Architecture of Transmissions

By Tom Mason, Minnesota AHC

We all know that only a few rocket scientists or weirdos can fix transmissions in our Austin-Healeys. Wrong! I used to feel that transmissions were too complicated to repair. Actually, what is needed is a little effort on our part to understand a complex mechanism. I feel very comfortable with overdrives and now it's time to get comfortable with transmissions. This is the first of several articles on transmissions and so consider this an introduction...

You might want to get out your *Moss or Victoria British* catalog, plus your shop manual. All of these have breakdowns of the parts in the transmission. Notice that many of these parts are unobtainium. Yes, that curious British alloy that appears and disappears now and again. However, the parts you most likely will need are available such as the synchronizing rings.

First of all, every tranny has shifting forks and the gearshift lever. Some are sideloaders and some are top shifters. We remove the bolts and the plate, and the three shifting forks will come out of the tranny. Look at these and then immediately reinstall them. Wow, you can do this! Now, remove them again until you get comfortable with them. Notice the slots the fork engage and where and how each one is installed, as you will get a test on this later when you are finished with the tranny. Spend a little time here, and it will save you later. The shifting forks move collars that pin the gears to the respective shaft at the right time. There are three collars that move back and forth. This the shifting process.

Okay. The gears in a tranny are always meshed together and do not move...gears are engaged by sliding collars that pin the gears to the shaft, otherwise they just spin free. Myth number one dissolved here, as you do not actually change gears but connect them to the shaft; the gears are always meshed. Notice the brass colored parts in the gearbox. These are the synchro rings or cones that spin the gears as you begin to shift and let the collars mesh without grinding. When they fail or wear down, the collars make grinding noises as they try to slide over the tips on the gears.

Finally, the top shaft is in two pieces that are withdrawn from each end of the tranny. There is a huge ball bearing on each end of these two shafts. Normally a drift is used to tap them out of the cases and the ball bearings are interference fit in the case. (Stick out your left thumb and then slide it into your right doubled fist...get the picture?) Most of the repair work involves removing all of the parts from these two shafts and replacing what is worn or tired. Normally, this will be the three synchro rings. These parts can be brought onto a table, and we will talk next time about repairing them. These shafts are put in the front and rear cases and tapped back together to reinstall them. Spend a little time looking at these parts. You can lay them out on a table and the parts book will tell you where each one goes, if you forget. Also, there are some ball bearings and springs that can fly way up in the air...so be careful, and we will talk about them at the appropriate time.

Lastly, in the bottom case is the layshaft. It has needle bearings and a metal shaft through the center that we will remove with a drift to check the bearings. The reverse gear is removed the same way, and you have it pretty much apart. So, enough for today, but if you think about it, we are halfway there to transmission repair.

I am getting excited about the idea of a 3.55 rear gear set (for the differential). I think it could be a great project, so if interested, contact Mark Lambert at 615-297-4823 and get your set. At $200 they are a bargain.

Gearboxes: A Primer

by Tom Mason
Minnesota AHC

Well, I have always wanted to learn transmissions and gearbox repair and I am finally getting my chance. I feel pretty comfortable with overdrives and their overhaul, although I don't think that I have seen everything that can happen to one yet. We have a lot of talented people who work down at Quality Coaches, so I am getting some training from some of the other mechanics on doing gearboxes. I don't claim omnipotence on transmissions yet, but I will share what I know and what I am learning with you. Part of learning for me is that some day I may have to do my own transmission. I know that tranny repair is very expensive if you have to pay for someone to do the job, and with good reason for it is complicated and not many people have the skill.

I have been working with MGB trannies which are very similar to Healey boxes. The MG tranny is very durable, in fact it is usually the OD that is giving trouble. Anyway, you remove the OD from the back of the tranny first. Then the gearlever assembly is removed by taking out six bolts and lifting up this cover. We generally mount the gearbox in a vise at this point by clamping onto the drain plug, and this makes it convenient to work on.

The next step is to remove the side cover, front cover, and set aside the parts. Also remove the OD cam and find a place for the little ball bearing which is made out of unobtanium (you may remember this curious alloy from other tech articles). On the MG there is a shift selector that must be worked up and out, and it looks somewhat like a pretzel. Now you can remove the end cover and set it aside.

Now we are getting to the fun part. Remove the locking nuts and slide back the shifter rods out the back of the gearcase. I like to label them and keep them in order. Since I'm new at this, I don't instantly know the differences in the rods. The second shifter rod also slides through a slot in the last rod, so pay attention (even if you are poor). Then remove the last shifter rod and set it with its brass shift fork.

You can now see all the gears and their working. Next, undo the bolt pinning the reverse gear shaft and slide the shaft out the back of the case. Remove the reverse gear and check its shaft, bushing and the condition of the teeth on the shaft. The laygear shaft must next be pushed out the front of the case and it should come out by hand pressure. The laygear and its two bushings (one on each end of the laygear) should fall down into the bottom of the case. Note that is has four sets of gear cut onto one shaft. On the MG all the roller bearings are caged and are easy to work with.

The next step is to tap out the rear bearing and the front bearing assembly. The main shaft splits into two pieces with the rear piece holding most of the parts that make up the tranny. On a clean cloth put both halves together and look things over. You will notice that the gears do not move but that a round shift assembly comes over the synchro rings to pin the gears to the shaft! The round shifter assemblies are generally trouble free and will not fly apart if you move them with the shafts together. If you try this off the shaft, you will lose little springs and balls all over the place. Check your service manual now.

The major wear point will be the synchros, and you test by seeing that they grab their conical hub without bottoming, and they should not completely slide down the cones. You may want to replace them all and also check for wear or chipped teeth. You can now also remove the lay shaft to inspect its teeth, the internal needle bearings, and the shaft should be perfect without galling or wear.

If you are lucky you will reinstall the front short main shaft and then tap the back half of the main shaft home. Note the pin that locates the rear bearing. Oh, you have to put the layshaft in the case first! The ears will all line up with the main shaft if you have done things correctly. If they don't, you have to find out why before you go on. OK, stand the case up and align the layshaft and push the shaft through. It should go easily or you have something in wrong. Install the reverse idler facing the right way. I did mine backwards the first time, so check yours with the book.

The shifter rods are slid through their bonze shifter. Then the rear cover and pretzel are installed. This is not a complete version, but it's the best I can do at this point. As I learn more, I will share with you. I plan on doing my tranny when the time comes. The Healey is British and very similar to the MG. In the meantime, shift easy and drive your car well. The other is expensive!

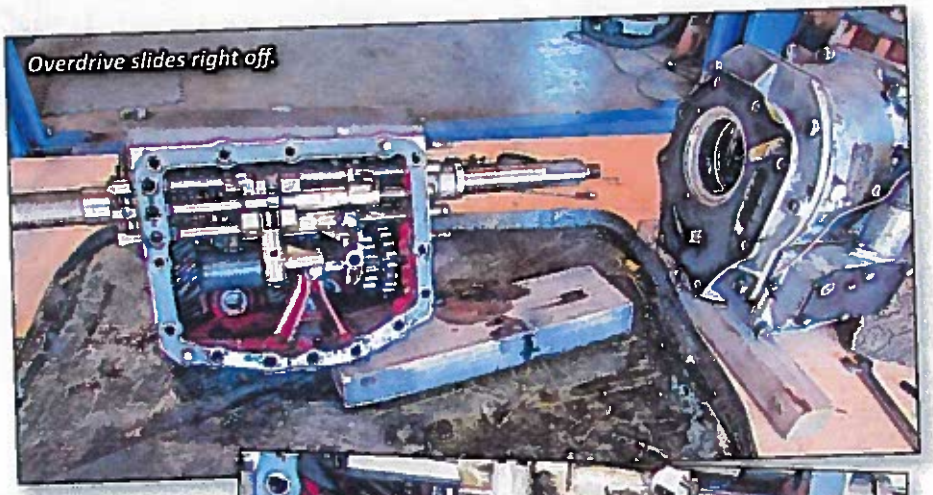
TECHNICAL SERVICE BULLETIN

The Gearbox, a.k.a. Bucket 'o Bolts

Mike McPhail, Dripping Springs, Texas, Gulf Coast Healey Club

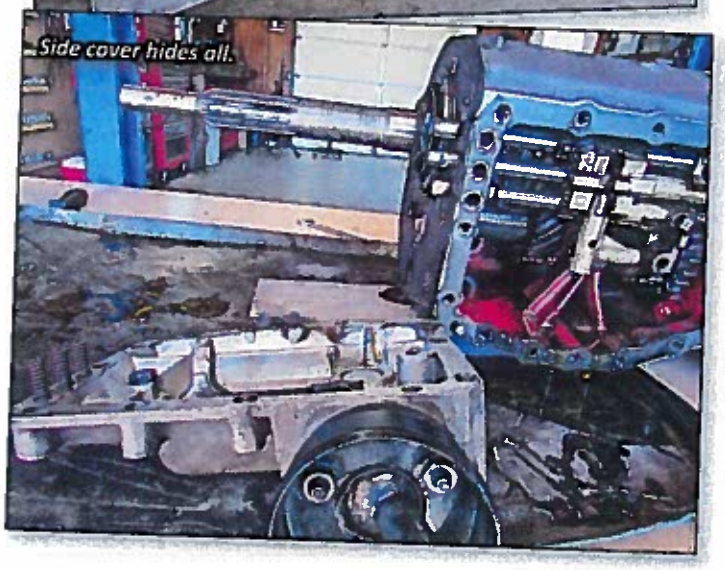
Now you may be thinking, "Why was Mike going on about the overdrive last month ... I couldn't even get it in gear!" All right, perhaps I put the cart before the horse. Probably the main reason so many of us (certainly not me) have swapped their Big Healey transmission for a Toyota 5-speed is that the poor box seemed absolutely beyond repair. This may be stretching the DIY thing a bit, but actually, this gearbox is one of the easiest there is to work on.

Now, I am not going to be able to tell you in this short article how to do a complete gearbox overhaul, but I will point out some typical problems. A handy fellow, armed with a repair manual and just a few common tools, can do wonders!


Overdrive slides right off.

Gear shift bushings and synchro ring.


Dummy layshaft keeps needles in place.


Side cover hides all.

My BN1 has the much maligned three-speed that I find superior in every way to the four-speed box found in all the other Big Healeys. However, I must admit, you can't beat the four-speed for that "Deuce-and-a-Half" Army truck shifting experience. When working properly, this transmission gives our cars that extra dose of manly appeal.

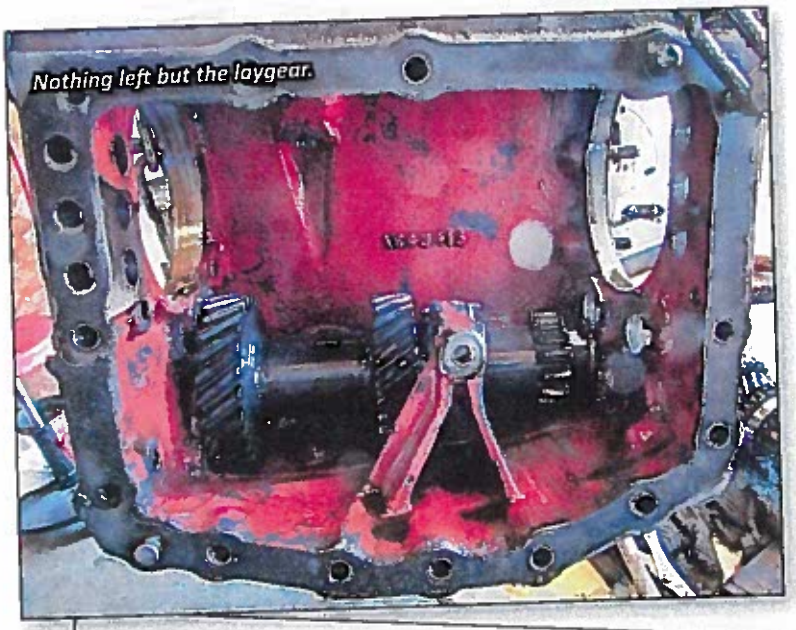
So let's roll up our sleeves and get to it. Buy a bunch of beer and get your two strongest buddies over to help pull the box out – it is really heavy! This would also be a good time to do a rebuild on the overdrive, but for brevity's sake, let us cut to the chase.

