ENGINE,

CYLINDER HEAD,

VALVE GEAR,

AND MANIFOLDS

NOTICE

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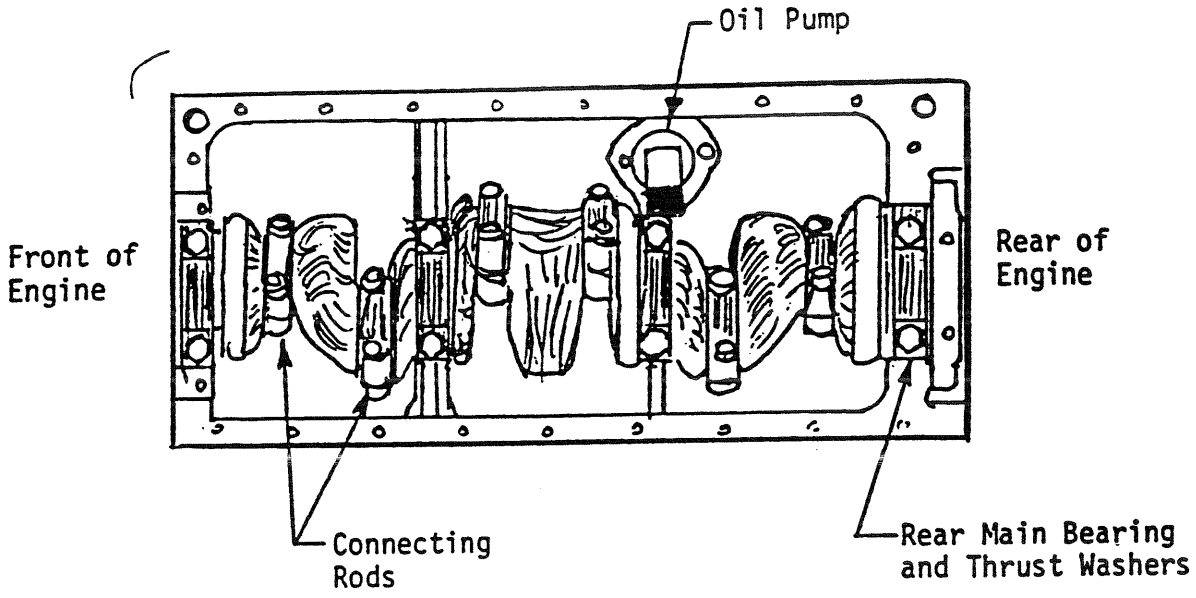
DOUBLE ENGINE LIFE WITH FREQUENT BEARING CHANGES

In no more than a day you can renew the connecting rod and main bearings in your TR-6. The only special tool required is a torque wrench. If this is done at about 50,000 mile intervals and accompanied by reasonably regular oil changes your crankshaft should last 200,000 miles without requiring a regrind. It is well worth the effort since a crank regrind requires engine removal and total disassembly plus about $150 of machine shop work.

The car should be firmly supported on ramps and/or jack stands. Oil pan removal is straight forward, there are no obstructions. Remove one connecting rod cap at a time (noting that they can not be rotated 180 degrees) and remove the bearing shell. The other bearing half can be removed from the rod by carefully pushing on the end without the anti-spin notch with a blunt screwdriver. It will then slide down around the crankshaft. On this first rod you should clean and dry the crank and use Plasti-gauge to check the clearance of the new bearing. This is done by laying a piece of Plasti-gauge transverserly across the new bearing in the connecting rod cap, then installing the cap and torqueing the bolts to specifications or a little less. Plasti-gauge is a fine plastic string of exact diameter. When the bearing is tightened against the crankshaft the plastic is flattened. The closer the clearance between the bearing and the crankshaft, the thinner (therefore wider) the plastic becomes. The cross-sectional area of the string doesn't change so area divided by width equals thickness. Loosen the bolts, remove the cap and compare the width of the Plasti-gauge with the widths shown on the wrapper for different clearances. Repeat for other rods except for checking clearances. Always use a torque wrench when tightening engine bolts.



