Clutch disk replacement and transmission input spline lubrication

The following outlines the steps that I took when removing the transmission from my 1982 R65LS and replacing the clutch disk – I also ended up replacing the transmission with a rebuilt unit as the input shaft splines had been heavily damaged from the clutch spline failure experienced on the road and under power. These same basic steps (but stopping short of disassembling and removing the clutch carrier assembly) can be used for performing regular transmission input shaft spline lube. I would recommend that a proper spline lube be performed on any BMW airhead at least every 3-4 years or 20K miles, or perhaps more frequently if operation in severe conditions is common. If you have a "new" bike without recent documentation history of having this done, or you buy a bike (which may still have very low mileage) which has been stored for years, I would recommend doing this as soon as possible.

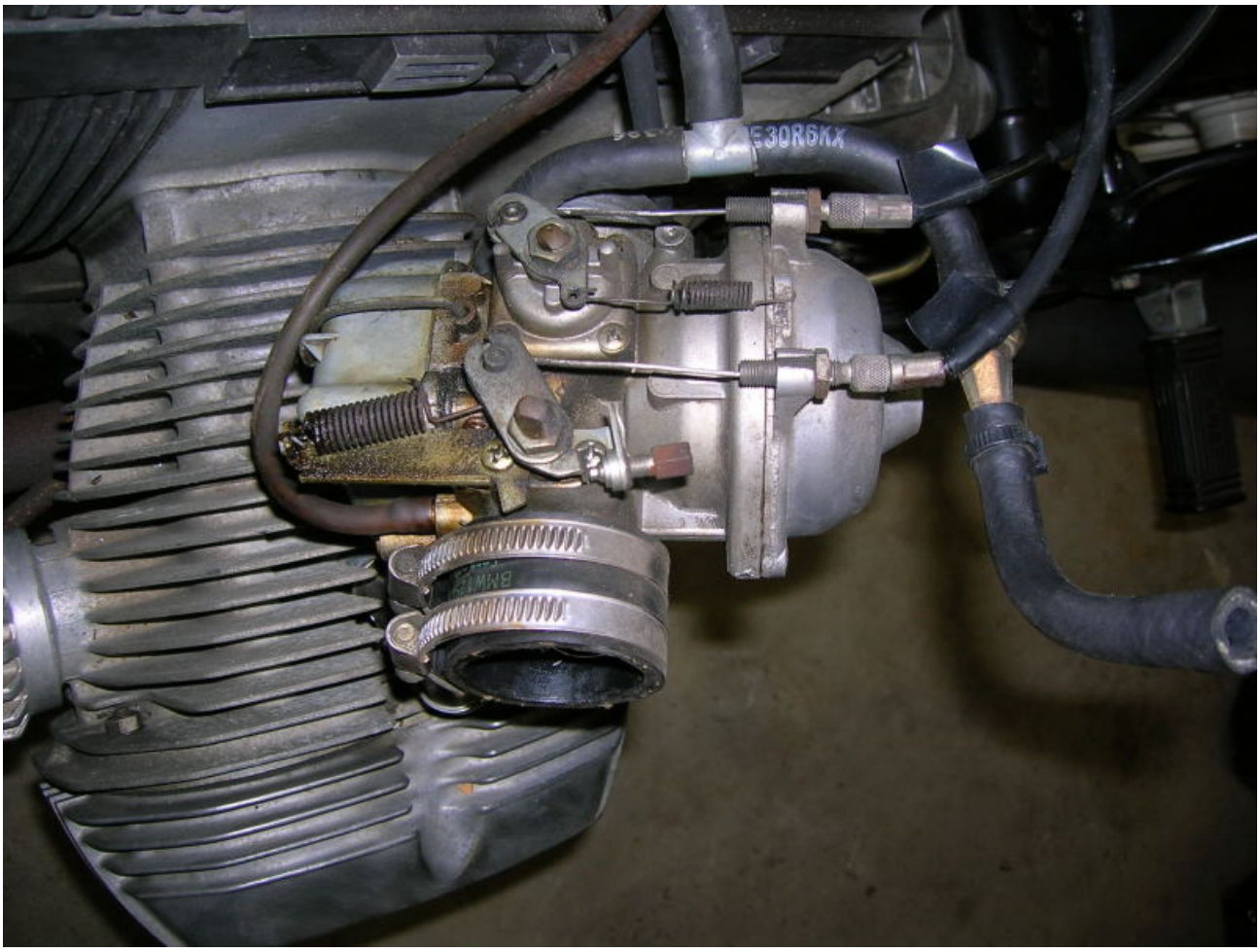
Getting Started

Before starting, put the bike up on its centerstand. I have found that it is very helpful to use an adjustable jack stand with an old shop rag for padding placed beneath the bottom rear cross tube on the frame, with the height adjusted so that the rear wheel is off the floor and the front wheel is firmly touching the workspace floor. You may want to put some other wooden blocking under the front of the engine/frame so that the bike is stable and not rocking or tipping easily as we'll be doing some pushing and pulling shortly.

First, we remove the seat and fuel tank – you might leave these on if you prefer, but we must take off the air filter assembly and the remove the battery and battery box out of the way, so to improve access to these items I just remove the fuel tank and seat as a practical matter. I won't go into the specific details of removal for these items as it isn't too complicated and the removal of these items are also covered in other articles. Along with removing the airbox, we remove the "horns" or elbows from the airbox into the carbs. The photo here shows the fuel line crossover and vacuum lines still in place at this stage, but they must also be removed/moved out of the way.