After studying the repair manual for a few days you will be ready to begin. Be sure to have a large clean work area at your disposal. The bell housing and overdrive can be pulled right off the box. Remove the side cover with the shifter still attached (center shift cars are just a little different, so follow the instructions in the book). This will expose the inner workings.

As you learned from your studies, the three shift rods are located by springs and balls held under the side cover. If you can find them, pick the springs up off the floor and then fish the balls out of the case with a magnet.

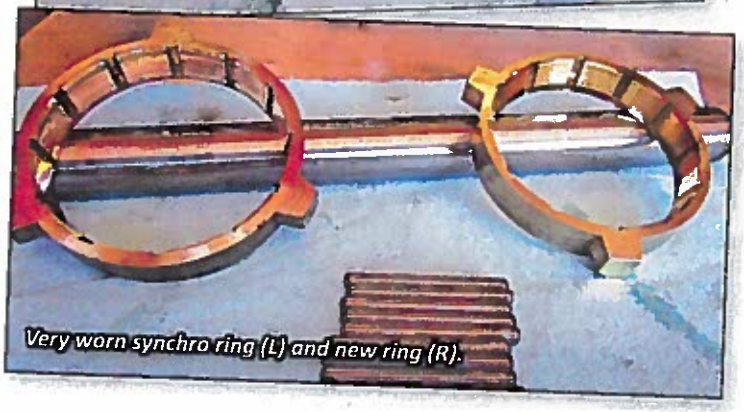
Major gearbox problem #1: The shift rod lock-out mechanism is jammed, making it very difficult to shift gears, or even allowing two gears to be selected at once, locking up the transmission. The lock-out mechanism is very simple: the outer two rods have balls in them that will jam when pushed off center by the movement of another rod. The center rod has a little plunger that can act against those balls in a manner that lets movement of any rod to lock the others in place. The plunger is held by a pin that allows it to move only enough for the locking function. The plunger often becomes stuck, which will make shifting difficult or impossible.

I have been able to fix this problem by removing the center rod, drilling out the pin, and honing out the hole where the plunger resides until it moves freely. An old nail can be used to make a new pin. In some cases the rods have been scored by the balls or even bent by the heavy-handed driver. Not you, of course! Must have been the DPO (Dreaded Previous Owner).


Nothing left but the laygear.

U.S. Army M35A2 deuce-and-a-half truck - not a Healey.


Worn synchro, input shaft and more needles, but a nice layshaft.


Very worn synchro ring (L) and new ring (R).

Most of the other common problems are not so dire. Poor synchronization is very likely just worn out synchro rings. The bad ring in the photo is extremely worn, but a worn ring is not always that obvious, so replace when in doubt.

Noisy gearboxes probably need new bearings. Once again, this is not always obvious to the examiner. Noise in neutral may mean a worn layshaft, which can be seen as scoring where the needles ride the shaft. Chipped gears can cause noise, but may not be fatal unless severely damaged.

Slop in the shift stick may be nothing more than a missing bushing. Difficulty in getting into reverse could be the double spring and plunger arrangement on the reverse shift fork. Popping out of gear may require a new synchronizer hub (ouch). Be aware that the 3&4 hub must be reassembled with a certain alignment. If not properly aligned, the box will go together nicely, but will not shift into third. Don't ask me how I know this! Of course, there is that guy with an ad on page 28 for the five-speed… HM

Repairing British Transmissions

By Tom Mason
AHC of Minnesota

After many false starts and dead-ends, I finally acquired a transmission to use in a tech session. A local junk yard in Minnesota was kind enough to loan me a 4-speed side shift to practice on.

I disassembled the gear box and practiced until I was comfortable with all aspects of the transmission. Yes, you can repair your transmission, and if you will work with the parts, it becomes simple and understandable to you. One of the first things I learned is that there are two ball bearings between the shift rods; this is in addition to the detent ball bearings. The purpose of these is to prevent more than one of the three shifting rods to move at any given time. Check your shop manual now and see if you can spot these two ball bearings. Work with the shifting rods until you are thoroughly familiar with how they go in and out of the gearbox.

The two-piece main shaft is removed by tapping out the ball bearings (on the outside of the bearing race!) and separating the two halves. Next, the layshaft and reverse gear are removed. Later cars will have caged roller bearings while earlier cars will have loose needle bearings. Fortunately, it is impossible to mix the needle bearings up as they are different lengths and diameters. The front half of the mainshaft will come right out of the case.

You will need to remove two locking collars to withdraw the gears, collars and synchros. You should work with the mainshaft and the maintenance manual until all the parts make sense. We are looking for wear or broken teeth. The gearbox that I disassembled had teeth missing from the layshaft. A replacement layshaft, shaft and bearings should fix this transmission. I would also replace the roller bearings, the needles and the synchros on the mainshaft. If you want a step by step review of this process, you can purchase a video tape of my disassembly. See my ad in the classifieds of this magazine.

There are three main causes of tranny failure. Running the box low on oil will cause early and severe wear. Rough shifting and poor clutch technique is second. Finally, all boxes should have second engaged before first or reverse is selected. Taking second first will align the gears and ease wear and tear on the tranny. A proper tranny should not leak oil and should last upwards of 150,000 miles. My gearbox is like using a rifle bolt and still is like new at over 100,000 miles. Good luck with your transmission repair.

Healey Q & A

Bill Lillibridge
AHC of Minnesota

Karen and I were 10 miles into the New England 1000 with our newly restored 100S (www.bklillibridge.com) when the gearbox went south. We had to finish it in a MB 500 SL. Mike Salter of Precision Sportscar built a new gearbox for us in time to show the car at the Greenwich Concours d' Elegance the following weekend.

Mike has a wealth of Healey knowledge, as can be seen in his explanation of the cause of the failure and has both used and new parts to go with it. I'd highly recomend him if anyone wants it done right the first time, especially with the Canadian exchange rate at a reasonable price

Michael Salter of Precision Sports Car offered this information in response to Bill's problem gearbox:

The gearbox failure was caused by an incorrectly manufactured lay gear bearing spacer. The original spacer had a bore of .789" and an OD of 9.758". The one that someone has made for the box has a bore of 9.758" and an OD of 0.995".

The result was that the spacer was a tight running fit on the shaft. Although many of the parts are damaged, it would appear that the spacer was also a little bit too long so that there was no end clearance for the rollers.

I think that this caused friction between the ends of the rollers and the spacer. This heated up the spacer taking up the 0.004" clearance and causing it to seize both inside the bear and onto the shaft. This resulted in the shaft seizing in the gear and then the whole lot rotating in the case.

This action wore away the case to the extent that the gears moved away from each other to a sufficient degree that they eventually came out of mesh and were destroyed. The laygear was so firmly seized on the shaft that the end of the case broke out as we tried to press it out.

The box that we built for your 100S has the correct spacer in it so there should not be a recurrence.

Smitty's Toyota Tranny Transplant Kit

by Smith Brody
Thousand Oaks, CA
AHCA & AHCPC

I have been asked many times how and why I made the five-speed conversion kit for the Austin-Healey transmission, and here's the answer.

After I bought my BJ8, I noticed that the oil spot under the transmission was getting bigger every day. It wasn't long before I had more oil under it than I had in it! After getting a couple of estimates on rebuilding the Austin-Healey transmission, I knew there had to be a better way.

As I started to look for a transmission to replace the A-H tranny, I decided I needed one that was fully synchronized, with a removable bellhousing; and after looking through the transmissions at the wrecking yard, I chose a Toyota five-speed. The fifth gear would act as the overdrive, one which works every time. I hand-fabricated a bellhousing and installed the Toyota five-speed; this conversion has worked out very well.

The new transmission has several advantages. Because it is fully synchronized in all gears, it shifts very easily and fast. With fifth gear as the overdrive, the need for the Austin-Healey oil pump is eliminated, as is all the heat that goes with it. Another advantage is that this transmission weighs about 100 pounds less than the A-H tranny.

After I had about 10,000 miles on the new transmission, my wife, Esther, and I decided to go to Sturbridge, MA, for Conclave '91. Two other BJ8 owners who were going to make the trip with us asked me if I would make a conversion for their cars, too. While we were in Sturbridge, people showed a lot of interest in the conversion, and I was given an order for one kit.

I knew then that I would have to make a pattern and have the bellhousing cast. By using as many A-H parts as I could—namely the A-H flywheel pressure plate and slave cylinder—to keep the price as low as possible, I was able to make this conversion for less than the cost of rebuilding the old transmission.

When using the conversion kit, there is no welding or cutting needed on the BJ8; the gear shift comes through the original gear shift opening. On the 100-6, the gear shift comes out through the ashtray hole.

Installation—Smitty Shares His Secrets

I get a lot of calls about installing the five-speed transmission: How hard is it? What is involved? How expensive is it?

As to cost, the most expensive part is the transmission itself, and the cost has a lot to do with where you live. A good, low-mileage tranny in the Los Angeles area, for example, costs about $300. The next item is a new drive line, about $100; a new clutch disk, $60; and the conversion kit, currently $450. It is best to have a new speedometer cable made.

Although it all adds up, the cost of the parts is less than an overhaul on an A-H tranny; and besides, when you're done, you'll have a transmission that is 40 years newer and has the fifth "overdrive" gear that works every time.

Installation of the five-speed is no more difficult than doing a clutch job. Remove the old tranny, along with the pressure plate and clutch disk. Let the slave cylinder hang; you will be using it. Clean the flywheel and install the new pilot bearing from the kit. You will need a new Toyota clutch disk, which must also be installed. Using the A-H pressure plate and slave cylinder, install the new bellhousing on the Toyota tranny. Place the new unit in the car, and slide the new rear mount from the kit in place. Now measure for your new drive line. As noted before, on the BJ8s, the gear shift comes out the ordinary center shift opening; and on the 100-6s, it comes out the ashtray hole.

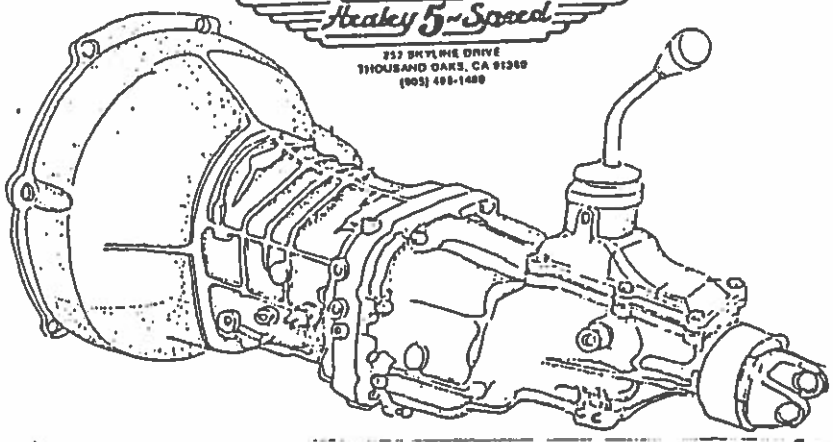
The five-speed kit comes with carefully illustrated, step-by-step instructions. In the past few years, I have sold approximately 100 of these conversion kits, shipping all over the USA, one to Australia, and one to Canada. This has been a wonderful experience for me, as I have made a lot of new Healey friends with this kit, while at the same time providing the owners with a reliable alternative that allows them to drive and enjoy their cars.

Editor's note: Additional information is available from "Smitty," a.k.a. Smith Brody, 252 Skyline Drive, Thousand Oaks, CA 91360. Phone: 805-495-1488.

SMITTY'S TRANS. CONVERSION

Healey 5-Speed

257 SKYLINE DRIVE
THOUSAND OAKS, CA 91360
(805) 498-1488



5-SPEED TRANSMISSION SELECTION GUIDE:

IDENTIFICATION:

TOYOTA TRANSMISSIONS ARE IDENTIFIED BY THE ENGINE NUMBER DESIGNATION THEY ARE ASSEMBLED TO. THERE ARE NO I.D. MARKINGS ON THE TRANS. ITSELF.