VIEW FROM BOTTOM OF ENGINE

Replacing main bearings is essentially the same process except for removing the aluminum cap below the front main and checking clearance. To check the main clearance you must either check one of the center mains or apply upward pressure on the rear of the crank. The latter is necessary because the flywheel and crankshaft weight will deflect the rear of the crankshaft downward giving a faulty reading. A handy tip on changing upper main bearings is given in the next article.

Probably the most important bearings are the ones rarely replaced, the thrust washers. These are two half circular rings that go in front and behind the upper rear main bearing. They are easily replaced. Unfortunately until recently there were no oversizes available and excess play lets the bearings wear very fast and drop out with disastrous results.

CHANGING UPPER MAIN BEARINGS

A simple way to change upper main bearing shells is to loosen all the caps a little. Usually, you can then push gently on

the end of the bearing shell with a screwdriver to start the bearing sliding around the crankshaft. It is then removable with your fingers.

However, it seems there is always the one that won't come. For the stubborn one try the following: Cut off a 20 penny nail 1" below the head. File any sharp edges off the head and bend the head to match the oil hole in crank. Turn the engine over by hand (removing spark plugs makes this much easier) until the oil hole is visible. Place the cut off nail in the oil hole and rotate the crank by hand until the nail pushes the bearing shell out. The new bearing shell can be installed the same way but go slow and be careful you don't screw up a bearing.

FREQUENT ENGINE THRUST WASHER REPLACEMENT IS A NECESSITY

All Skill Levels

In the preceding articles I have urged you to replace the engine bearings about every 50,000 miles or less (less on high mileage cars). This greatly prolongs the life of the crankshaft and therefore delays considerably the time when the engine must come out of the car. This is a job you can do in an afternoon with just basic tools, a set of ramps if possible, and a toque wrench (don't skimp on the torque wrench, it is a very important tool required to accurately tighten the bearing caps). If you don't feel you have the skill, have the job done, but don't put it off.

The most important part of the job, however, appears to be the least important - the thrust washers. These are the little half circle things above the rear main bearing. The factory says the end play (distance the crankshaft can move from front to back between these washers) should be .006" to .008" (6 to 8 thousanths of an inch). I've always maintained this was

excessive and, when coupled with high mileage and poor or no oil changes, resulted in the crankshaft "beating" back and forth until the thrust washers wore thin enough to drop out. Once the thrust washer drops out the crankshaft and the engine block eat each other up rapidly. I had this happen on an engine and I know several others that have had the same misfortune. It is an expensive lesson, given that a new crank and block goes for about $500. Until recently, however, there was little you could do about it because thrust washers didn't come in oversizes.

Since oversize thrust washers have become available I've had occasion to take the pan off an engine I build with great care using a new block and crank. The mileage was 19,870 or say 20,000. When I built the engine I used an end float of .002". When I dropped the rear main bearing and examined the crankshaft and the thrust washers they looked fine, with a mirror polish. However, the end float was .007". Now, let's just use a straight arithmetic projection of this wear to say 60,000 miles. That .005" growth in end play would be .015" - one hell of a lot. Also, the more wear, the greater distance the crankshaft has to travel back and forth; ergo, the harder it can "pound" on the thrust washer. Therefore the increase in end play is likely to be exponential rather than arithmetic and at 60,000 miles the damn things could easily drop out.

It used to be thrust washers were available in only stock sizes. For some time now, the Roadster Factory has had oversize sets. By mixing these you can come up with a combination that will get you in the .002" to .004" range.

Take extreme care to make sure you have the proper side against the crankshaft. Even experienced mechanics put them in backwards.

