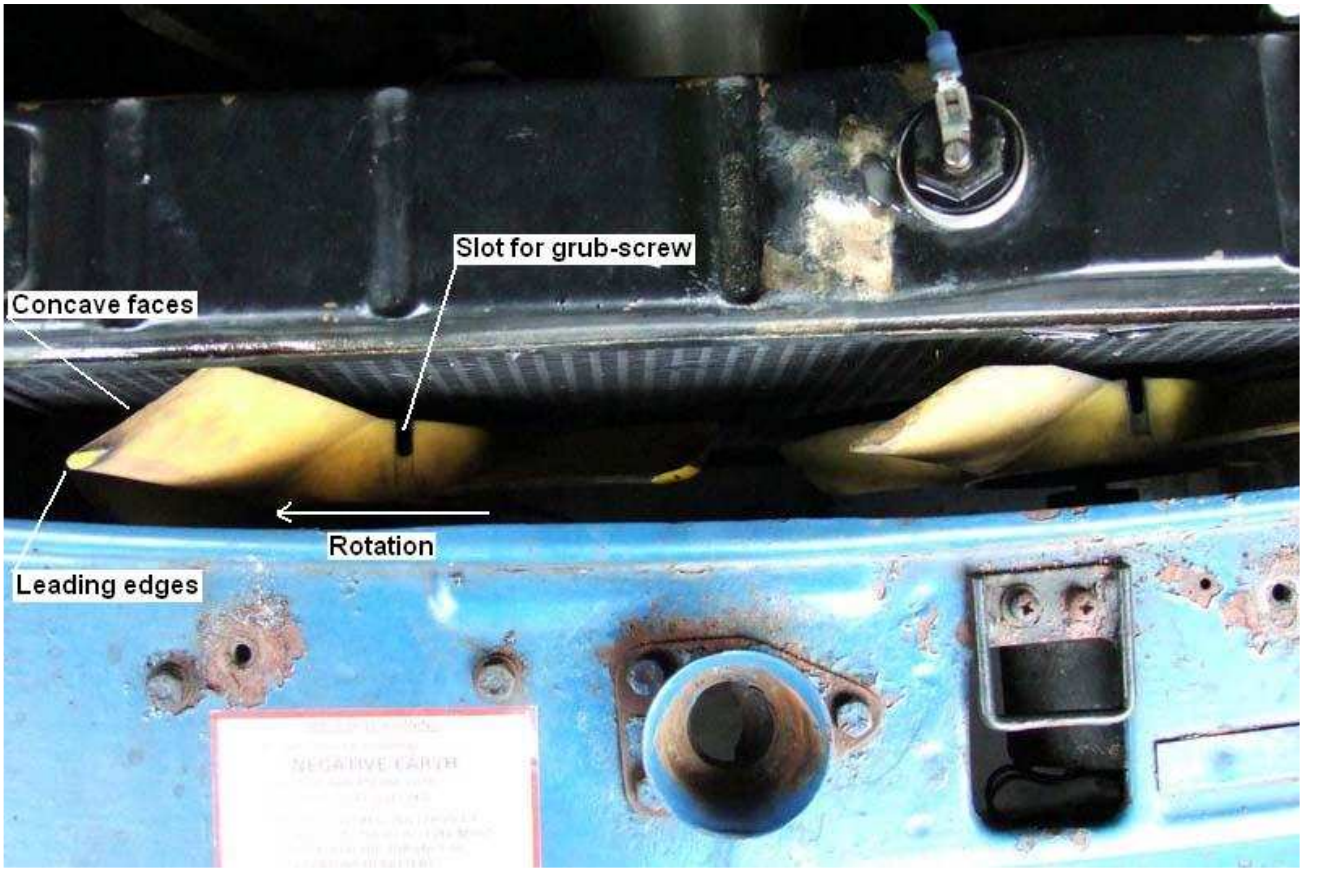
Drawing from Leyand Parts Catalogue with several errors: The slot for the grub-screw and hence the boss should be facing **away** from the motor, the leading edges are on the wrong side for anti-clockwise rotation, and three of the concave faces (B, C and D) are facing the motor and one (A) facing the other way! With the exception of the concave face on A all the other aspects would be correct if the fan was turned round.



Motor and fan as removed from my V8 and never separated.



Fans as fitted to my V8.