ONE GOOD METHOD OF SELECTING YOUR TRANSMISSION IS TO FIND ONE IN A COMPLETE CAR. HERE YOU CAN CHECK THE MILEAGE AND KNOW WHICH YEAR AND MODEL YOU HAVE. IF YOU FIND THE TRANSMISSIONS OUT OF THE CAR AND STILL BOLTED TO THE ENGINE, THE APPROPRIATE ENGINE NUMBERS ARE:

22R ENGINE '81-'90 } THESE ENGINES CAME IN
22RE ENGINE '84-'94 } TOYOTA CARS AND PICK-UPS

5MG ENGINE 1982-1986 TOYOTA SUPRA

7MG ENGINE 1986-CORRENT (NON-TUBRO) TOYOTA SUPRA

'91 TO CURRENT 2-WHEEL DRIVE PICK-UP TRUCKS.

GEAR RATIOS:

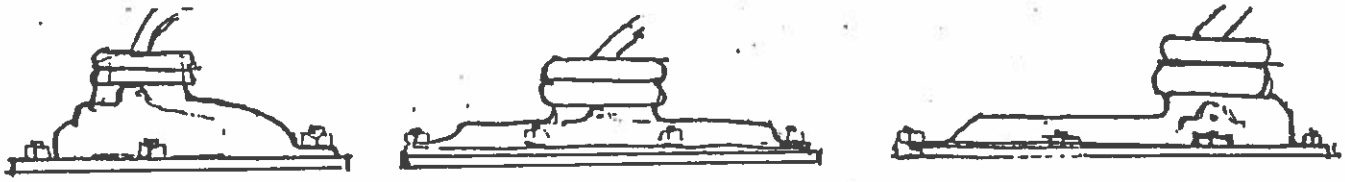
THESE 5-SPEED TRANSMISSIONS ARE FITTED WITH THE FOLLOWING GEAR RATIOS:

1ST	3.286
2ND	1.894
3RD	1.276
4TH	1.00
5TH	0.783 (22% OVERDRIVE)

DIFFERENTIAL GEAR RATIOS FOR THESE TRANSMISSIONS VARIED FROM YEAR TO YEAR FROM 3.70 TO 4.30, SO YOUR HEALEY DIFFERENTIAL RATIO OF 3.90 TO 4.11 FALL IN THE MIDDLE OF THIS RANGE.

SEE WHAT DIFFERENCE A TRANSMISSION MAKES!!

SMITTY'S TRANS. CONVERSION
Hurley 5-Speed
257 SKYLINE DRIVE
THOUSAND OAKS, CA 91360
(805) 495-1488

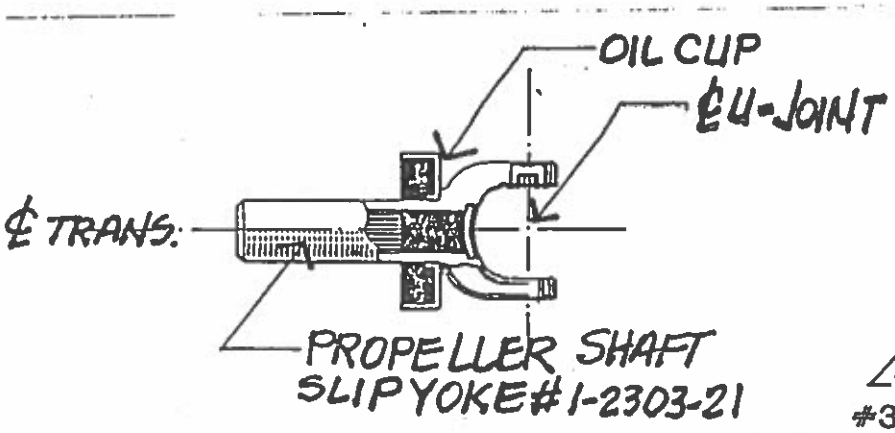


FRONT MIDDLE REAR

FIGURE NO. 1

SHIFT TOWER LOCATIONS: (SEE FIGURE NO. 1)

THERE ARE 3-SHIFT TOWER LOCATIONS AVAILABLE ON THESE TRANSMISSIONS; EITHER FRONT, MIDDLE, OR REAR. ALL OF THESE CONFIGORATIONS WILL WORK FOR YOUR CONVERSION. THE FRONT SHIFTER LOCATION, OFTEN FOUND WITH THE 22R ENGINE IN THE '81-90' PICK-UP, IS THE MOST DESIRABLE AS THE SHIFT LEVER REQUIRES VERY LITTLE BENDING, ESPECIALLY IN THE LATER "BJ" CARS.



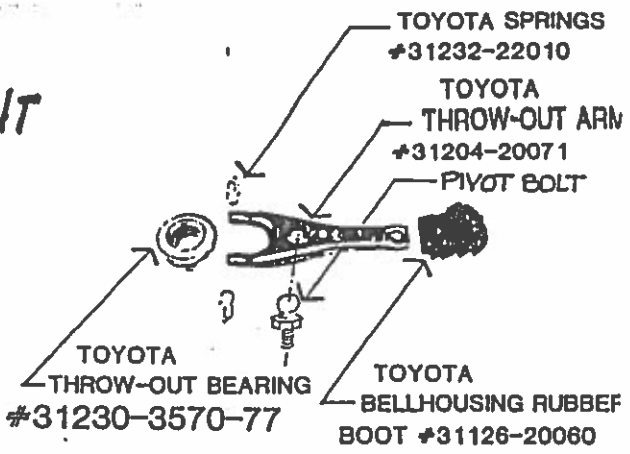


FIGURE NO. 2

PARTS INCLUDED WITH TRANSMISSION PURCHASE: (SEE FIGURE NO. 2)

WHEN YOU BUY YOUR 5-SPEED TRANSMISSION, BE SURE TO GET ALL THESE PARTS WITH IT: THROW OUT BEARING, THROW OUT BEARING CARRIER/THROW OUT ARM, BELLHOUSING RUBBER BOOT, THROW OUT PIVOT BOLT (BALL), TRANS. SIDE BOLTS & PROPELLER SHAFT SLIP YOKE. INSPECT ALL USED PARTS FOR WEAR AND REPLACE AS NECESSARY. RECOMMEND AT LEAST A NEW THROW OUT BEARING, (SEE SMITTY'S PARTS LIST FOR PART NUMBERS)

SEE WHAT DIFFERENCE A TRANSMISSION MAKES!!

Healey 5-Speed
252 SKYLINE DRIVE
THOUSAND OAKS, CA 91360
(805) 495-1488

SMITTY'S PARTS LIST

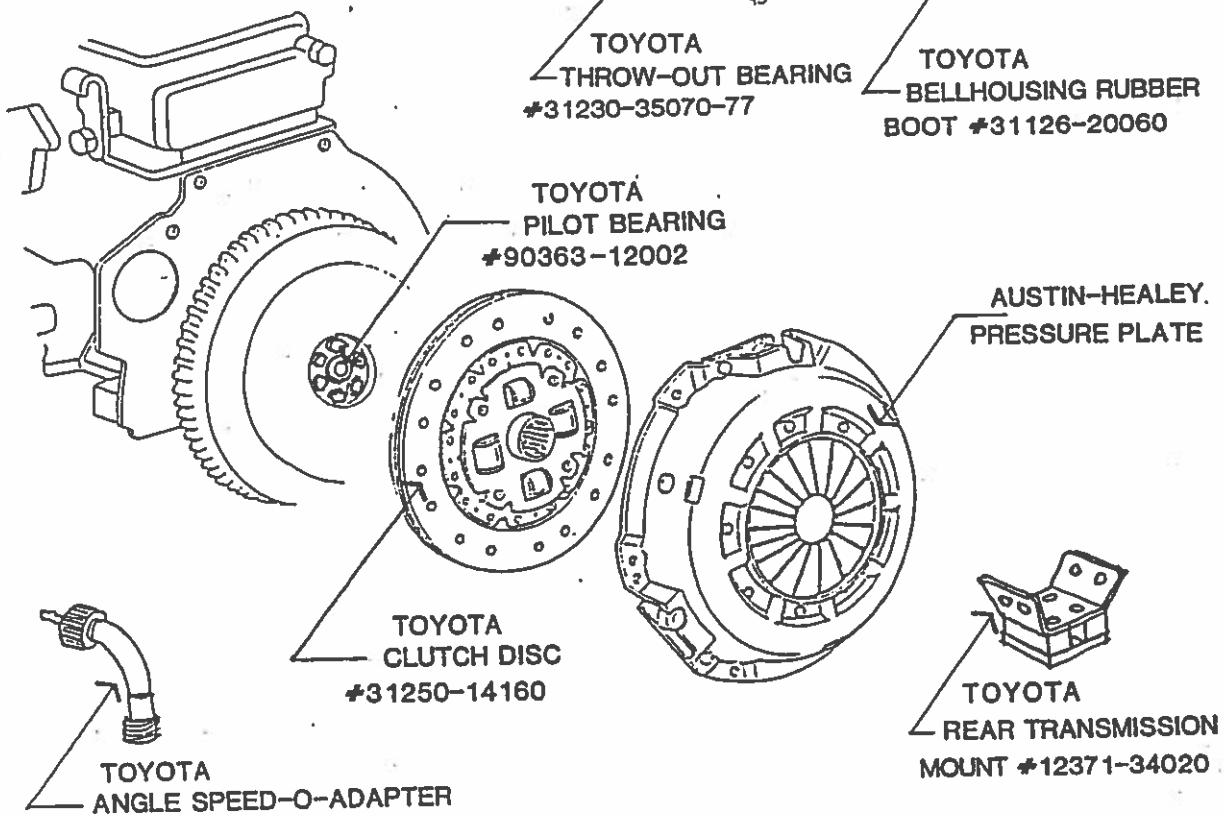
SEE P.2 FOR TRANSMISSION SELECTION GUIDE.

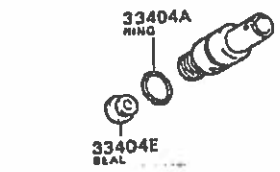
GASKET KIT FOR TRANS. #04331-20050

REAR TRANS.SEAL(ONLY)#90311-38032

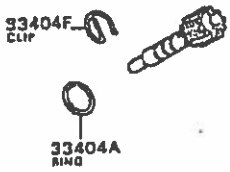
TRANS.FRONT SEAL(ONLY) #90311-30115

SEE P.11 FOR PROPELLER SHAFT SPEC.'N.





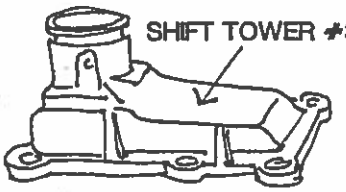
SPEED-O-GEAR HOUSING
#33404-22010



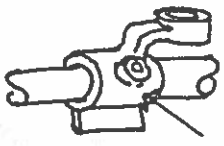
SPEED-O-GEAR DRIVE
#33403-19245

END BUSHING FOR SHIFTER
#03548-310

TO CONVERT TO A FORWARD SHIFTER USE:



AND



HOUSING SHIFT #33521-35221

CLUTCH MASTER CYLINDER FOR 100-4 USE 69 TO 1973 NISSAN 620 & 520 P.U.
(I HAVE THESE CYLINDERS IN STOCK)

SMITTY'S TRANS. CONVERSION
Stealey 5-Speed
[redacted]
THOUSAND OAKS, CA [redacted]
[redacted]

SMITTY'S PARTS LIST:

OPTIONAL TRANSMISSIONS: IDENTIFIED BY ENGINE TYPE (SEE TEXT)

22R ENGINE	'81-'90	THESE ENGINES CAME IN CARS AND PICK-UP TRUCKS
22RE ENGINE	'84-'94	
5MG ENGINE	'82-'86	TOYOTA SUPRA
7MG ENGINE	'86-CURRENT	(NON-TURBO) TOYOTA SUPRA
	'1991-CURRENT	TWO WHEEL DRIVE PICKUP (TOYOTA)

PART NAME:	PART NUMBER
THROW-OUT BEARING	TOYOTA #90363-40022
THROW-OUT ARM	TOYOTA #31204-20071
BELLHOUSING RUBBER BOOT	TOYOTA #3126-20060
TRANSMISSION MOUNT (BLACK RUBBER)	TOYOTA #12371-34020
CLUTCH DISC	TOYOTA #31250-14160
ANGLE SPEED-O-ADAPTER	TOYOTA #83770-30070
PILOT BEARING	TOYOTA #90363-12002