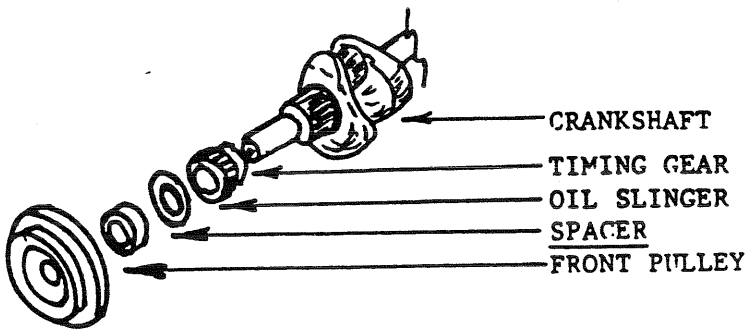
Don't put the job off. It's like saying you're going to look into AIDS prevention next month - once it has happened there ain't no cure Clyde!

ENGINE FRONT OIL SEAL IMPROVEMENT

Skill level A/B

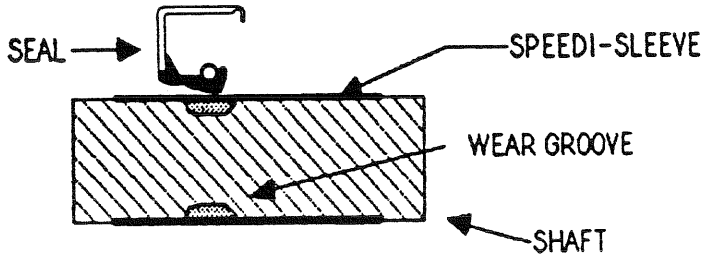
When rebuilding an engine or even when just replacing the front seal in the timing cover most people just put in a new seal and assume all will be well. Not necessarily so! Due to the seal location, low and at the front of the car, it catches a lot of grit, water, and leaking oil. Combined these make a wonderful grinding compound and a groove - usually not too deep - developes in the spacer (see illustration below). In most cases a new seal will still work with some shaft wear, but in the case of the TR-6 the seal barely contacts the crankshaft spacer to begin with. There are three ways to cure this:

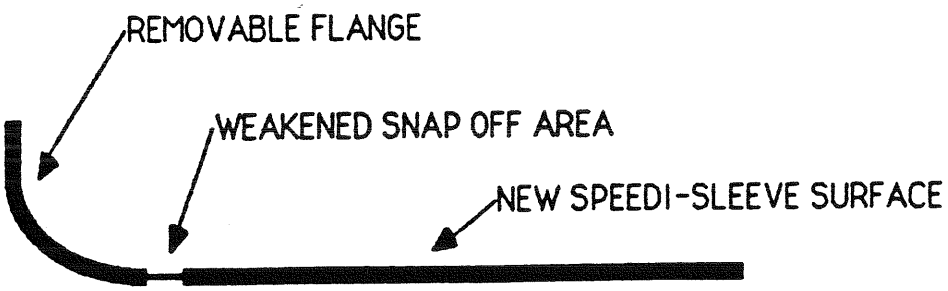
1. A new spacer for $25.
2. A speed-sleeve over the spacer (see accompaning article) for $20 or so. This has the advantage of increased shaft diameter.
3. Reversing the spacer on the crankshaft to provide a new wearing surface.



SPEEDI-SLEEVES - A BETTER IDEA

There are a lot of instances, like on axle shafts, front spindles, and engine timing gear covers, where neglect and high mileage have resulted in hardened seals cutting a groove in the shaft. This usually means that new seal won't work well or even work at all. SPEEDI-SLEEVES are the cure. They are precision machined stainless steel sleeves of thin (.005 inches or so) steel with a flared end on them. They are driven over the worn area of the shaft using a tube much like exhaust pipe to drive against the flange. Once the SPEEDI-SLEEVE is in place the flange can be broken off and removed or left in place. They come in sizes from 1/2 inch in diameter through 8 inch diameter. Cost for a 2 inch sleeve is about $20 and a 1inch is about $10. Available at most industrial bearing suppliers.