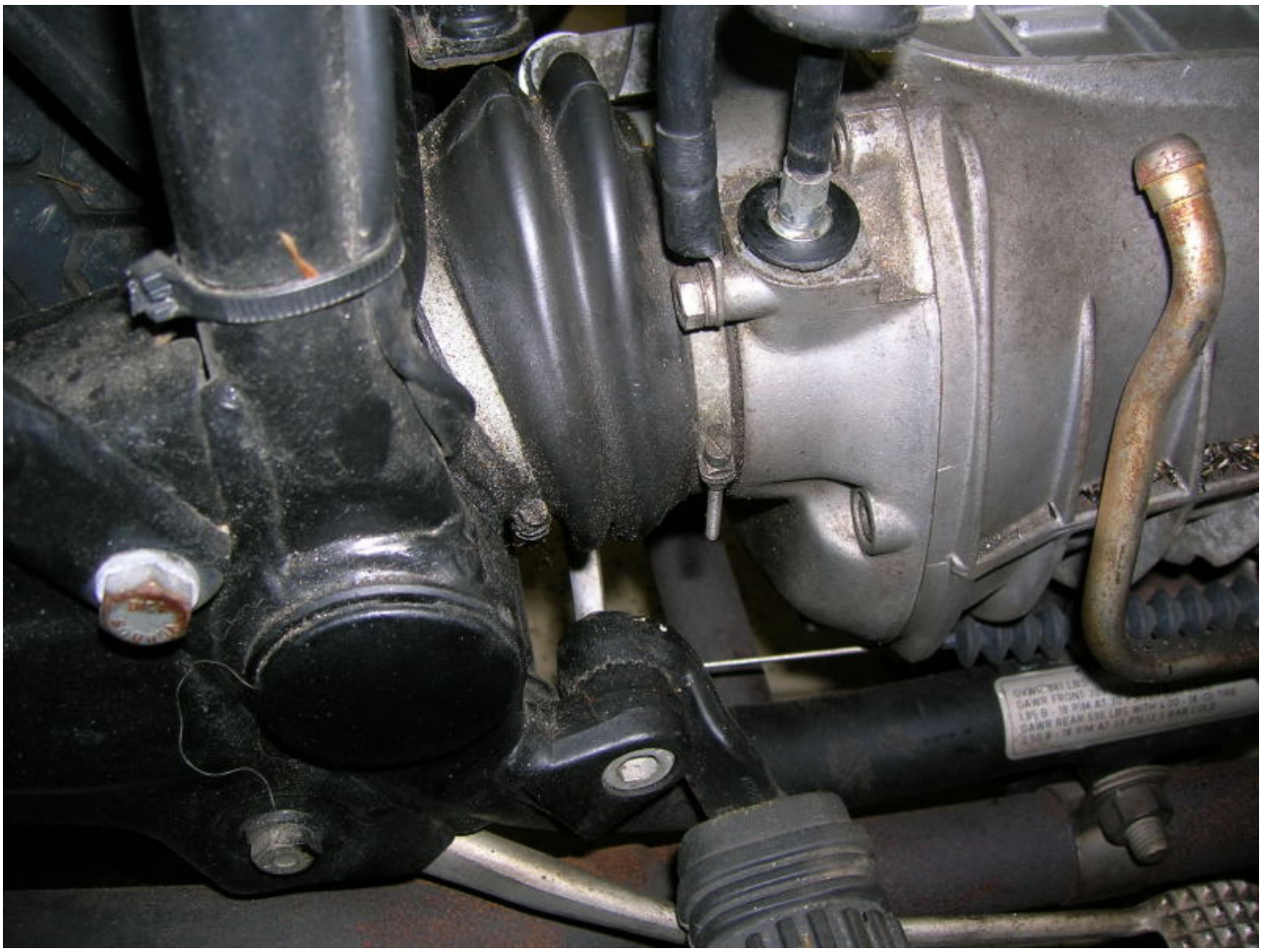
<insert clutchjob01.jpg>

Next, we must remove the carburetors from each side. It is OK to loosen up the screws on the rubber intake tubes that connect the carbs to the engine heads, and slide them off each side. You can carefully leave the carbs connected to their cables and rest them on their respective cylinders. Again, I use some old rags as padding to help them stay in place, and also stuff something in the intake tracts to prevent foreign objects from falling in there. As you can see in this picture, I've got some carb cleaning to do at some point, too!