CLUTCH MASTER CYLINDER (ICD-4 INSTALLATIONS) '67-'72 NISSAN PICK-UP

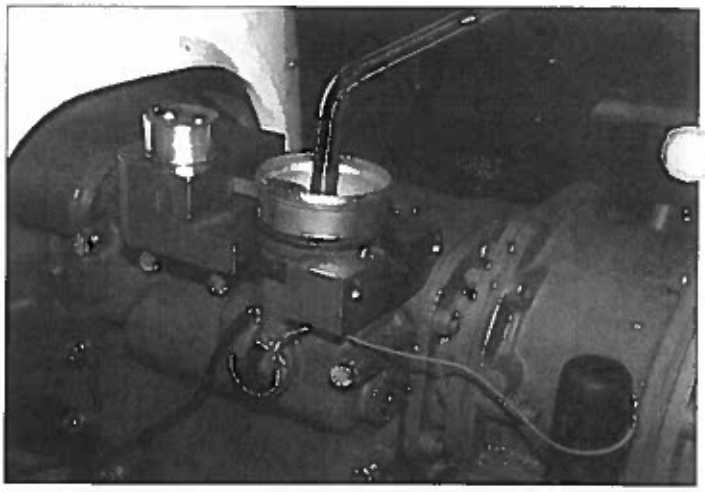
PROPELLER SHAFT — TO BE SHOP FABRICATED (SEE TEXT)

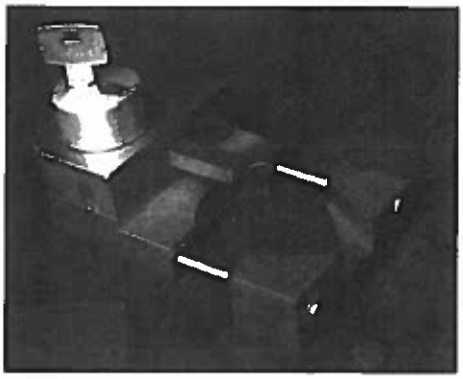
Austin-Healey Transmission Lock

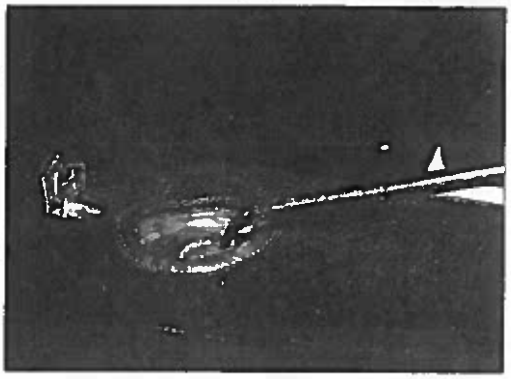
by Bob Benisek

International News

Auto theft is a problem throughout the world. Here is one deterrent designed and built by a member of the Austin-Healey Club of Germany. The transmission lock prevents a thief from shifting gears even if he is able to get the engine started.







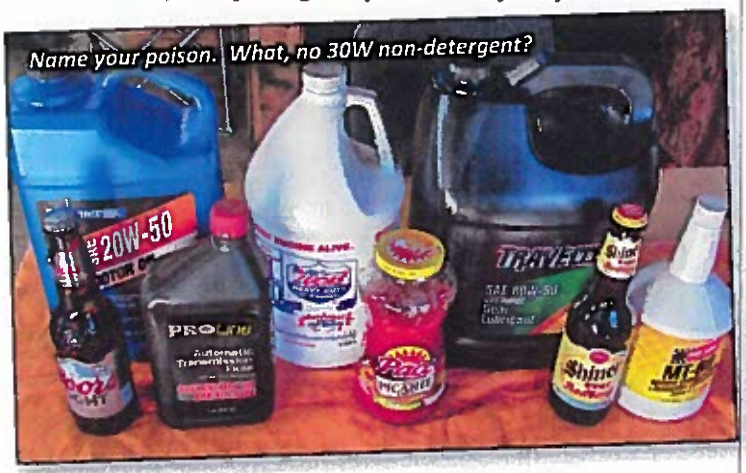
Below: Transmission lock. ***Top right:*** *Transmission lock mounted on an Austin-Healey transmission.* ***Bottom right:*** *When the transmission tunnel and carpeting are installed, the transmission lock can not be seen.*

TECHNICAL SERVICE BULLETIN

The Overdrive, Part One

Mike McPhail, Dripping Springs, Texas, Gulf Coast Healey Club

Got your Healey up on jack stands for the winter? Clever idea – it keeps those tires from getting flat spots and gives Fido a cozy place to nap! Of course, if you don't mind the dog hair, now is a fine time to figure out why your overdrive quit working. The most common symptom is that nothing happens when you flip the switch. Let's take this problem step by step – no sense in just replacing components willy-nilly.



Name your poison. What, no 30W non-detergent?

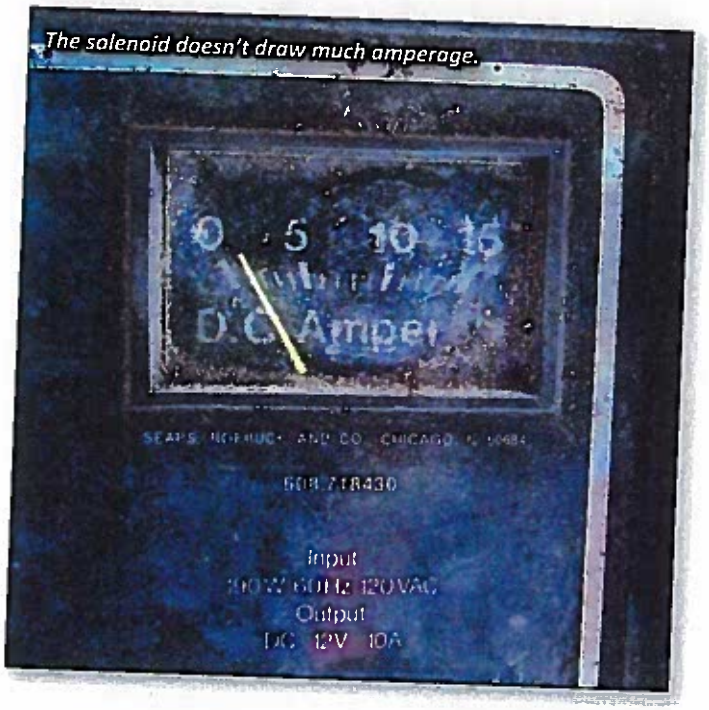
We all know that the Laycock de Normanville "A" Type overdrive unit is bolted to the rear of the gearbox and is operated by an electric solenoid. The solenoid opens a valve in the unit that applies pressurized oil to a pair of pistons which in turn cause the internal mechanism to shift into overdrive. Here is a short list of the most common problems that can be cured without pulling the transmission out of the car:

Low oil level.
Loose wires.
Missing solenoid plunger stop.
Defective solenoid.
Defective relay.
Defective dash switch.
Defective lock-out switch.
Solenoid out of adjustment.

First of all, we (you) might as well change the oil in the gearbox and overdrive. This should be done annually. It holds about three quarts. Bone dry? Oops! Wow, look at all those brass and steel filings!

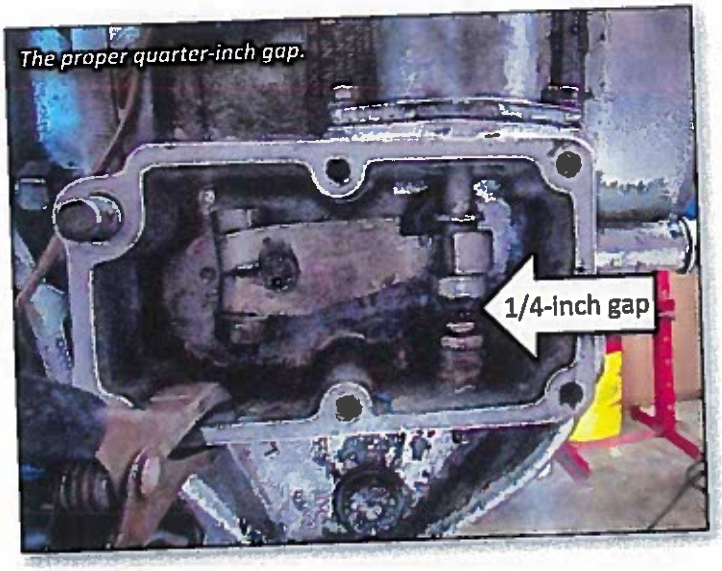
Next, unscrew the big drain plug on the OD unit and clean the screen and the three magnetic rings. Not there? Oh-Oh. Refill with your favorite oil. Make mine 20w50 with a bit of oil treatment; the same thing I put in the engine. Now after checking for loose wiring, we can get down to business.

More often than not, the solenoid is not operating. Put the gearbox in top gear, turn the key on, and flip the switch. The

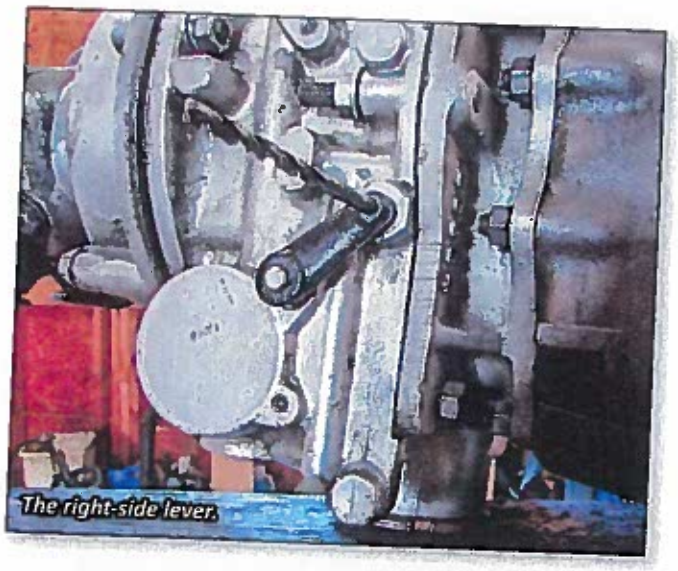


The solenoid doesn't draw much amperage.

relay on the firewall and the solenoid should both click. To be absolutely sure of the solenoid, have a dog lover crawl under the car and observe the lever on the right side of the OD unit. There is no return spring, so you might want to hold it back with your finger. If all is well, the lever will move forward forcefully, stopping over the adjustment hole in the case. If the lever is reluctant to move when restrained, the stop under the solenoid plunger may be missing. This stop provides a 1/4-inch gap when the solenoid is engaged.



The proper quarter-inch gap.


The right-side lever.

Let's say the solenoid did not operate. Get your old-time battery charger with the built-in amp meter and use it to operate the solenoid. A good solenoid will suck that piston up smartly so fast that it will make your head spin. The meter will show just a couple of amps, as the operating coil is opened when the piston hits the tiny switch in the end of the bore and the holding coil takes over. If the meter is pulling 8 amps, this has not happened, and you will soon see smoke! This condition could indicate the need for adjustment, which will be covered in tedious detail next month.

Now that the possibility of a defective solenoid has been eliminated, the next place to look for trouble is the OD relay on the firewall. Now if you have a three-speed BN1 you are in trouble, because it has two relays under the dash and an additional centrifugal switch on the OD – I'm not even goin' there! Well, maybe later.

Instead, pop the bonnet of your proper four-speed Healey and note the two relays on the left side firewall. Okay, I know I said one relay. The second one with the rod connected to the throttle linkage is the PITA ("Pain In The A**") disengagement override relay. We will talk about that later. For now, disconnect one of the two wires on this second relay until we are done testing.

The relay we are interested in has four terminals: C1, C2, W1, and W2. If this relay does not click, use your voltmeter to check for battery on Winding 1 and ground on Winding 2. Got power to the windings, but no operation? Temporarily pull the wires off W1 and W2 and hit the terminals with the battery charger. No worky? Must be bad!

Oh, it does work? OK, test further. There should be battery on C1 when the ignition is on – sorry, no fuse on this circuit. The second wire on C1 goes through the OD toggle switch on the dash and back to W1. Consequently, touching a wire across C1 and W1 will operate the relay, just like flipping the switch. If this is the only way the relay will operate, check out the toggle switch and associated wiring.