Fan Belt

Lucas Fault Diagnosis Manual showing 1/2" to 3/4" in **one** direction, and apparently towards the opposite of the loop

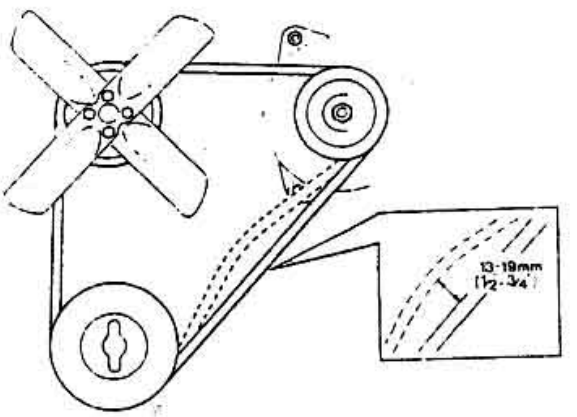


Fig. 56 Drive belt tension

V8 Hose Guard

Bottom hose, cut through by fan belt

Correct hose showing slight rearward angle of bottom hose port

Not the prettiest piece of fabrication you ever did see but it was just beaten and twisted into shape with a hammer and pair of pliers after being cut to size and shape from a card template

In-situ and secured to the bottom alternator mounting bolt ...

... and a convenient front-cover stud and nut. As well as curving in the horizontal plane under the hose to the lower fixing it is also curved in the vertical plane i.e. along the run of the fan-belt to give the greatest clearance.

The cracking in Vee's bottom hose after just 15k miles, albeit 7 years...

... and the wear caused by the oil pipe flange, despite the hose having been shortened before fitting to give more clearance.

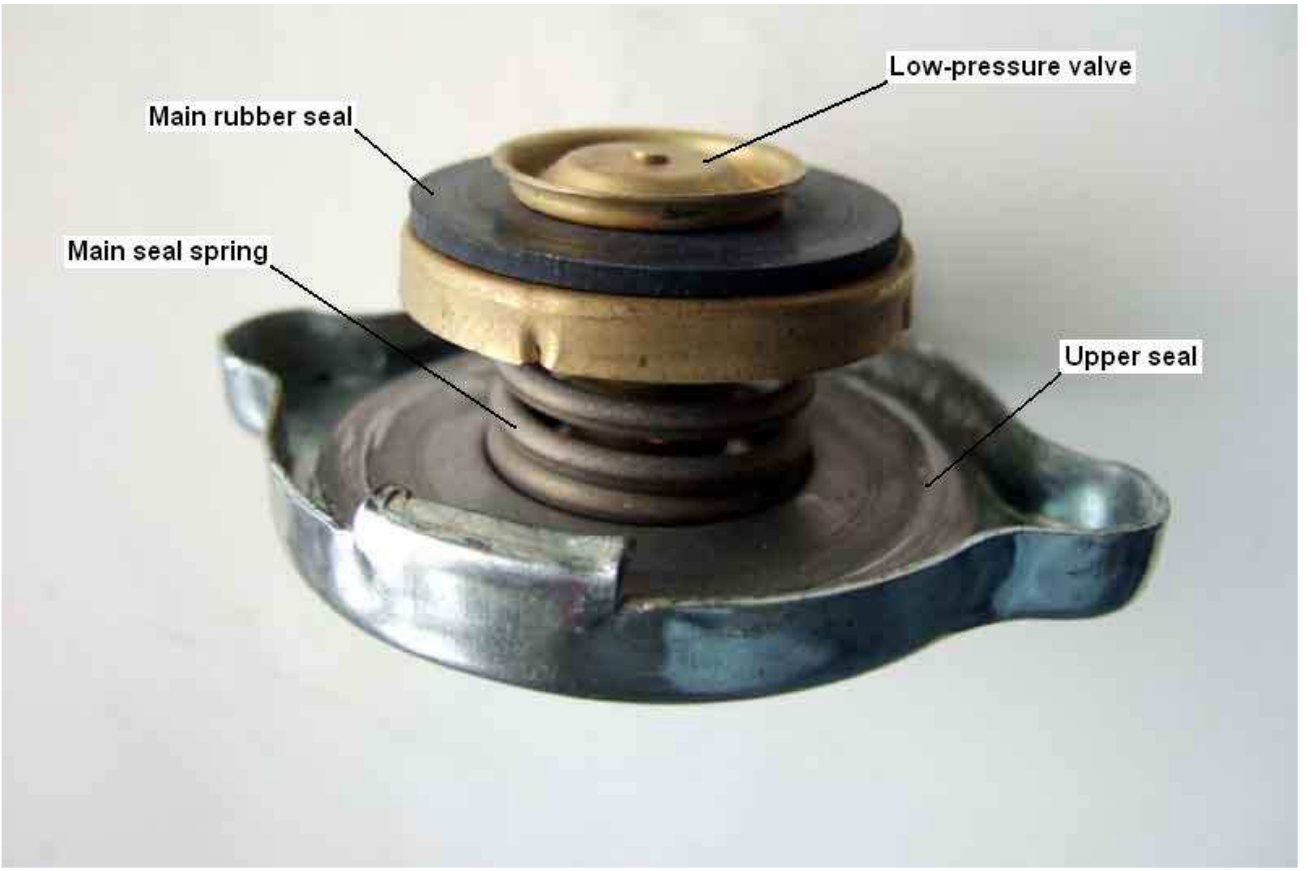
1/4" cut off new bottom hose...