MATCHING A NEW OR REBORED BLOCK AND NEW PISTONS

Skill level B

Many owners and even professional mechanics assume engine blocks and pistons are automatic fits, especially new ones. It just isn't so, and this applies to putting new pistons in a rebored block as well as a new block. Due to machining tolerances of both pistons and blocks there can be more than acceptable clearance, or worse, too little clearance. Manufacturers compensate for this by indexing the pistons and the block with a size code and then match like coded pieces at assembly. I'm told that things were so bad with Chrysler back in the '30s that they even had to do it to crankshaft bearings. Triumph apparently didn't have too bad of tools since they only had three ranges of pistons and bores of .0004" each on early engines and two ranges of .0006" on later engines.

Piston to block clearance should be about .0025". However,let's say you have a late block with the lower limit of the smaller range (2.9405) and you get late pistons with the upper limit (2.9391). You would have .0014" clearance, or a hair more than half enough (with the lower/upper mix of early parts the pistons wouldn't even go in). The usual result of this is skuffed pistons and cylinder walls which leads to early high oil consumption. But it can also cause broken pistons, broken piston rings, and seized pistons with disasterous results. The early codes are F,G, and H from smallest to largest respectively. The late codes are A and B.

REPAIRING THE OIL PRESSURE LINE

Skill level C/D

This article is supplement by the article on curing and preventing rocker shaft and cam failure. Please read it too. It is a very easy to break the plastic line that carries oil from the oil distribution gallery to the gauge. It is located behind

and slightly above the oil filter. By now most of these formerly tough pliable nylon tubes are getting brittle and a good bump will break them. This usually happens right at the adaptor between the line and the engine. Your first feeling of utter panic is normal but not justified. Simply remove the adaptor and take it to your local auto parts store - it doesn't have to be an import parts place because the threads on these fittings are the same as U.S.. Get a double ended male compression sleeve fitting of the same thread, a female nut or fitting and a compression sleeve for 3/16" tubing. Simply put the male fitting in the engine block, slide the female fitting compression sleeve (which resembles a little barrel) over the tubing and insert the tubing into the male fitting. Tighten the nut enough to squeeze the compression sleeve tight on the tube but don't overdo it - remember the tube isn't metal. In the event you have broken the line in the middle, simply use the above plus another female nut and compression sleeve to join the two halves of the sleeve.

OIL ALL OVER THE LEFT SIDE OF YOUR ENGINE

The problem is a blocked breather hose at the valve cover. This article will appear in the first yearly supplement. If you need a copy now it will be sent on request.

ROCKER SHAFT SET SCREW

Skill level D

Next time you add oil take an extra second to look into the valve cover while the filler cap is off. If it looks like someone sprayed silver paint in there or looks very dry (oil free) the odds are the set screw has come out of the rocker shaft.

If you don't remove the valve cover for the above reasons first, the next time you set the valves it would be a good idea to check or tighten the set screw.

The rocker shaft is prevented from rotating or moving fore and aft by a single screw in the rear rocker stand. Worse still is the fact that this screw has a countersunk phillips head - the worst possible fastening devise to tighten. What makes this screw so important is the location of the oil gallery in the rear rocker stand and rocker shaft. If the screw comes out all the oil goes straight up the screw hole and the rockers run dry except for splash oiling; or worse, the shaft rotates and the oil supply is totally cut off. I've seen this on more than one TR-6 so take the extra minute the next time you adjust your valves.

Remove the screw. Clean the screw and hole in the rocker stand and shaft thorougly with spray brake cleaner or CRC Lectromotive Cleaner (same stuff but brake cleaner is cheaper). Apply Loctite liberally to the screw and threads. Use a screwdriver tip for you 3/8" ratchet to get the screw sufficiently tight.

CURING/PREVENTING ROCKER SHAFT, ROCKER AND CAM FAILURE

Skill level B/C

Awhile back I received a spurt of phone calls about rocker arm, rocker shaft, cam, lobes and cam follower failure. Most were apparently from dry running or insufficient oil. This struck me as a rather strange thing because I had never encountered it (with the exception that follows) in any of my TR-6 engines - even the one with 275,000 miles on it. The exception is that I have seen engines on which the set screw for the rocker shaft had come loose. This screw is located in the top of the rear rocker pedestal and the above article deals with it in detail.