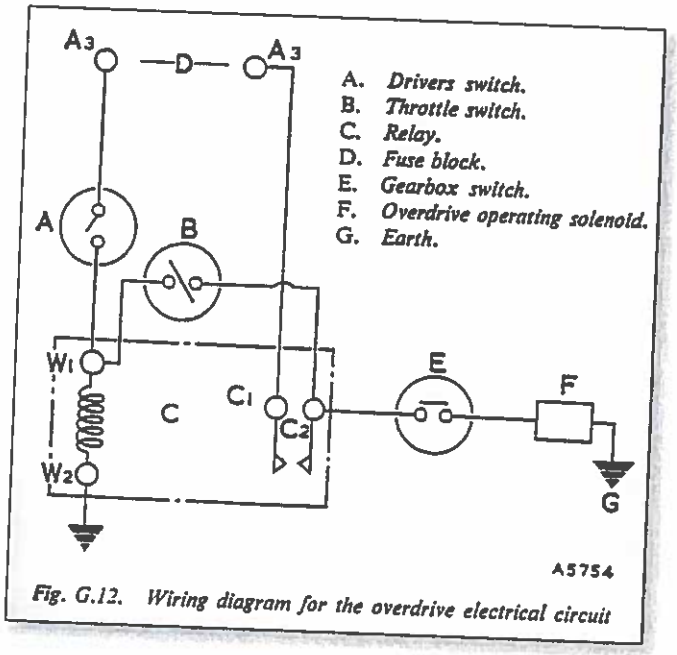
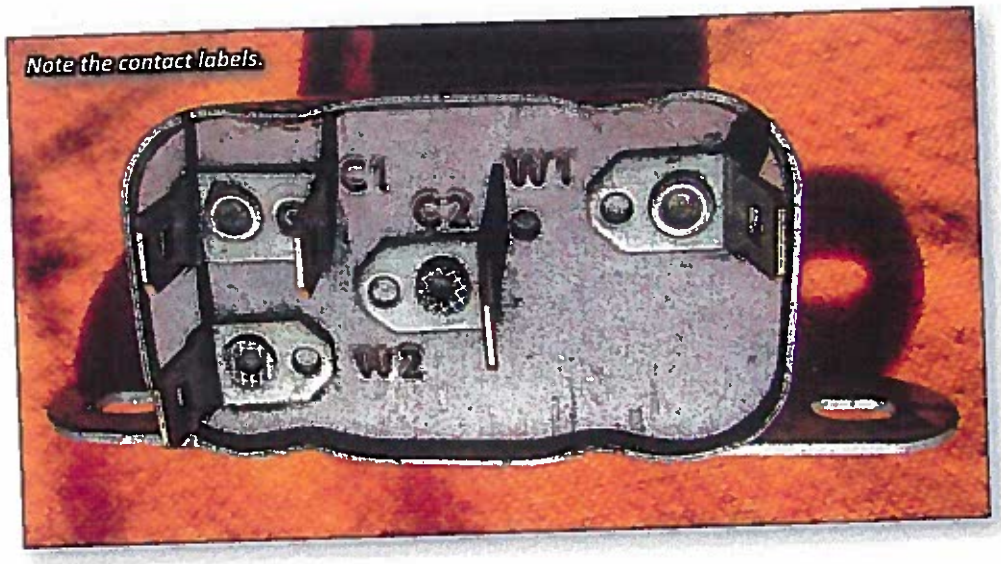


Fig. G.12. Wiring diagram for the overdrive electrical circuit

All right, the relay is now operating, but still no clicking solenoid? Cross your fingers and short Contact 1 and Contact 2. If this makes the solenoid operate, the contacts are bad, which is one of the more likely scenarios. In a pinch, the relay cover can be removed and the contacts adjusted. No kidding!



Note the contact labels.

Still no response from the solenoid? We are running out of options folks! The lockout switch on the gearbox is the last bit in this puzzle and will most likely require the removal of the transmission tunnel for access. Do not even think about bypassing this important piece. Well, okay, just for testing, run a temporary wire from C2 to the solenoid. The solenoid will now operate regardless of what gear you are in, including reverse, but if you were to back up in OD, you can kiss your A-type goodbye!

To be continued HM

Title: OVERDRIVE SOLENOID INFO SHEET

Message:

CAUTION: incorrect adjustment can cause major transmission and overdrive damage by having the solenoid come on when it shouldn't be. Also, you'll risk cooking the solenoid
All solenoids should be tested before fitting it to the car.
A good solenoid will almost Jump in your hand when energized. Cleaning points or checking alignment of points often will get a solenoid going again. While the cap is off, check to see if the points to the primary winding open up when the plunger is at the top of the stroke.
How to set the adjustment:
On late model overdrive units there Is an adjustment to limit the overall travel of pinch bolt lever operated by the solenoid plunger. On earlier models, you can install a 10/32 machine screw in the hole below the solenoid. Use a nut both below and above the hole to keep the screw in place.
The adjustment setting seems to work best at 3/16" to 7/32".
You would want half of the travel to be free and the other half of travel to lift the spring loaded ball. You should be able to feel the resistance in the transition between free play and when the ball starts to lift (at the half way point).
Check to see if at the on Position, the adjust. lever can still be lifted slightly--this will ensure the primary points are opened and the secondary winding is holding the plunger-. You can double check your adjustment by using the factory manual method and it should be very close.
The method outlined above takes into account wear on the components and address the overall lift of the plunger

by Tom Mason

Minnesota AHC

More OD Diagnostics

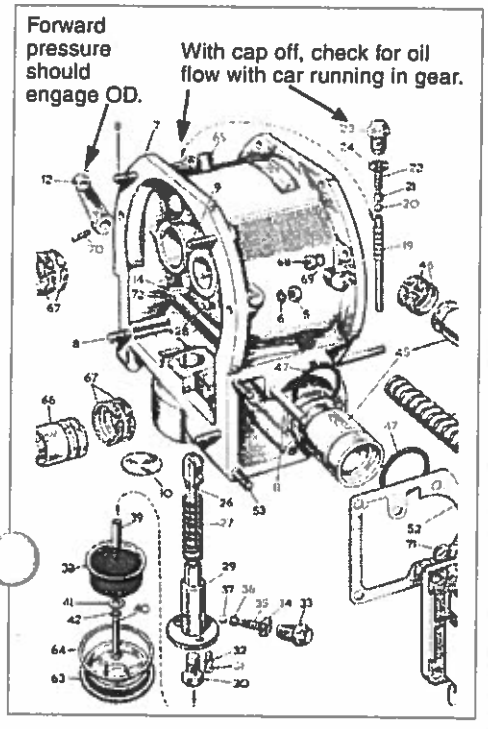
I had today off from work, so I did the hardest part of beginning to fix my overdrive, which is just starting the project. Actually, taking off the tunnel took only about an hour or less. First the center arm rest, then the console with radio. Seat belts off, then the center tunnel carpet, and then 10 sheet metal screws and the fiberglass tunnel can be removed. The speedometer also has to be disconnected from the gauge end.

Well, that wasn't so bad after all. Actually, we are at the fun part of looking at the tranny and OD unit. I reread the section in the service manual about the OD last night. The first thing to do is to remove the operating valve cover which is a half-inch cap, more or less on the top of the OD. Check pages g-2 and g-5 in your service manual. I also made sure the solenoid was moving up and down.

I then jacked up the car and started it to let it run in gear. Well, the OD pump began to pump oil up the uncovered operating valve hole. (BE CAREFUL RUNNING THE ENGINE AND TURNING THE DRIVESHAFT; IT HAS THE POWER TO SERIOUSLY HURT YOU.) So, at this point I knew that the oil pump was not the problem. I had hoped that was the problem because it's the easier fix.

I sat in the car and realized that I probably was going to have to take the OD off and out of the car. Probably a bad accumulator or seal, or worse. However, before I did that I did one more thing. I ran the car and took the solenoid off the left side and tried engaging the OD manually, operating the rod and linkage on the passenger side of the OD. Well, guess what? It worked!

I cleaned up the sides of the actuating rod, oiled it, and installed a new solenoid. I then test drove the car, and the overdrive worked. I guess the old solenoid just got weak or tired. See the attached picture for the two places to check. Well, I am happy not to have to tear into my OD just yet; they really should last over 200K unless they are abused. Maybe these checks on your OD will save you some grief, as they did with me and my car. I vacuumed the car and waxed the leather with classic leather wax, before I put it in the garage. I didn't even mind the rain that started. Life is good.



Mr. Finespanner Talks Overdrive

(Part I of a four-part series.)

by Del Border
Northeast Region

This month we deal with the overdrive unit, looking at in-car repairs and tweaks, some of which never before appeared in print. This article is written from over 30-years experience repairing overdrives and is Mr. Finespanner's personal observation, and some sections may not agree with popular opinions.

Many articles have been written about maintenance and repair of the overdrive unit. This article is meant to supplement what has already been written and not cover the information available in repair manuals or other tech articles.

The overdrive unit is a very dependable unit, able to function over a period of 10 to 15 years and 100,000 miles of normal driving with no more than a switch and solenoid replacement, and adjustment of the valve setting lever. As strong as it is, the overdrive unit is still the weak link in the Healey drive train. In a season of weekly hill climbs and autocrossing, you can expect to destroy two or three overdrive units.

For the vast majority of Healey owners, driving one or two thousand miles a year and autocrossing two or three times a year, the overdrive should last at least ten years — not bad overall. When it does fail, it won't be a catastrophic failure as it usually is from all-out racing.

Let's start with the basic overdrive problem — the OD unit does not engage. Check the oil level and top off if necessary. I use straight weight (no multi-viscosity) 40-weight non-detergent oil. The original Healey manual recommends 20/40, 20/50, or thereabouts for summer driving. Triumph TR3s and TR4s use the identical OD unit and their manual recommends 80/90 weight hypoid oil — go figure.

If the oil level is satisfactory, remove the metal/fiberglass gearbox cover, then energize the solenoid to see if the solenoid is operating. NOTE: If the solenoid does not function, follow instructions in the factory manual to trace wiring and/or switches. If the solenoid is moving the valve setting lever (located on the opposite side of the OD unit from the solenoid), the next step is to adjust the operating valve using this lever (see Fig 6.16 and 6.17).

The manual describes how to adjust the valve setting lever by energizing the solenoid, inserting a $^{3}/_{16}$ inch diameter rod into the lever and adjusting the control mechanism (a clamp on a shaft passing through the OD unit) until the $^{3}/_{16}$ inch rod slips into a hole in the OD casing. When the rod passes into the hole in the

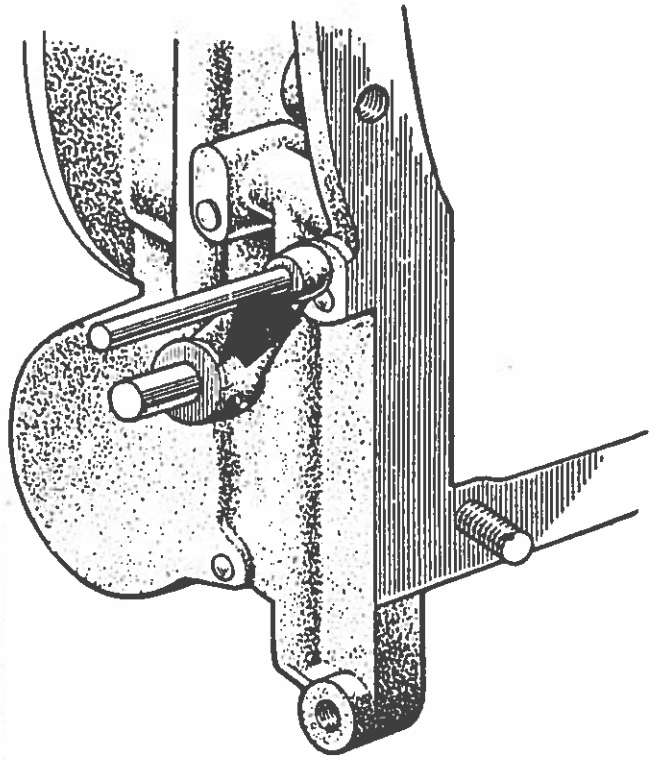


Fig 6.16 VALVE SETTING LEVER (ARROWED)

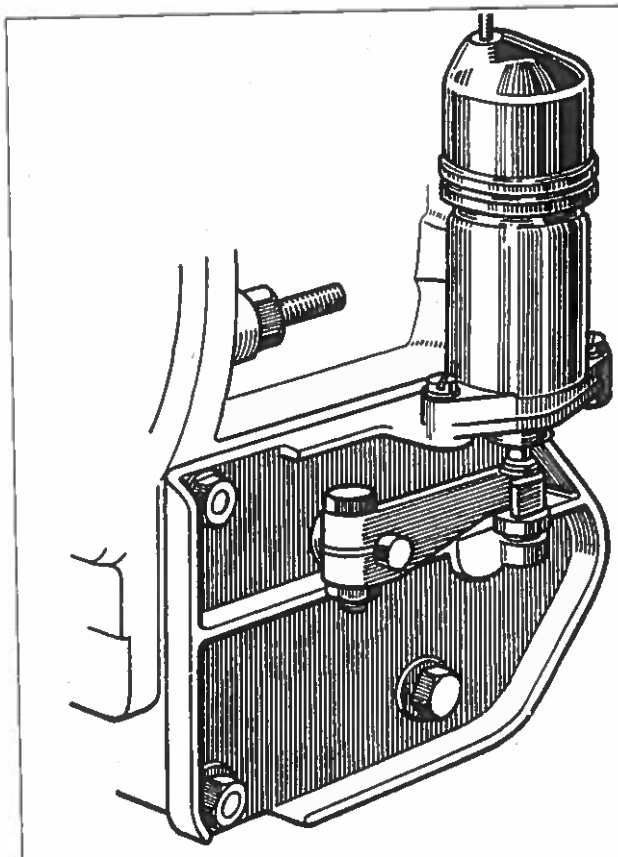


Fig 6.17 SOLENOID PLUNGER BOLT RESTING ON RUBBER STOP

OD casing, the operating lever will lift a ball 1/32 inch off its seat. THIS DOES NOT WORK!