... still plenty of clearance to anti-rollbar ...

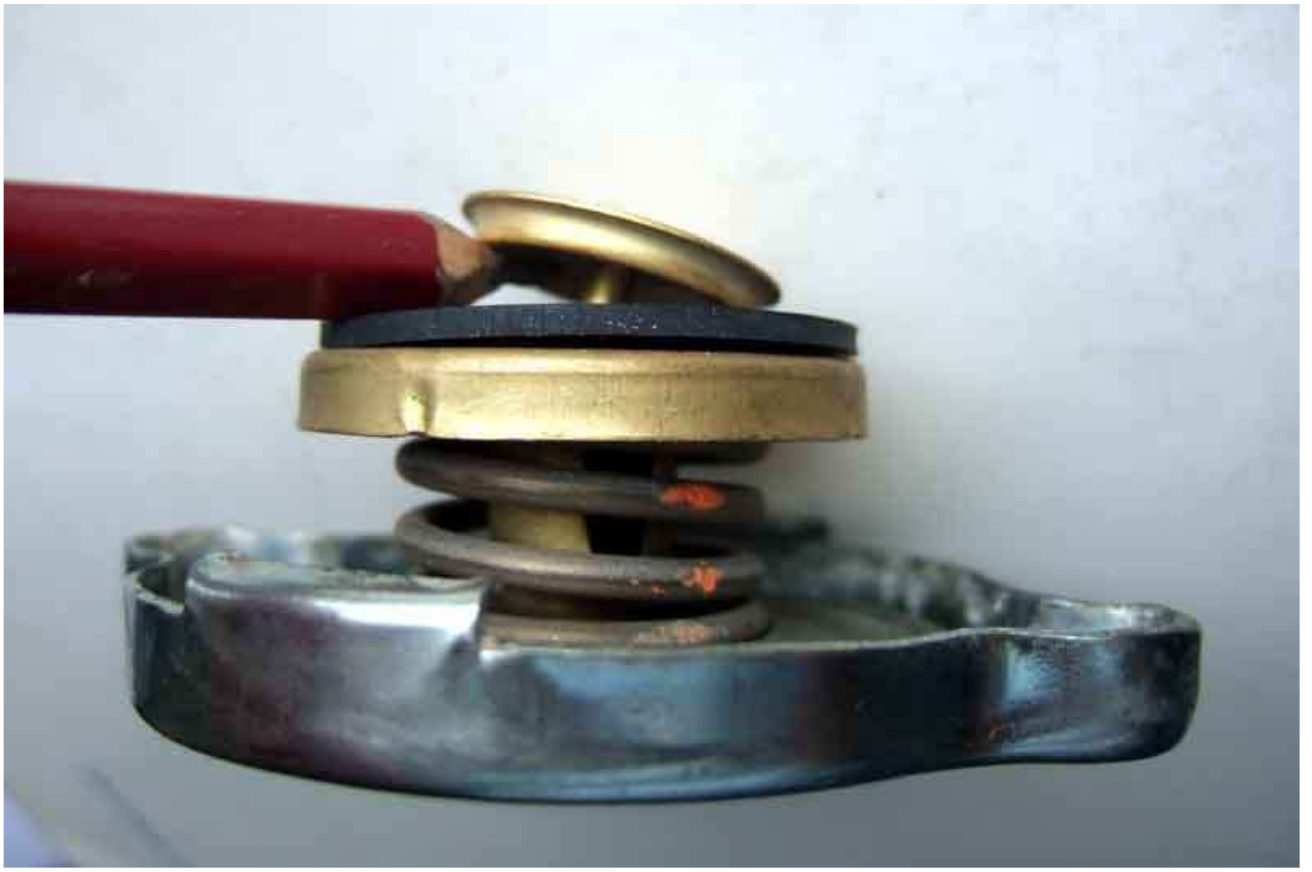
... but still barely any clearance to the oil pipe flange, and the hose is yet to swell under pressure.

Radiator Cap

The component parts of a typical radiator cap. The main seal must make good clean contact with the lower part of the filler neck or the system cannot build pressure and is likely to boil. For the same reason the low-pressure valve must make good clean contact with the main seal. The upper (recovery) seal should make a good contact with the upper part of the filler neck to contain any steam or coolant expelled during excess pressure, and must make a good seal if lost-coolant recovery is to be employed. It seems that some caps in the USA have the upper spring seal but do not have the low-pressure valve and so cannot be used for lost-coolant recovery. There is also a risk with these caps that on cool-down after venting excess pressure or coolant, the system will be at negative pressure, so will not reach normal pressure the next time the engine is run which could result in boiling. Another source indicates that there are caps **with** the low pressure valve to prevent a partial vacuum developing, but **without** the upper seal so coolant recovery from a catch-bottle cannot take place.