This screw's function is to keep the shaft from rotating or moving fore or aft. It also happens to be in the top of the same hole which carries oil up through the engine block and cylinder head to the rocker shaft. It is a phillips head screw and they are notorious for being impossible to tighten sufficiently. When it comes out, either the oil shoots straight up or the shaft turns

and cuts off the flow of oil. In either case the result is no oil to the rockers and shaft. The cure is a clean screw and Lock-tite. Of course, I immediately asked the callers about this but none had experienced it.

My thoughts then returned to those good old days of my youth when I used to hang around my uncles machine shop. This was after WW II in a town near the Pennsylvania Turnpike and although I was only 10-12 years old I was struck by the fact that two of the "best" cars of the day - Lincoln V 12 and Buick- were burning up engines and valve gear at those "high" turnpike speeds of 60 MPH while the Fords just rolled on by. The cause was plugged up oil passages and the cuprit was sludge. Sludge is accumulated dirt and broken down oil which was common in those days before detergent oil. It appears that this same fate befell at least the valve gear of a couple of these TR-6's. One of the callers had also had a replacement rocker shaft go bad in only 100 miles. He felt that dry or not that was too quick and I agree. I've heard that some non-Stanpart shafts are not hardened and this seems to bear that out.

The reason I thought back to those old cars (and wasted the paragraph above) was the cure the mechanics used on the Buicks (I don't recall the Lincolns being cured except for another engine). The Buicks had an oil passage that fed the rocker assembly very similar to the TR-6 set up. The cure was to tap the oil supply very close to the oil pump, tap the hole in the cylinder head and then connect the two with a supplemental oil line of 1/8" copper tubing. The same thing will work for a TR-6.

The take-off point is the connection for the oil pressure line just behind the fuel pump. A tee fitting is used to connect the extra line.

The connection at the cylinder head is the plug at the left rear corner.

The easiest type of fittings to use are the compression fittings mentioned in the preceding article on repairing the oil pressure line. However, for safety sake (or "insurance") I'd

suggest threaded fittings. If in doubt what fittings you will need, just take the plug from the head and the fitting in the block at the oil pressure line to the parts store and let them find the fittings you will need.

Oh yes, I forgot the cam lobes and followers. They are lubricated by the oil that has passed thru the rockers and is running down over them on its way back to the sump. The followers can be checked if the rocker system and push rods are removed. A cam check requires considerably more work and skill (call me if you need help). ABOVE ALL, USE DETERGENT OIL!

Also a lesson learned here is to check reproduction shafts for hardness before installing."

CYLINDER HEAD AND MANIFOLD INTERCHANGES

Skill Level B/C

Give your late model higher compression and more power, or add real duals to your early model, or... You mathematicians can probably come up with more possible combinations here than a punk rocker can find colors of eyeshadows, but here's what does and doesn't fit. Incidently, this was learned as the result of a cooked engine and head on our TR-6 engined TVR. Remember kids - putting a TR-6 engine in a TVR is like putting Victoria Principal between Jerry Falwells' sheets.