There are simply too many parts involved in this Rube Goldberg design to accurately lift the operating valve the correct distance, especially with 30 or more years of wear. The OD currently in my car does not function if the valve setting lever is set as described in the factory manual.

The only function of the solenoid, plunger, shaft clamp, rod valve setting lever, and operating valve is to lift a ball in the operating valve chamber 1/32 inch to allow oil under pressure from the accumulating piston to flow to the two operating cylinders which move the pistons forward to engage the overdrive clutch. Rather than using the hole in the valve setting lever as an alignment device and assume that the ball is lifted the correct amount, we will set the OD solenoid adjustment by observing the ball and adjusting the solenoid directly from the movement of the ball.

Before we adjust the valve setting lever, let's find out how close the setting was before we adjust it correctly. Using the working end of a 3/16 inch diameter drill bit, clean out the hole in the valve setting lever and the hole in the OD casing from years of crud and road grime, then energize the soenoid and place the smooth end of the drill bit into the valve setting lever until the drill bit either bottoms out on the OD unit or slips into the hole in the OD unit. (Be careful you don't rotate the lever and get a false reading — you can override the solenoid.) Put enough pressure on the drill bit so that when you de-energize the solenoid, the valve setting lever does not move. If the drill bit slips into the hole with the solenoid energized, this is the correct factory setting, but possibly not the setting we need. If the drill bit bottoms out on the OD casing, de-energize the solenoid, and using the drill bit as a handle, rotate the valve setting lever toward the hole in the OD casing to get an idea of how far away the drill bit is from the hole in the casing. De-energize and energize the solenoid as many times as it takes to know the relative location of the hole in the valve setting lever to the hole in the OD casing.

Now let's actually set the adjustment. (See Fig 6.18.) Remove the operating valve plug, valve spring, and ball valve plunger, leaving the ball (or ball valve as it's called in the manual) and operating valve in their normal position. Loosen the solenoid lever clamp (under the solenoid) so you can freely move the valve setting lever. (Note: This lever will now rotate 360 degrees and if it does, the operating valve inside the OD will slip into the bowels of the unit. If this happens to you too (Yes, I've done it.), remove the ball, then insert a small round screwdriver or stiff wire into the hole in the operating valve and lift the valve from the unit. Rotate the valve setting lever to its approximate correct position and lower the operating valve to its normal position and replace the ball.) Rotate the valve setting lever toward the hole in the OD casing. As you approach the vicinity of the hole in the OD casing, you will see the ball beginning to lift. Rotate the valve setting lever until the ball lifts at least 1/32 inch, but less than 1/16

(continued on page 22)

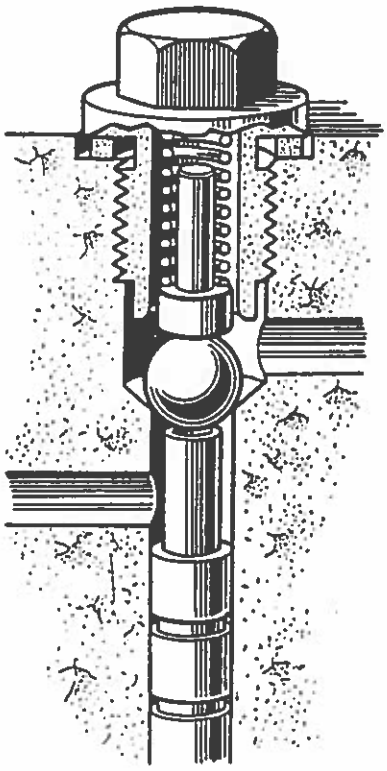


Fig 6.18 CROSS SECTIONAL VIEW THROUGH OPERATING VALVE

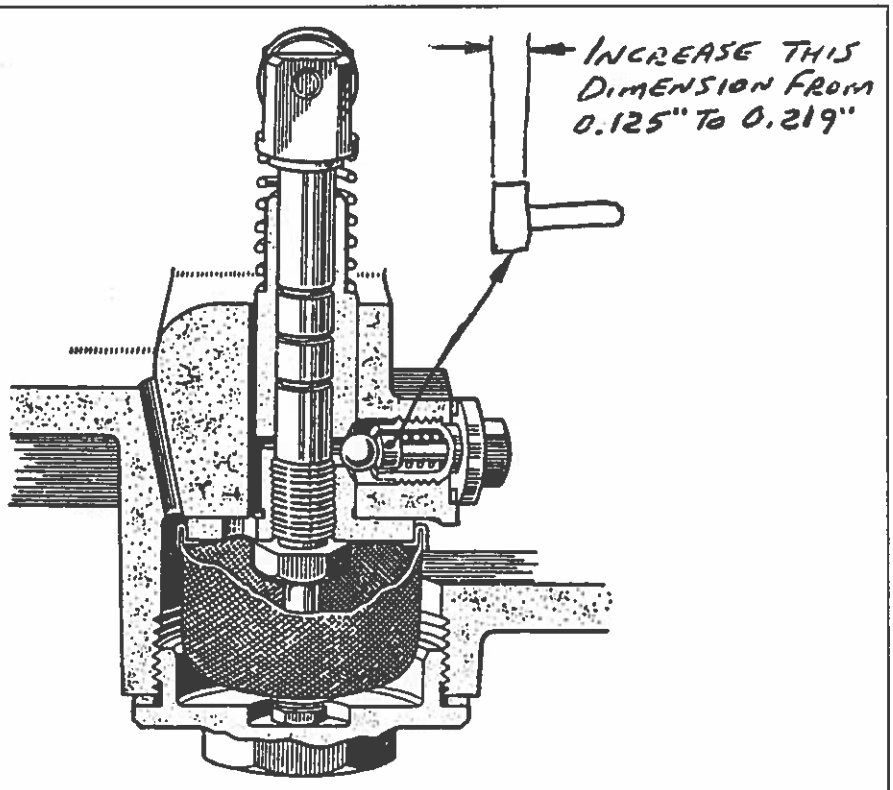


Fig 6.19 CROSS SECTIONAL VIEW THROUGH PUMP AND NON-RETURN VALVE

Mechanicals

Mr. Finespanner Talks Overdrive

(Part II of a four-part series.)

by Del Border
Carolinas AHC

As promised, this month continues with the OD unit, specifically the OD pressure fix. However, before we start with the OD pressure fix, let me re-emphasize the need for an oil pressure gage. If you or someone else rebuilt your OD without the benefit of a pressure gage, there is NO WAY to know the status of your hydraulic system. Remember that the OD unit will engage at only 100 psi; but for proper operation, the pressure should be at 470-490 psi.

Now, finally... the OD low oil pressure cause and fix. A fatigued spring in the non-return valve portion of the OD (see Fig. 6.19). What? Is that it? You must be kidding — I waited a month for this? Yes, it does seem sort of anticlimactic; but this spring can cause major frustration. Springs are like people — as they age, they get shorter and weaker. As you can see in Fig. 6.19, the spring pushes against a ball and plunger. The purpose of this spring is to allow the ball to lift from its seat at each power stroke of the OD pump, allowing oil to flow into the pressurized accumulating chamber, then applying enough pressure to re-seat the ball at the non-power stroke of the OD pump. A shortened, weakened, fatigued spring does not have enough force to re-seat the ball valve, allowing oil to leak past and cannot build pressure to the required 470-490 psi.

You're probably thinking that all I have to do is replace the spring — Right? Yes, that would work for a while, unless you use an incorrect spring that could be too weak, too strong, or too long. I recommend that you pre-load the existing spring by making a new, longer ball valve plunger as shown in the sketch in Fig. 6.19. This longer plunger will increase the pre-load on the spring by $^3/_{32}$" — it doesn't sound like much, but its all you need. Don't make it any longer, it could bottom out the spring, not allowing the ball to move off its seat. Use 1040 carbon steel for the material — if you have a friend who works in a machine shop, this is duck soup.

Now for the actual fix. Remove the drain plug from the OD unit (not the gearbox) to drain the oil. Remove the solenoid from its mounting bracket. Now remove the mounting bracket — early model cars have direct access to the mounting screws, later models have a cover. All the 6-cylinders have enough room to remove this bracket with the OD in place, but if my memory is correct, the 4-cylinder Healeys have to raise the OD unit (not remove) to clear the frame. This bracket also pre-loads the OD accumulator spring, so take your time removing the screws and follow the shop manual directions closely. Note that you should have a spacer behind the clamp and a rubber O-ring sitting in its own counterbore on the back side of the bracket. Since the accumulator spring and distance tube are now loose, remove them from the unit.

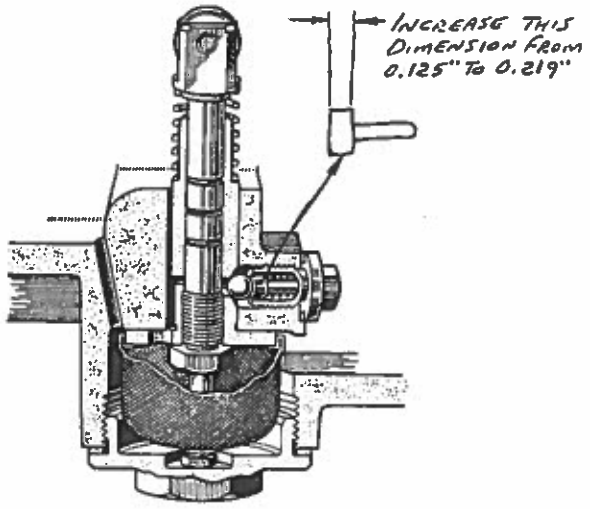


Fig 6.19 CROSS SECTIONAL VIEW THROUGH PUMP AND NON-RETURN VALVE

You can now see the hex head of the non-return valve plug. Remove this hex-head screw using an 11mm socket. Be aware that these screws are usually VERY tight. Remove the spring, ball valve plunger, and ball. Inspect the ball for wear and inspect the valve seat for dirt and wear. Inspect the OD pump spring to ensure that it is not broken. Turn over the engine with the car in gear while watching the OD pump shaft go up and down. If everything looks good, reseat the ball by tapping it on its seat with a light hammer and drift, reassemble the pump non-return valve using the old spring and the new, longer ball valve plunger.

We're not quite done yet, but if you're like I am and REALLY want to know if the new, longer ball valve plunger solves the OD pressure problem, reassemble the OD and test as described in last month's OD tech article. You will probably find that you have 450-470 psi showing on the gage. The next section will get it up to 490 psi.

You already should have removed the accumulator spring and distance tube, exposing the piston and sleeve. Remove the piston and sleeve one of two ways: Using a tool that opens when you squeeze the handle (similar to outside diameter retaining ring pliers), grasp the inside diameter of the sleeve (where the distance tube fits) and remove the sleeve with piston by turning and pulling. A pair of needle-nose pliers can also be used by forcing the handle open, using the outside of the pliers against the inside diameter of the sleeve. Scratches won't hurt this surface — they can easily be removed prior to reassembly.