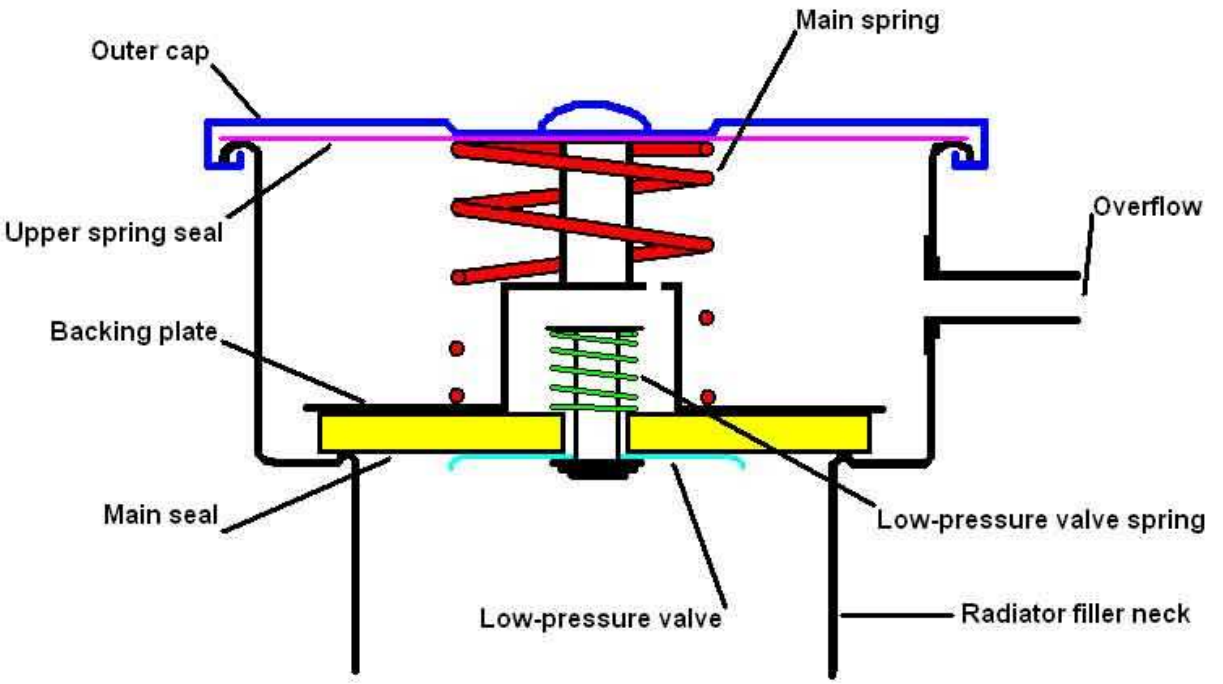


The low-pressure valve shown lifted. This is on a very light spring, unlike the main seal spring, and can be lifted with finger-tips. Note also the paint on the spring that denotes it strength i.e. cap pressure. This should ensure that it is mated with the correct cap during manufacture, which shows the pressure in lb and k Pa, but I did purchase one cap which had an incorrect (weaker) spring. I noticed it seemed easier to press down and fit than the old cap, and when I put the two caps 'front to front' and pressed it was the new cap which gave way and not the old, the opposite of what one might expect.