1. Either head can be used on either block.

2. Head gasket must match block (early/early or late/late.

3. Either exhaust manifold will fit either head. Surprise!

4. The manifold gasket and intake manifold must match the head. It appears possible to use the late manifold (which I

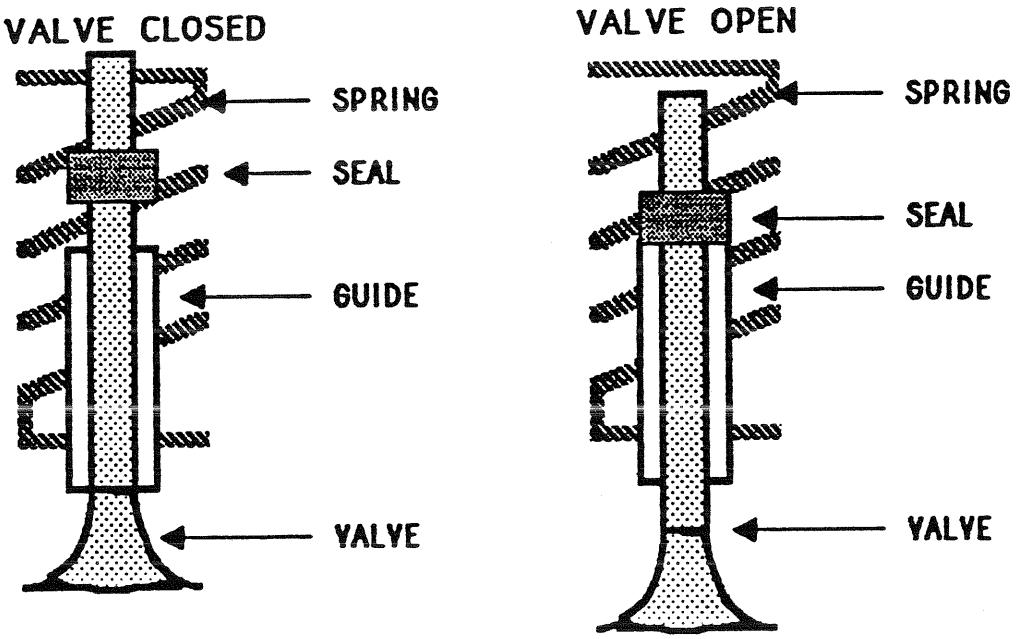
suspect has better flow) on an early head but the porting work is beyond the capability of most of us.

5. The pushrods, rocker shaft, and rockers are the same but the rocker adjustment screws aren't (trust me, I broke a rocker on a shaved early head/late block combo). Match the screws to the head !

For a real rocket try the early head shaved .050" with the late exhaust manifold, 8 degrees ignition advance, and pre '72 carbs. The TVR went like hell for 300 feet until it overheated again. Those creeps in Blackpool never did figure out the radiator couldn't be a foot below the water pump.

THE BLUE CLOUD, THE SIGN OF VALVE GUIDE WEAR & WHAT TO DO

When you let off the gas and brake reasonably hard, then accelerate again, and your TR 6 puts out a cloud of blue smoke you have worn valve guides. Aside from the embarrasing smoke, you really aren't a candidate for a major engine overhaul unless the smoke is pretty bad. There are other causes of smoking, of course, like bad rings, but these cause more constant smoking. TR 6s don't have seals on the valve guides like most cars do. These seals are usually little rubber rings on the valve stem that come down against the end of the valve guide when the valve opens. They keep oil from being sucked down the valve stem into the cylinder. This suction is especially high when the throttle is closed and the reason the blue cloud occurs then. With any appreciable wear in the valve guide a fair amount of oil is sucked in. It is not burned but is largely vaporized, thus the cloud. The best sign of when you <u>need</u> to do something is given by the spark plugs. Excessive oil usually shows up as a heavy white/gray chalky deposit on the plugs at abnormally low miles (like 2000-3000 miles) with the accompanying rough running. If you are going to do a valve job or have one done be sure to use valve guide seals from a Chevy v-8 (or most any engine with the same size valve stems). These seals are usually available seperate from a complete gasket set.



EASY VALVE GUIDE REPLACEMENT

SKILL LEVEL B

One of the things you can do to save a few bucks on a valve job is to replace your own valve guides. Usually you have the machinist install new guides and then ream them to the proper inside diameter. This is no longer necessary and the job is a lot easier than you think. The valve guides are just pressed into the head and can be driven out. The trick is that to drive them out easily and to install the new guides you must have a stepped tool which has a pilot shaft the diameter of the inside of the guide, a body diameter slightly less than the outside diameter of the guide, and a larger upper shaft on which you pound.