If the sleeve and piston are stubborn and refuse to come out, remove the pressure gage, valve spring, ball valve plunger, ball, and operating valve. Now blow air into the chamber and the piston and sleeve should pop right out. I use a bicycle pump with the needle attachment (for footballs, volleyballs, etc.) inserted into the operating valve chamber, cover the hole with a rag, and one or two quick bursts always breaks the piston and sleeve loose.

Push the piston out of the sleeve and inspect the piston for broken rings. I've never seen broken springs, but I'm sure it's happened to someone. Inspect the sleeve for scoring (not the normal scuffing from the metal piston rings). Notice the O-ring at the front of the sleeve. This is a high durometer (read hard) O-ring and should be cut to remove. Because of its hardness, it's difficult to replace. If you do not have a replacement O-ring and your OD pres-

(continued on page 24)

Mr. Finespanner

(continued from page 22)

ure was 450 psi after installing the longer ball valve plunger, why worry? Your pressure gage told you that you don't need it, and it will tell you when you do. See the possibilities of this tool?

Now to get the pressure to 490 psi. Somewhere, years ago, I read where BMC increased the accumulator spring pressure to raise the pressure in the accumulating chamber from 450 to the 470-490 psi range. What I have noticed in some of the later model OD units, is a flat washer placed in the bottom of the piston that we just removed. It is my opinion that this is how BMC increased the pressure to 470-490 psi. That is how we will increase our pressure to 490 psi. Check the bottom of the piston for a flat washer. If there is none, place two washers, each $^1/_{16}$" thick into the bottom of the piston. Again, this doesn't sound like much, but it will make a noticeable difference.

Insert the piston into the sleeve and place the assembly into the OD unit. Insert the distance tube and spring, then complete the assembly paying particular attention to the two hex-head screws that must be screwed in together to compress the spring.

Recheck the OD oil pressure, button up everything and enjoy the responsiveness of the like-new OD. This whole process should have taken less than 4 hours from start to finish. Not bad for so much enjoyment. WHAT? You're still not satisfied? You want Overdrive in all four gears, and you want to squeal the tires when you shift into Overdrive?

Next Month: OD Competition Secrets of the 1960s!

Mechanicals

Mr. Finespanner Talks Overdrive

(Part III of a four-part series.)

by Del Border
Carolinas AHC

This month we continue with the OD unit — the competition secrets of the 1960s (and today). If you read the past two tech articles on the OD unit, you'll recall that several checks and modifications can be made to the unit without removing it from the car. The following competition modifications can also be made without removing the unit from the car, and can be part of the first two tech articles, all able to be completed in less than four hours.

The competition parts consist of two springs and a piston with rings. If you read *The FLASH* and *CHATTER*, you've probably noticed advertisements for competition OD parts. What they don't tell you is that these parts are stock Triumph parts. In the first OD tech article, I mentioned that Healeys and Triumphs used the same OD unit. However, BMC removed the large piston and springs and replaced them with an aluminum sleeve, smaller piston and spring and a distance tube.

We simply do the opposite — after removing the distance tube, spring, aluminum sleeve, and piston, replace all those parts with the new, larger piston and two springs (one spring fits inside the other). Before you install these parts though, be aware of the effect this will have on your driving enjoyment.

The Healey piston is 1.125" in diameter under 490 psi pressure. When OD is engaged, the force exerted by the piston against the oil (and the two operating cylinders) is 487 pounds (and you thought those physics classes you took were wasted).

The Triumph piston is 1.750" in diameter, and with the larger springs, now under 600 psi pressure. Since you now have a pressure gage, you can verify this. When OD is engaged, the force exerted by the piston against the two operating cylinders jumps to 1443 pounds— about three times as much force.

What does this mean to you? If you are driving in competition and engage OD, it will give you goose bumps. If you are driving the car for pleasure and engage OD, it will give you whiplash and possibly a ticket for "laying rubber." When I drive my car on the road, I shift into neutral before engaging OD, so that should give you a clue as to how uncomfortable it is.

If you are crazy enough to increase the pressure with the "competition" parts, you might as well go all the way. There is a switch mounted on the side of the gearbox that allows OD to engage in third and fourth gear only. Bypass, jumper, or hot-wire that switch so you have OD in ALL four gears. At an autocross when you shift from 2nd to 2nd OD and back to 2nd again, the psych value alone is worth a second against your competition. There is one small drawback though — OD can be engaged in reverse. If this happens, be prepared for *expensive* repairs to both the OD and transmission.

In an autocross, it is a big advantage to have the OD switch mounted on the gearshift knob. "Works-type" gearshift knobs with OD switch are now available, but you can also use a gearshift knob from a truck that has a two-speed rear axle. Run two wires directly from the OD toggle switch on the dash to the gearshift knob. This also bypasses the OD switch on the gearbox and will also give you OD in all 4 gears.

Also in competition, it is advantageous to have the OD shift from OD to normal instantly, instead of waiting for the self-synchronization of the OD unit or the throttle switch on the firewall. Simply disconnect the two wires from the throttle switch at "A" as shown in Fig. G.13 and cover the ends with electrical tape. The wires can otherwise be kept in their original location. To quicken the response time of the OD unit to shift from OD to normal, remove the operating valve and increase the size of the hole in the side of the valve from $^{1}/_{32}$" to $^{3}/_{64}$".

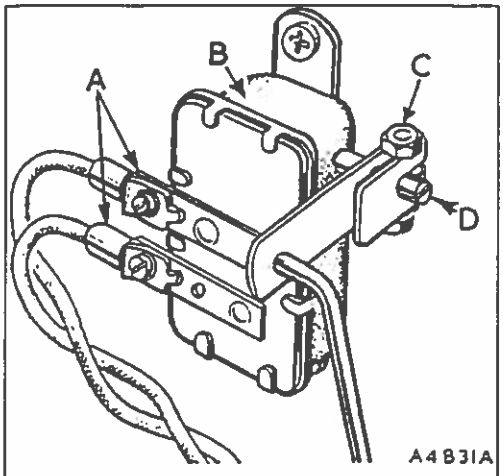


Fig. G.13. The overdrive throttle switch showing,
A. *Switch terminal.* C. *Lever clamping bolt.*
B. *Switch body.* D. *Operating shaft.*

The instant shift from OD to normal is great when running an autocross, but is hard on the transmission and OD. When driving my car on the road, I shift into neutral before disengaging OD. Something else for you to consider.

Here ends our discussion on tweaks and repairs to the OD unit which can be performed without removing the unit from the car.

There is one more problem I would like to cover with the OD unit — clutch slip. Yes, the manual lists several causes, but not the ones I've experienced, and you will too.

Next Month: Clutch Slip in Overdrive.

Overdrive Pump Pressure Gauge

by Lauren Frazier

Bluegrass AHC

As many of us know, the old overdrives in big Healeys begin to shift slower and slower with age. Particularly on those long pulls when the oil temperature climbs higher than we would like. There can be several reasons for this, but isolating them is not so easy without a pump pressure measurement.

Faced with this problem and not finding anyone with an 18G251 service gauge, the dilemma still seemed solvable. The recommended pressure range for the pump in the Laycock overdrive is in the 450psi range and US Gauge makes a 600psi 1.5" dia. gauge with a 1/8" pipe thread as a bottom mount. The model number is P500, 1.5, 600 and it sells for about $15 at gauge supply houses. A welding supply store can lead you to a gauge supply house if one is not readily known.

The gauge requires a spare overdrive operating valve plug, a little drilling and brazing and some assembly according to the accompanying sketches. I bought a 10 inch steel brake line with fittings attached and cut it in half. I then sanded the zinc coating off the end that is brazed into the drilled valve plug (for obvious toxic heavy metals reasons).

The reason for drilling the plug as shown, leaving a shoulder, is so you can attach the gauge with the check valve, ball and plunger in place. With the check valve in place, the pressure may be monitored as the overdrive is shifting.

After attaching the gauge and jacking up the rear wheels (or taking the brute for a ride with the transmission tunnel removed and a partner to watch the road), you can watch the pressure behavior as the pump delivers oil to the accumulator.

The accumulator is really a pressure relief valve with storage volume that stores a quantity of oil at a high pressure just waiting for the operating valve to be actuated. When the operating valve is actuated, the accumulator oil flows through the valve into the overdrive operating cylinders which cause the OD to shift into overdrive. The OD shifts out by the operating valve draining the operating cylinder oil back into the sump. This is why the dang thing always shifts out of overdrive quickly regardless of how old and feeble the pump is.

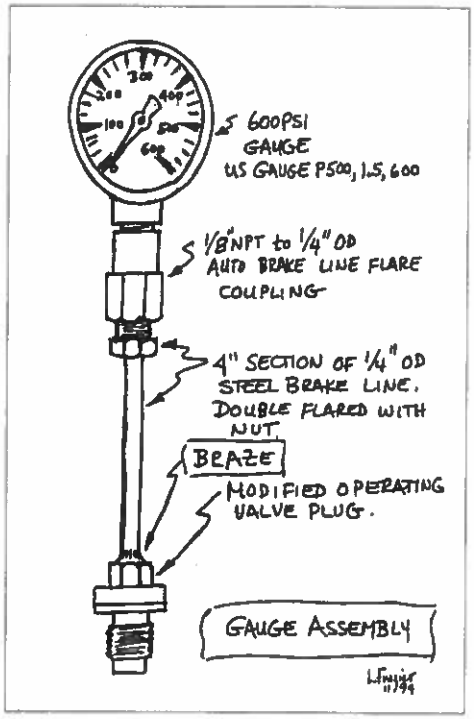
The pump has a piston operating at output shaft speed and a spring loaded ball check valve feeding the accumulator volume through a passage in the OD housing. When the transmission output shaft starts rotating, the pump starts pumping. As the output shaft speed is increased, pressure should rise until the accumulator relief pressure is reached. At this point, the pressure should remain essentially constant even thought the transmission output shaft speed continues to increase or until something is done to drain off the accumulated oil (like the operating valve being moved by the solenoid).

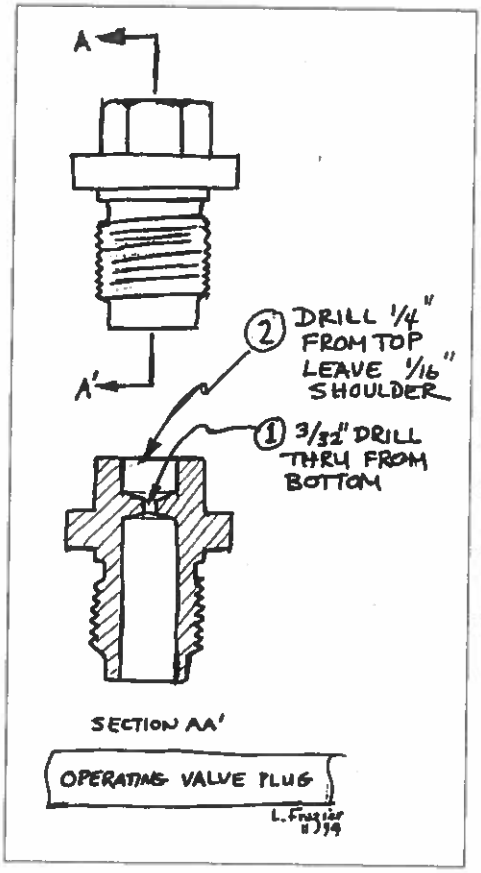
The pressure relief level of the accumulator is determined by that humongous spring behind the solenoid mounting plate on the side of the OD housing. I found my relief pressure was low and, following the advice of Jack Summers, shimmed it a little at the outer end with some thin stainless steel washers. (They were stainless 'cause that's what was in my junk box.) For a shim thickness of .020", I got about 20 psi pressure increase. I pushed he pressure up to about 480psi with several shims.

My pump was able to deliver more than the accumulator relief pressure so this worked just fine and improved my OD shifting significantly. It is conceivable that a pump could be worn to the point that pump piston leakage would prevent the fluid pressure ever reaching the accumulator pressure relief level. If this were the case, the pressure would rise slowly as transmission output shaft speed increases and would continue to rise, never reaching the accumulator control level even at high output shaft speed.