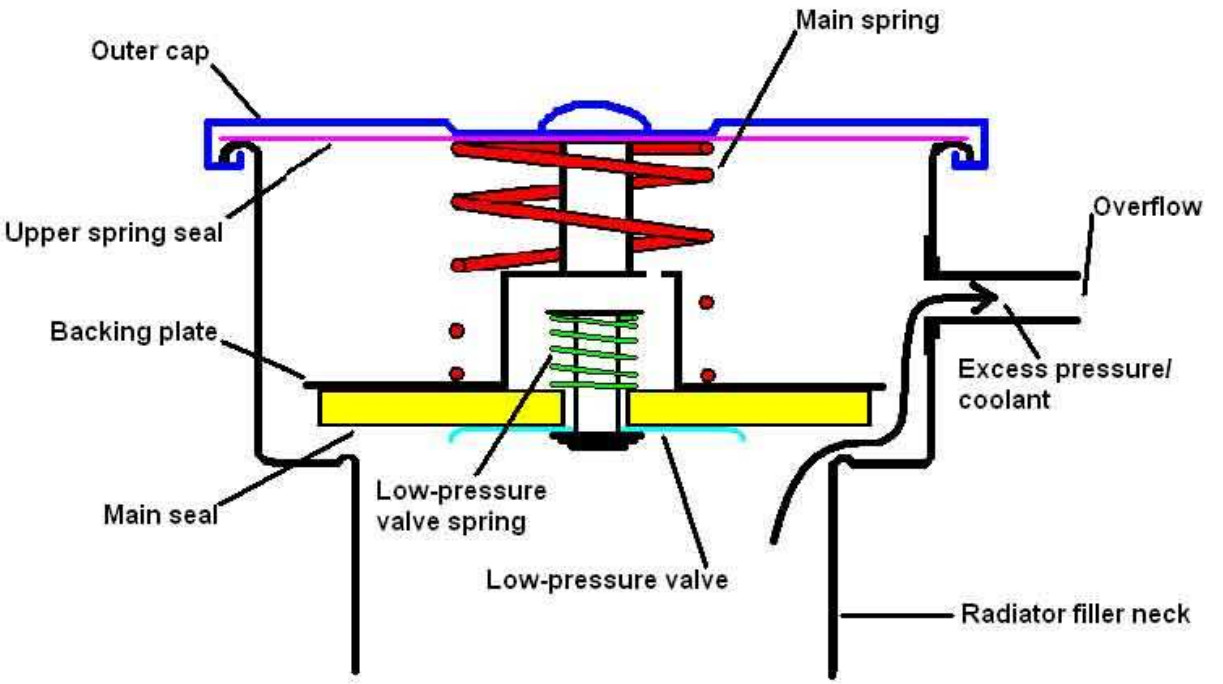


A typical UK cap. This is a 20psi cap I was using while trying to resolve the cooling system on the V8, note that after a few months of use the bottom hose exploded in spectacular fashion shortly after switch-off one day, so I can't recommend its general use! See the main text for the correct pressure caps.

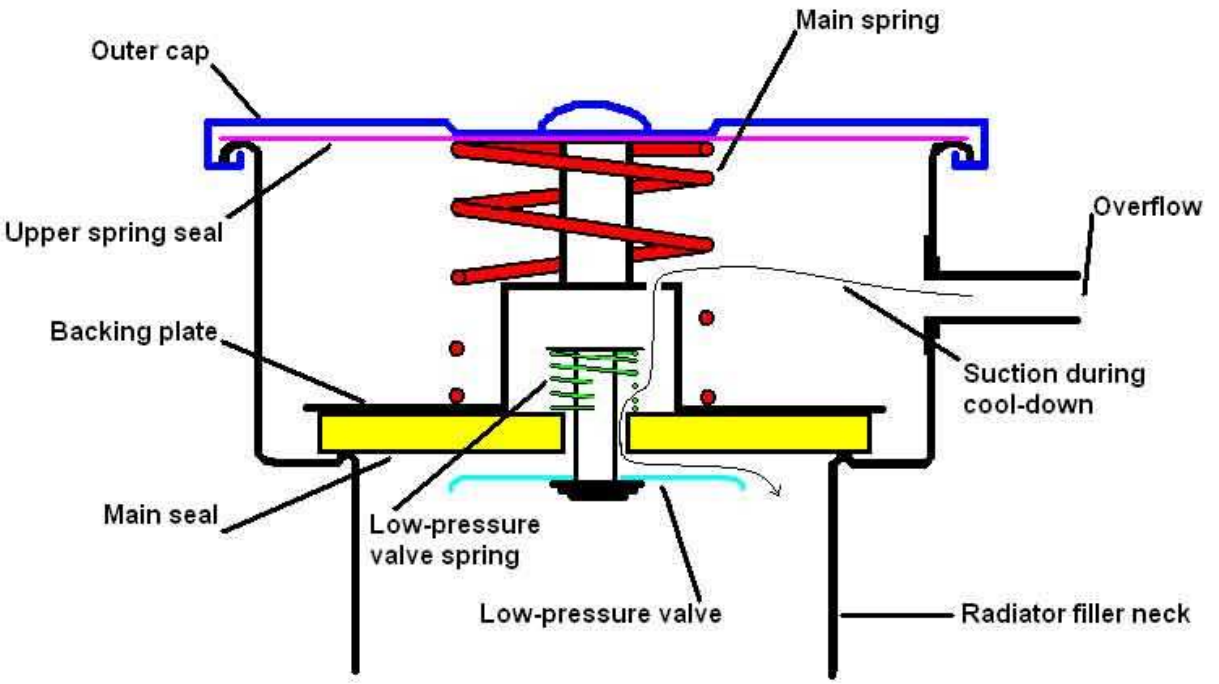
A typical UK cap and radiator filler neck in context.



Excess pressure raises the main seal compressing its spring, allowing the pressure and/or coolant to escape via the overflow tube. The upper seal prevents it escaping from around the cap itself.