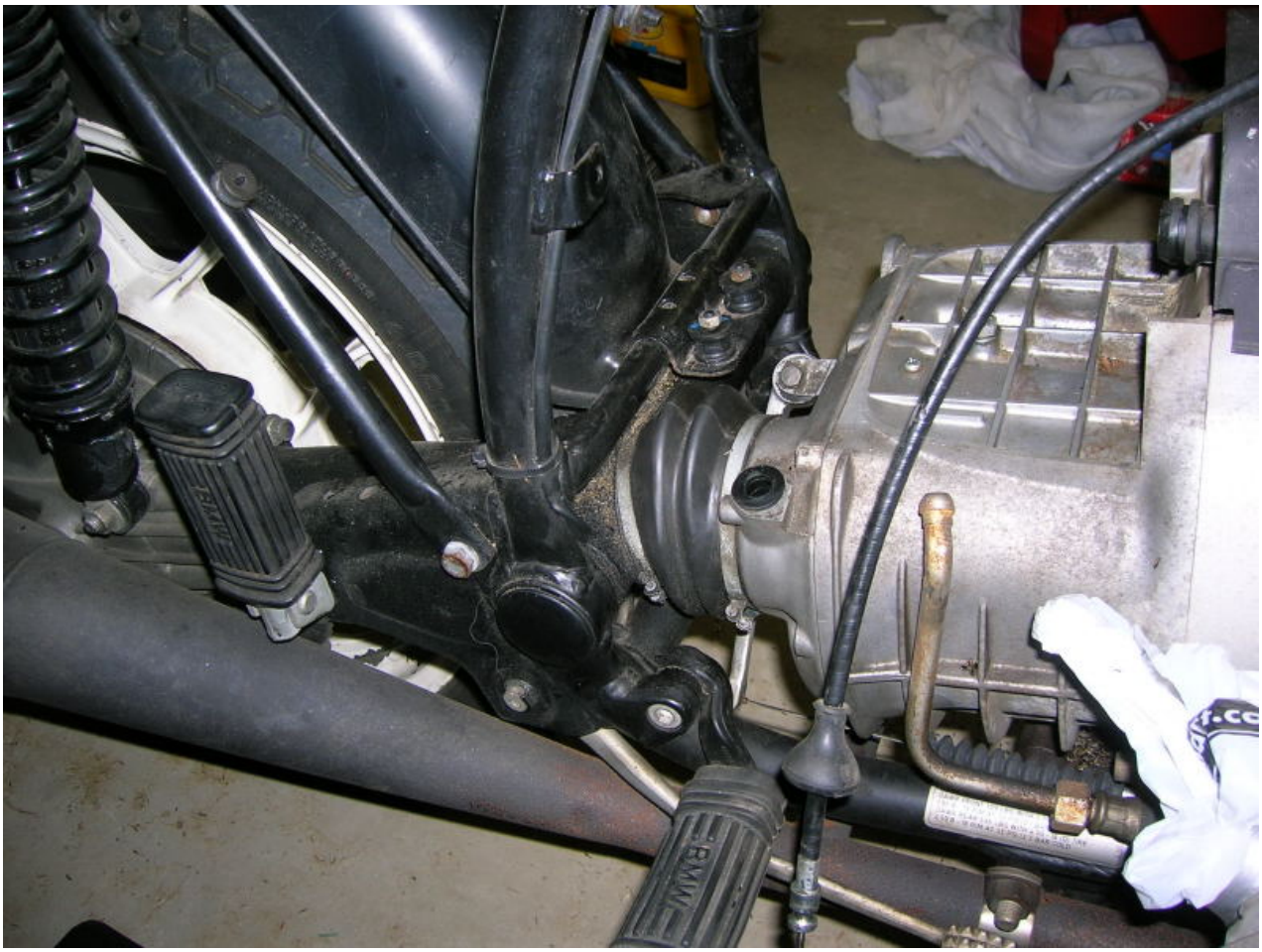


<insert clutchjob02.jpg>

We next must remove the speedometer drive cable from the transmission. It is held in place by a special bolt (the bolt has a breather hole through its center and a special protruding nose which fits into a recess in the drive cable's end). The bolt also provides the electrical ground connection for the negative battery cable. This is a special bolt, so be nice to it and don't lose it! Remove the bolt, negative and negative battery cable. Pry up the rubber boot on the end of the speedometer cable carefully and inspect it for cracks – if it has any holes or tears, order a new one right away. This is the most common path for water to enter into your transmission and if it does, damage can start to happen shortly after, and transmission repair work is expensive.


<insert clutchjob03.jpg>

I put a small plastic bag over the end of the cable and tape it tight so I don't lose the boot, etc. and just set it up and out of the way. Make sure that the retaining bolt's center "breathing hole" is clean and put the bolt and its washer back into its threaded hole on the transmission, finger tight for safekeeping. Stuff a small rag or something into the hole to prevent contamination (small parts) from falling in the hole. DO NOT remove or loosen the Philips head screw that you see on the top shelf of the transmission – it holds an internal plate in place and removing the screw can cause the plate to come loose inside the transmission and again – a time consuming/expensive repair could be the result.



<insert clutchjob04.jpg>

Next, remove the front clamp that holds the front of the large rubber swingarm boot to the back of the transmission. We do this so we can access the (4) 12-point driveshaft bolts that are inside and remove them. It is a small area, but the thin BMW closed end 12-point wrench in the standard toolkit works well for getting in there and removing these. Step down hard on the rear brake pedal and/or have an assistant help you hold the rear wheel. If your clutch disk splines aren't destroyed you might also find it helpful to put the bike in gear as well to provide resistance to driveshaft rotation as you firmly set the wrench on the bolt head and give it a good pull to loosen. Then slowly rotate the rear wheel (take bike out of gear again if necessary) to the next bolt and loosen it. Go through all (4) bolts. Once you've loosened them all you can unscrew them the rest of the way and remove with your fingers. The OLD fashioned bolts have split lockwashers and are longer (to accommodate for the lockwasher thickness) while the NEW style bolts have no lockwashers and are stretch bolts. I would definitely recommend using new bolts when it is time to put everything back together, especially if the ones you took out were stretch bolts. I've been able to do this while basically keeping the rubber boot still loosely clamped to the swingarm to facilitate getting everything back together again.