By watching the pressure behavior as it is rising from zero, one can also get an indication of the performance of the pump check valve. In my case, the pressure surged with each pump stroke and then dropped back quite a bit. I blamed this on poor check valve performance and attempted to seat the pump check valve by removing the plug, spring and plunger and then tapping the ball lightly with a plastic dowel and light hammer. This, according to the manual, insures the ball seat is smooth and round. The results were quite noticeable as the surging was reduced and the pressure increased faster.

With a little thought and just a little knowledge about the theory of the Laycock OD, this little gauge can provide a lot of insight into what is going on inside that mysterious box.





USING THE OVERDRIVE

Roger Moment
Longmont, Colorado
Rocky Mountain Austin-Healey Club

I have been asked numerous times over the years, "How should you operate the overdrive when shifting in or out of it?" In thinking how to respond, I have concluded more than just one technique will work quite satisfactorily. However, there also are procedures which I believe could result in, or lead to, internal damage to the overdrive unit. Before describing how I engage and disengage overdrive, I think it is best to first review how the unit and its electrical control circuit work.

The overdrive adds a "higher" gear to the gearbox and reduces engine RPM for either of the top two gearbox gears when it is engaged. The following table lists the ratios of final drive to engine RPM:

Final drive ratio

Gear	BN1	BN2	100-Six	3000 Mk I	3000 Mk II	3000 Mk III
1st	9.28	12.6	12.6	11.453	11.453	10.038
2nd	5.85	7.85	7.85	8.025	8.025	8.095
2nd O'dr	4.43 - 32.4% 4.56 - 28.6%	N/A	N/A	N/A	N/A	N/A
3rd	4.125	5.46	5.46	5.116	5.116	5.105
3rd O'dr	3.12 - 32.4% 3.28 - 28.6%	4.24	4.24	4.195	4.195	4.196
4th	N/A	4.1	4.1	3.909	3.909	3.909
4th O'dr	N/A	3.18	3.18	3.205	3.205	3.205

Note: The BN1 has a 4-speed gearbox with first gear blocked out, making it a 3-speed box. Thus, 3rd gear is direct drive, the same as 4th gear in the 4-speed gearbox of the BN2 through 3000 Mark III. In terms of the gear shift "H" pattern, on 4-speed gear boxes, 3rd and 4th are on the (right) side of the "H" pattern, while on the BN1 3-speed gearbox, 2nd and 3rd are on the (left) side; the shift pattern is a mirror image of that on 4-speed gearboxes. To keep things simple, I will refer to gear selections in the 4-speed boxes from here out.

Also notice that 3rd overdrive final drive ratio falls between 3rd and 4th, though it is closer to 4th than 3rd.

Shifting within the overdrive unit is accomplished by oil under high pressure (around 400 PSI) being directed through an operating valve (which is activated by the electric solenoid) to internal operating pistons.

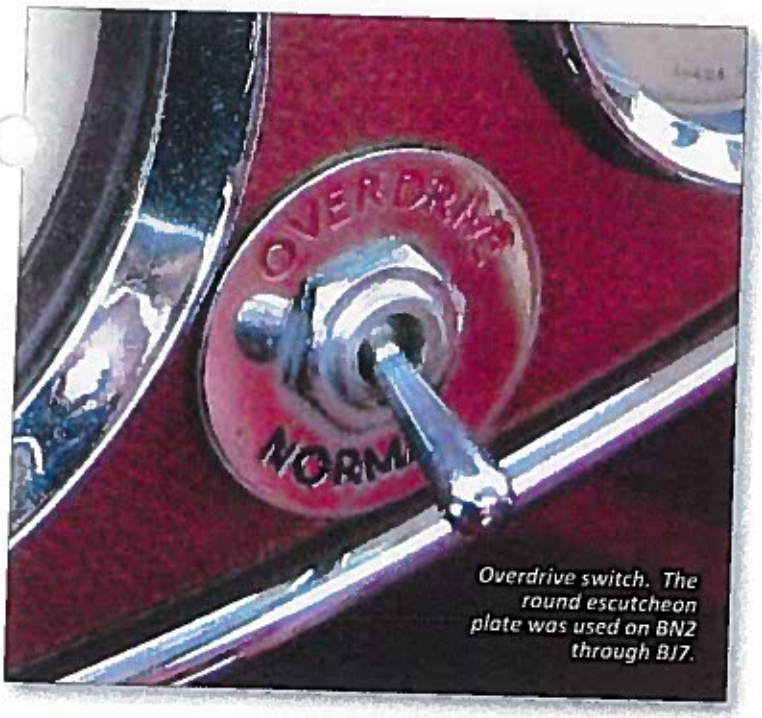
The electrical control circuit consists of a number of components: a dash toggle switch that is used to initially connect to electrical power; an electrical relay (two on BN1s) that is used to energize the overdrive wiring harness; a switch on the gearbox that connects power to the overdrive solenoid when the gear lever is in the right side of the "H" shift pattern on 4-speed gearboxes (left side on BN1s); and a throttle switch that keeps the circuit energized under less than 1/4 throttle to prevent down-shifting out of overdrive unless power is being transmitted from the engine to the rear wheels. On BN1s there is an additional centrifugal switch that prevents the solenoid from actuating below about 40 MPH.

On cars with 4-speed gearboxes, with the gear lever in the right side of the "H" pattern, flipping the dash switch will immediately cause shifting into overdrive. If you move the gear lever into neutral, the solenoid will be deactivated and the overdrive will immediately shift back to direct or "NORMAL." If you down-shift from 3rd to 2nd (with overdrive engaged), you will "skip" direct/normal 3rd gear and experience a jolt when you release the clutch because of the larger mismatch of RPM between the engine and gearbox than if you had been down-shifting from 3rd-normal. (Note: On Healey 100 BN1s, the equivalent down-shift would be from 2nd to 1st).

If you leave the dash switch in "OVERDRIVE" as you brake to a stop, the unit will shift out of overdrive when you put the gearbox into neutral, but the electrical circuit will still be partially energized. When you start up again you'll be out of overdrive in 1st and 2nd, but upon moving the gear lever over to 3rd, the gearbox switch closes, actuating the solenoid and engaging the overdrive. By the time you release the clutch (from your 2nd-3rd shift) you will find you are not in 3rd, but rather 3rd overdrive – almost as if you had shifted from 2nd directly to 4th (but not quite as large a jump). As a result, you'll notice a substantial drop in torque and acceleration.

If you flip the dash switch to "NORMAL" while your foot is *off* the accelerator pedal, the overdrive circuit will remain energized, and the overdrive will stay engaged. You will be able to continue driving in overdrive as long as you don't depress the accelerator more than about 1/4, at which point the throttle switch contacts open causing an immediate shift out of overdrive.

This electrical control was designed to assure that shifting of the unit out of overdrive will not occur under engine braking, which could harm internal overdrive components from a shock being transmitted through the unit in the reverse direc-



Overdrive switch. The round escutcheon plate was used on BN2 through BJ7.

tion. Such a situation could result from a misadjusted throttle switch.

To summarize, I feel it is best to have the overdrive circuit de-energized before starting up from a stop. This is best done when shifting out of overdrive from 3rd or 4th gear by depressing the accelerator enough to open the throttle switch contacts. It can also occur when starting from a stop as the accelerator pedal will likely be depressed past the 1/4 point during acceleration in 1st gear, which will cause the throttle switch points to open. Additionally, I would not recommend downshifting from 3rd to 2nd without first disengaging overdrive.

There are various techniques you can use to manage control or operation of the overdrive unit. In practice, this is what I do:

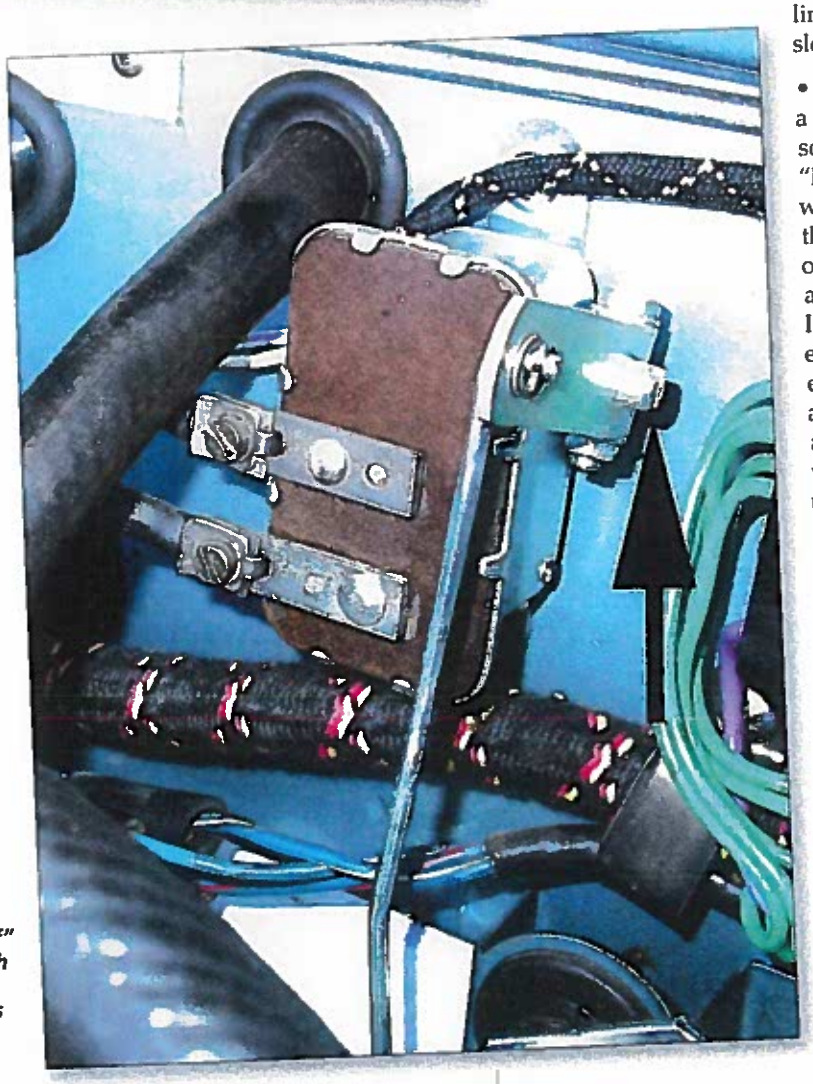
• When stopped, I always make sure that the dash switch is in "NORMAL" and there is no "residual" activation of the circuit if I had been driving in overdrive. Quickly depressing the accelerator about 1/2 way and immediately releasing it is one technique to assure the overdrive circuit is fully off.

• I typically shift into overdrive from top gear, rather than from 3rd (2nd for a BN1), and only when I expect to be travelling for some time before having to slow down or stop.

• When in overdrive, if I anticipate a slow-down or stop approaching soon, I will flip the dash switch to "NORMAL", but continue to drive with a "light" foot on the accelerator, thereby keeping my speed, but with overdrive still engaged. At a reasonable distance before having to brake, I quickly depress the accelerator enough for the throttle switch to disengage overdrive and then release it, affecting a clutch-less down-shift and assuring that the overdrive circuit will not be energized when I start up. I also use this procedure when using exit ramps from freeways.

With a little practice, and an understanding of how the electrical circuit is controlled by the various switch components, you will develop skill at getting in and out of overdrive quickly and avoid putting unwanted stress on its internal components.

Post script: Backing up with overdrive engaged will cause costly internal damage to the unit. If you suspect it is stuck in "overdrive," when trying to use reverse let the clutch slip as you gently release it, but disengage it immediately if the car seems to not want to creep backwards. HM



The throttle switch. To adjust, make sure that the ignition is turned off, remove one terminal wire (and bend it out of the way), and clip ohmmeter leads to the two terminals. Make a spacer (e.g., out of wood) to fit between the accelerator pedal and floor and stop it at about 1/4 depression. While a helper pushes the accelerator against this stop, loosen the pivot arm clamping screw and use a screwdriver to turn the shaft (arrow) first a bit clockwise (if necessary) to get the ohmmeter to read zero and then counter-clockwise to the point where the resistance jumps from 0 ohms to a high value, and re-tighten the clamp screw. Remove the spacer and check that the ohmmeter reads zero with the accelerator fully "off" and jumps to its high value as depression of the pedal reaches the 1/4 position. Finish by removing the ohmmeter and re-connecting the terminal wire.

Special thanks to John Hodgman for providing a critical review and valuable suggestions.