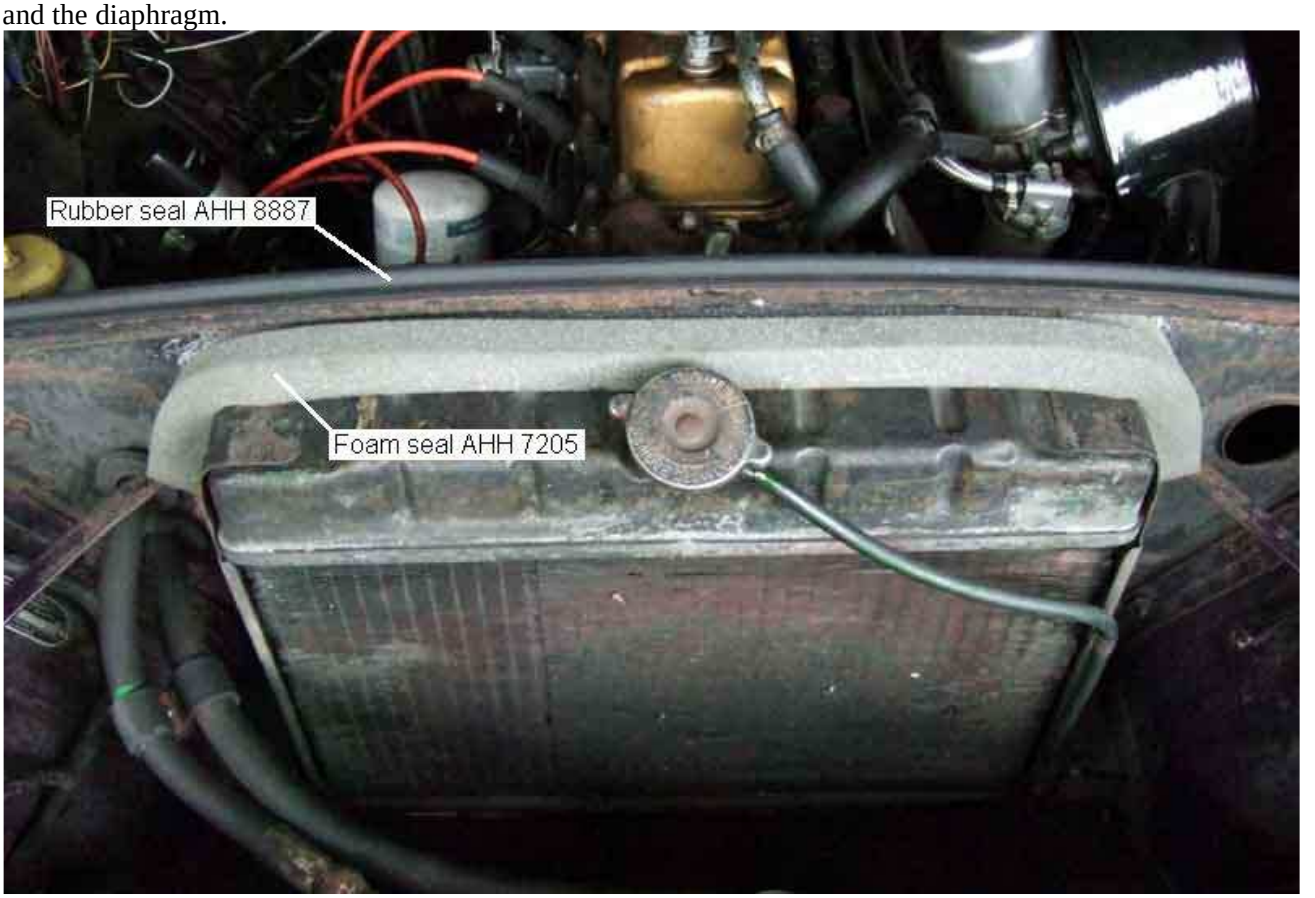


After excess pressure and/or coolant has been expelled and the system is cooling down. Only slight negative pressure is required to pull the low-pressure valve down, normally allowing outside air to enter the cooling system. But if lost-coolant recovery is in use and the end of the overflow tube is sitting in coolant in a catch-bottle, this will be sucked up and returned to the cooling system. The upper seal must make full contact with the upper filler neck for this to happen.



Radiator Diaphragm Seal

The two seals that should be present - rubber from the diaphragm to the bonnet and foam between the radiator and the diaphragm.



For completeness the bonnet seals are shown here.

Dual Temp/Oil Gauges

KAC 456

The following images are from Leacy MG:

Farenheit, various markets up to October 1968

Centigrade, various markets up to October 1968

C-N-H, used from October 1968 to August 76

V8 60psi used up to June 1974. A 100psi gauge was used briefly after June 1974, possibly the 4-cylinder gauge, although it may have also had the V8 red and white cross-hatching of the H zone.

V8 80psi used used after the 100psi gauge up to the end of production. Note the oil needle is angled up at rest and not horizontal like all the other gauges.