<insert clutchjob05.jpg>

Now, I am going to skip ahead just a bit to show you the most that you can possibly hope for as far as seeing/accessing the transmission shaft input splines if you try to cut corners and don't pull the swingarm back and pull the transmission out. Here you can see that if we don't move the swingarm back, the "ears" that the clutch actuating lever pivot in (part of the back cover of the transmission) will contact the swingarm tube in a little over an inch of travel.

<insert clutchjob06.jpg>

It would not be easy to even get this much visibility (photo taken from near the timing hole on left side of engine case). As you can see here on this bike, significant damage/wear to the input shaft splines is evident, with lots of shiny metal particles. There shall be no cutting corners on this job !

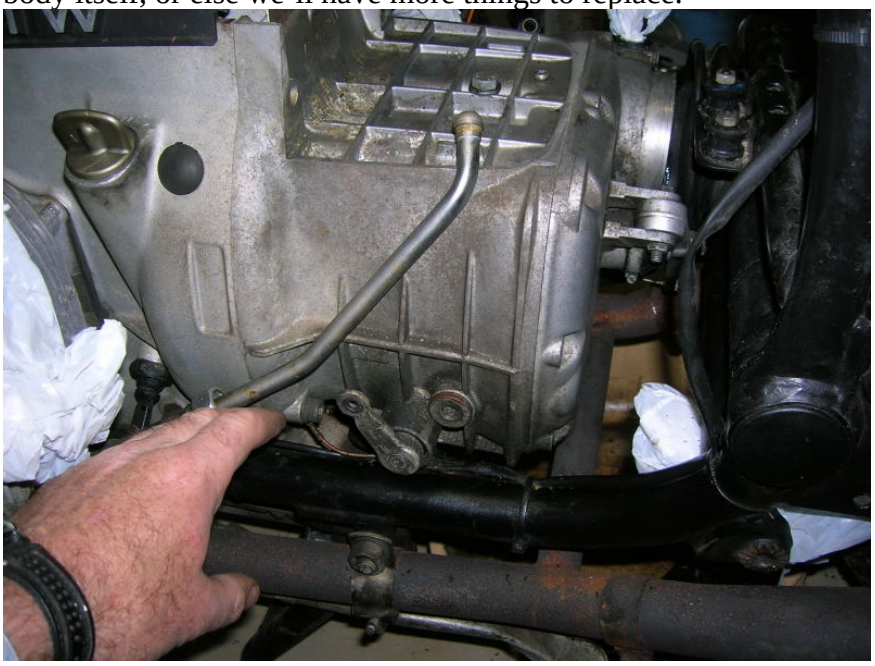

<insert clutchjob07.jpg>

So, back to the normal, recommended process.