Two things make this job easy and save you some bucks. First, The Roadster Factory has valve guides which do not have to be reamed - they are the correct size to start. Second, is a valve guide driver set from K-D Tools, part # 812. It costs about $20 and has 3 drivers (I think you can even buy the TR 6 size seperately). It should be available at any parts store serving the auto trade. Make sure you measure the height above the head of your old guides first for reference and try freezing your new guides to make them easy to install.

RAISING YOUR OIL PRESSURE AND CHECKING BEARING CONDITIOON

Skill Level D

Just forward of the oil filter on the drivers side of the engine there is what appears to be a large nut about 1" in diameter and 2" long. This is the oil pressure relieve valve assembly. Its purpose is to keep the oil pressure from becoming too high and to return unneeded oil to the sump. It does this when the pressure becomes great enough to compress the spring and let the piston off the seat in the engine block (see illustration). The excess oil is returned to the sump and the required oil continues to flow through distribution passages to the bearings, etc.

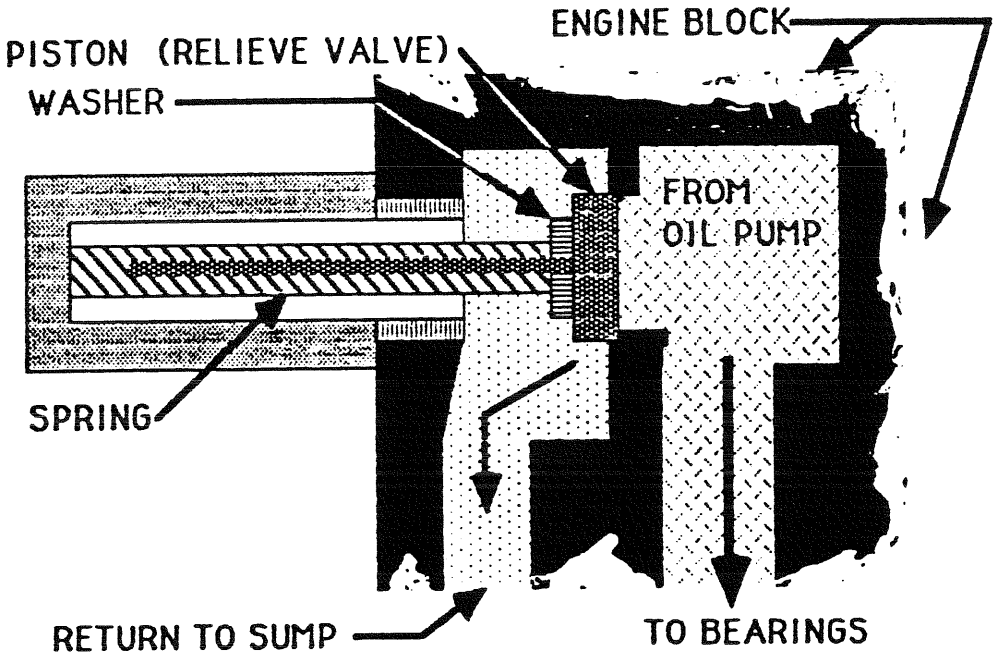
A problem can arise with the spring that will lower your oil pressure and cause needed oil to be returned to the sump when engine speed is high. The springs are just cut from a continuous coil rather than being individual springs. A very small difference in length can make a considerable difference in pressure exerted by the spring and this appears to be the case with many. You can be damn sure these springs aren't calibrated.

To correct this problem simply place a number 10 flat washer between the head of the piston (valve) and the spring to insure the spring is compressed enough. However, if one washer is good that doesn't mean two is better. You must be sure you're not raisng the pressure too much. It is highly unlikely that your pump is strong enough to put out enough pressure to really harm anything (over 100 P.S.I.) but it could happen.