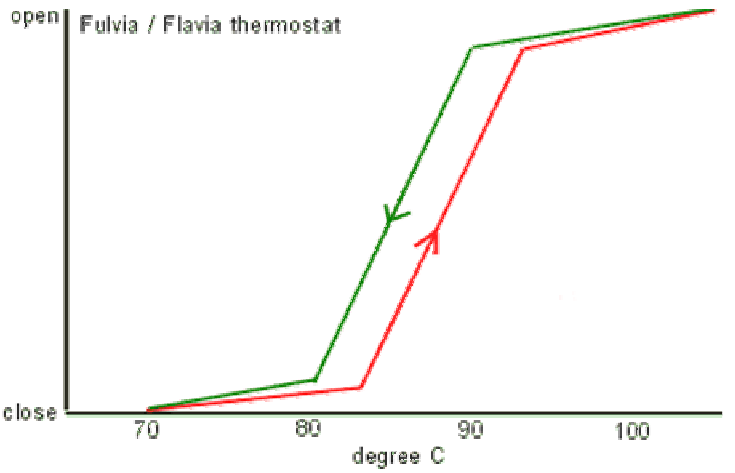
For completeness, the later electric single C---H gauge, used from August 77 on. Presumably the 'N' was dropped in a 'failed' attempt to prevent owners getting paranoid about the quite normal range and variation of 'normal' temperatures.

Thermostats

Typical wax-pellet stat:

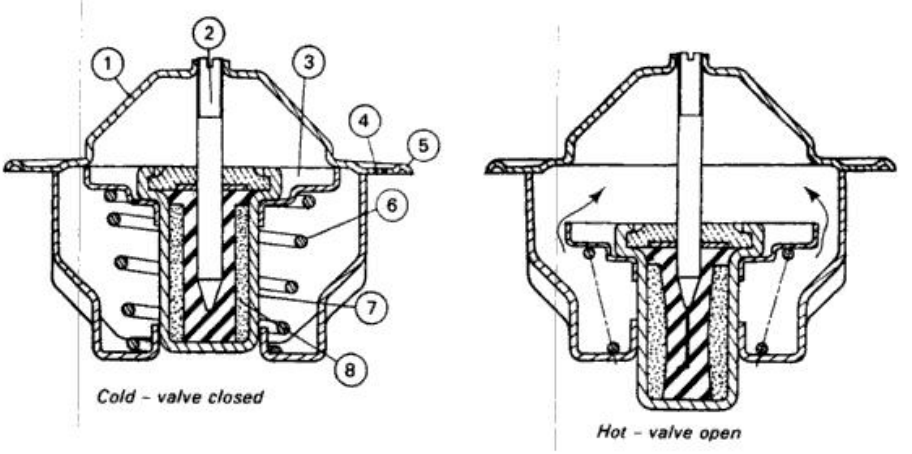
Thermostats are rated at a given temperature - typically 82 in the case of the MGB - stamped on the bottom of the metal cylinder containing the wax pellet:

Typical Wahler thermostat and its 8 degree or so range from starting to open to fully open, and the 2 or 3 degrees difference between warming up and cooling down to reach a given partially open point. It is the ability to start closing when the temperature has dropped by only a couple of degrees that allows the thermostat to maintain a minimum coolant temperature (in most circumstances) with varying demand on the engine and changes in ambient temperature. The exception is in very cold conditions where surface cooling of the sump, block, and use of the heater may take so much heat out of the coolant it never gets hot enough to open the stat. Image from 'viva-lancia.com'.



A wax stat when cold (left) and hot (right). The metal cylinder containing the wax (7) is in the coolant that is being heated by the block and head i.e. below the valve (3) which is closed. As the wax is heated it expands, squeezing the rubber sleeve (8). At a given temperature this overcomes the pressure of the spring (6) and starts to push the thrust pin (2) out of the rubber sleeve. Because the top of the pin is attached to the bridge (1), which is part of the flange (5) which is clamped between the head and the thermostat cover, this movement actually causes the metal cylinder to move downwards, which pulls the valve (3) downwards. This open the valve and allows coolant under pump pressure to circulate via the radiator and initiate cooling. If the temperature of the coolant starts to drop below a certain point the wax starts to contract, and spring pressure

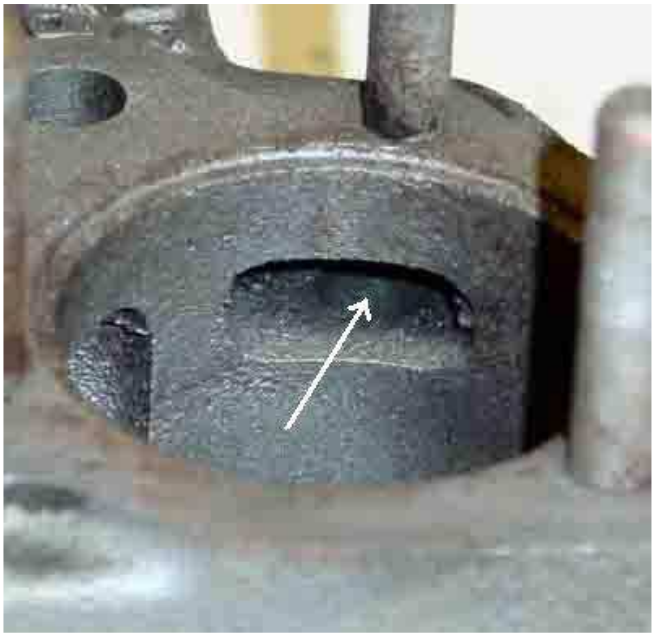
forces the pin back into the rubber sleeve to start closing the valve. Image from Hillier's Fundamentals of Motor Vehicle Technology.