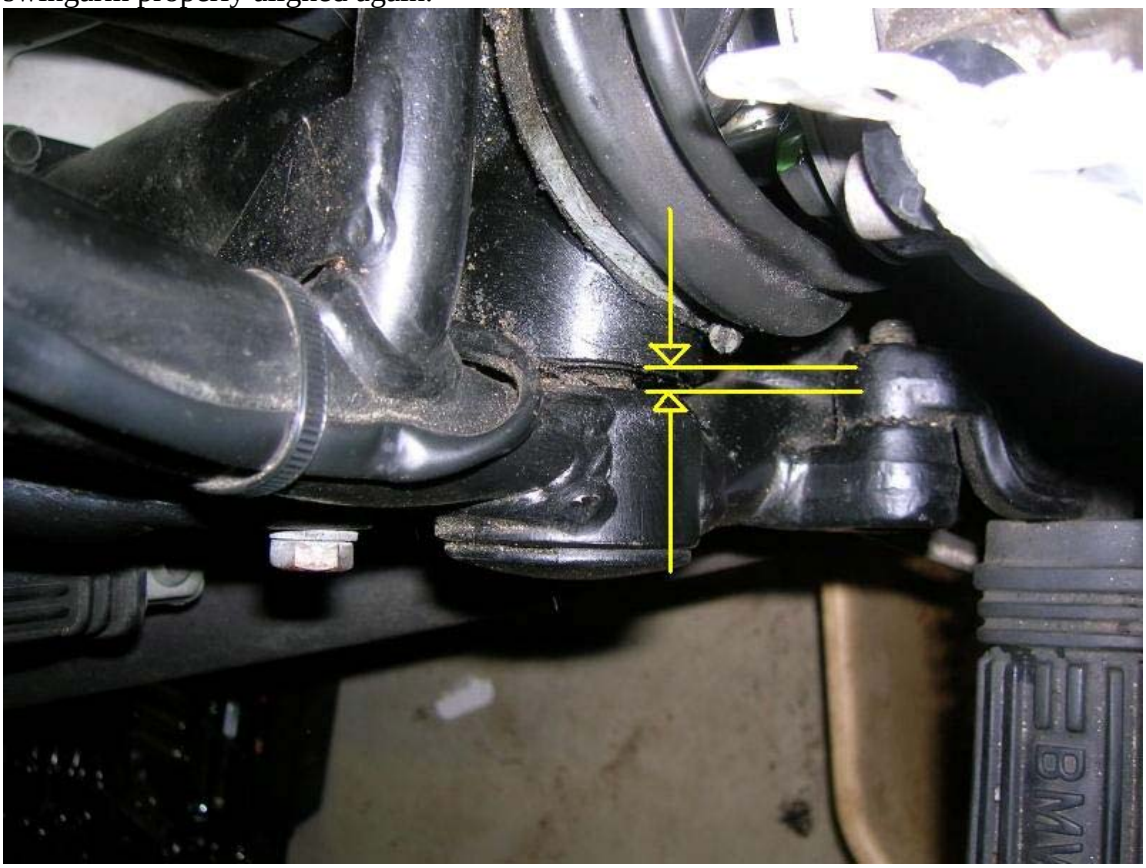
Next, I remove the wingnut at the rear brake actuating rod – before you do take a digital picture or make a note of about how many threads it is screwed in so you can easily get it back to where it ought to be on reassembly. I then let the brake rod hang. I then remove the rear brake lever mount for freeing up the swingarm to move backward. (but will keep the lever, rod, etc. all attached). You can also loosen – but do not remove- the bolts that connect the top and bottom of the rear shock absorbers on both sides – this will make things "swing" more freely when we pull the swingarm back.


<insert clutchjob08.jpg>

Moving back over to the left side of the bike, I must disconnect and remove the shift lever linkage from the transmission. I then remove the left side footpeg and entire shift lever assembly. This will give us needed clearance to remove the transmission from this (left) side of the bike. Also take note that there is a ground wire connection at the lower left Allen bolt which also holds the transmission onto the engine. Near this bolt, but on the underside of the transmission is the neutral switch with (2) wires going to it – we must be careful when we remove the transmission to first disconnect the wires and not break the tabs on the switch or the plastic switch body itself, or else we'll have more things to replace.


<insert clutchjob09.jpg>

Next, measure as carefully as you can, the gap, or space between the ends of the swingarm tube and the frame, where the swingarm pivots are located on each side (might not be exactly the same). I use a machinist caliper, but accuracy to within .001" isn't necessary. A yardstick is not likely to be good enough. Write the measurements down where you won't lose them. You'll need this info upon reassembly so that you can get the swingarm properly aligned again.