To determine if you have a relief valve problem or a worn out engine do the following. Use 20-50 oil. Thoroughly warm up the engine by driving about 20 miles at highway speeds (35 or 40 in winter). Observe the oil pressure at 60 to 70 MPH. If the pressure is below 50 to 55 P.S.I. you have a relief valve problem or worn bearings. Stop and let the engine idle. If your engine is in good condition the oil pressure should be about 25 P.S.I. If it is appreciably lower you have excess bearing and/or crankshaft clearances but it still won't hurt to try this.

Remove the body and the valve assembly being careful not to lose the sealing washer. Install the No. 10 washer as shown and reinstall the assembly. Start the engine. If the pressure is above 25 or 30 P.S.I. when hot, gas the engine a few times and observe the pressure at about 2500 to 3000 RPM. If it exceeds 75 P.S.I. with the engine thoroughly hot you should remove the washer or use a thinner one. Try it on the road. If you haven't gained any pressure you can try another washer but you are probably wasting your time and risking too much pressure when cold.

It has been my observation with TR 6 engines that the oil pump can only produce about 60 to 75 P.S.I. at 70 MPH when the oil is hot and that most relief valves do open some at higher speeds.



DON'T RAISE YOUR OIL PRESSURE AND DROP YOUR TEMPERATURE

All Skill Levels

The oil pressure part of this is not directly applicable to TR 6s because they have an oil return passage on which the pressure relief valve works (see the preceding article). But it probably applies to some of the older cars many of you have in which the oil pressure regulator (note this does not say relief valve) was integral to the only passage from the oil pump to the bearings. The cool running part applies to any car.

The concept of engines running cool with lots of oil pressure is a carry over from the "good old days" when non-detergent oil and alcohol antifreeze were in common use. These ideas die hard and some people still think this way. The concept was very true back in the 40s and 50s because those old oils thinned and broke down quite rapidly with increasing temperature. Alcohol antifreeze, of course, boiled off at relatively low temperatures. Todays multi-viscosity detergent oils thrive at temperatures of 250^{0} and more. In fact, at lower temperatures they absorb condensation which forms harmful acids in the oil. Modern antifreezes also do quite well at elevated temperatures.

A common way to raise oil pressure is by placing washers behind the oil pressure regulator spring. The idea is that with lots of pressure oil will be forced into all the tiny parts in great quantities. Well, 'taint so. Who says ? Good old Bernoulli. Bernoulli's principal of physics says, in effect, "where the pressure is high, the velocity and volume are low, and vice versa". So, what you are doing by raising the pressure is making it more difficult for the pump to push oil through the regulator, thus lowering the quantity of oil delivered to the bearings. Theoretically you could have huge oil passages through which great amounts of oil could flow without impedence and the pressure would only be, say 20 P.S.I. On the other hand, if you close the passage down to 1/4", the pump will

be pushing like mad in a vain attempt to supply large amounts of oil and the pressure would be very high. You don't believe it ? Well, consider this: Most Rolls-Royces prior to 1960 or so run 20 P.S.I. on the road and 4 P.S.I. or less at idle. When was the last time you saw one of them with fried bearings ?

Regarding temperature, use antifreeze year round, and remember that it not only prevents freezing, but prevents boiling to some extent.

A good rule of thumb for any engine is that half a gauge of oil pressure at road speed is safe and that a full shot of antifreeze will let you get by with 250^0 f.

ALWAYS USE TWO MANIFOLD GASKETS

Skill level C

If your TR 6 has suddenly taken to idling fast or seems to have a miss on a cylinder or two that show good compression and good spark, you may well have a blown manifold gasket. TR 6s are very prone to this. To change the gaskets don't disassemble the carbs, etc. Just take the heater hoses off the manifold, disconnect the throttle at the lever near the firewall, and disconnect the brake booster hose. Remove the manifold bolts and the manifolds will pull back out of the way. A 6" and a 3" extension together are just right for getting under the manifold. When reinstalling those clamps under the manifold use a mirror and flashlight to check their position.

To prevent the problem simply use two manifold gaskets with the asbestos faces against each other. Torque the bolts, then retorque after the engine is hot, and again a day or two later.