1. Bridge
2. Thrust pin
3. Valve
4. Hole
5. Flange
6. Spring
7. Metal cylinder
8. Wax-filled rubber sleeve

Filling/bleeding arrangements. In the example above there is just a plain hole in the flange, which will allow some circulation of the coolant via the radiator during warm-up and so slow it a little. Below on the left there is an example of a 'jiggle-pin' (circled) in this hole which allows maximum bleeding but zero circulation during warm-up. On the right is a cost-reduced version with no hole in the flange and hence no jiggle-pin, but a very small notch in the edge of the disc valve instead (circled).

The bypass-port in the head. It lies just below the resting place for the thermostat, and you can see that when the original MGA stat's sleeve rose up it would cover this port. Note also the drilled passage inside the port leading down into the block (the faint circular marking inside the port, arrowed). From Bob Muenchausen's 'MGB Engine Cooling' page.



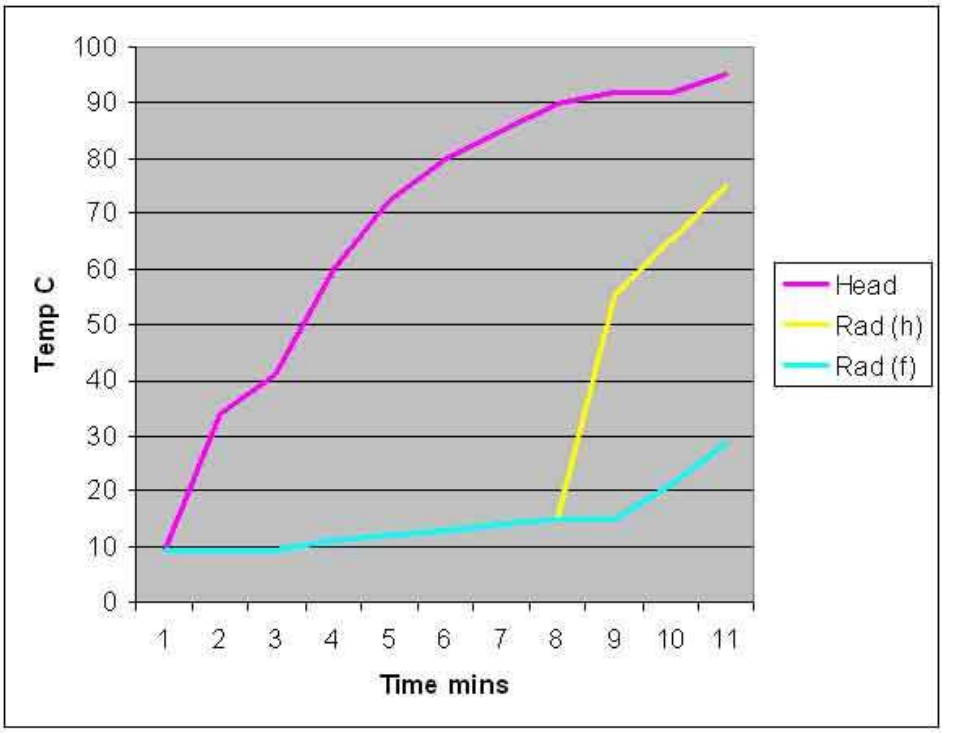
This is the OE Smith's thermostat for the MGA. Note the moving sleeve around the outside of the lower portion. This sleeve blocks off the bypass port in the head once the engine has warmed and the stat has opened. Photo: Neil Cotty, from Bob Muenchausen's 'MGB Engine Cooling' page.

A blanking sleeve from Moss Motors suitable for the MGA, MGB and Sprite/Midget.

Standard MGB stat modified to become a restrictor by cutting the lower part of the frame off and removing the wax pellet with valve, and the thrust pin from the bridge:

At a pinch you can achieve much the same thing by removing the spring (hook one end outside the frame then 'unscrew' it) and manually pushing the valve open:

Typical temperature gradients for the head and the radiator inlet (Rad (h)) and outlet (Rad (F)) during warm-up, working thermostat fitted. With no stat, or a stuck open one, the first two lines would be close and parallel, but flatter taking much longer to reach working temperature. With a stuck closed stat the head line would continue to rise and the rad line would stay very low until the coolant (in the engine) reached boiling point.



V8 Steam Pipe

The steam-pipe between the inlet manifold and thermostat cover.