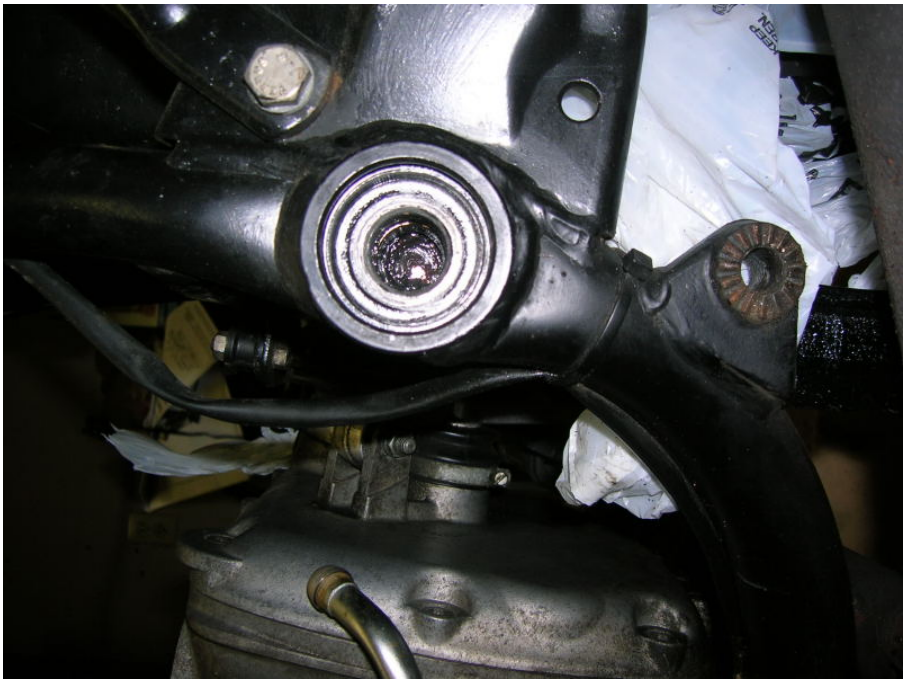
<insert clutchjob10.jpg>

Now, pry off the plastic end caps which cover the swingarm pivots. You will need to use a modified 27mm socket to loosen the retaining nuts. A thin-walled Sears Craftsmen socket might work without modification, I have been told, but I use a modified socket to ensure that the socket gets a good solid grip on the nuts, which do have to be tightened to a reasonable torque. Once the nuts are loosened by a few turns, I take an Allen wrench and insert it into the center hole of the swingarm pivot pin and unscrew it. We will do this on each side – be aware that the swingarm may very well decide to move (swing) when you remove the second pin.

<insert clutchjob11.jpg>

<insert mod_27mmsocket.jpg>

Swingarm lock nut and pivot pin removed:


<insert clutchjoba01.jpg>

You might need an assistant to help steady things, but I had the bike pretty firmly blocked in place so it wasn't too difficult to move the swingarm back. The swingarm needs to be held back solidly or there is a danger of getting your fingers mashed while maneuvering the transmission out, so be certain it cannot move forward! I found that simply inserting a length of 2x4 which was long enough to completely pass through both sides of the frame worked wonderfully to block the rear wheel/swingarm and provide enough clearance to work. As you see here, the 2x4 is between the rear wheel and the rear fender. The swingarm is only moved back by a couple inches, but that is all that I needed.

<insert clutchjoba02.jpg>

Next, we disconnect the clutch cable from the clutch actuating lever at the back of the transmission. First take a digital pic or take some measurements on the distance from the cable "boss" which holds the end of the cable sheath at the bottom of the engine case to the clutch actuating lever while the cable is still attached. This measurement will be your goal/sanity check to meet when you are re-assembling things. There is a spring under the boot at the back of the transmission which will snap the actuating lever back with some force once the cable is disconnected, so be careful and hold the lever and let it move gradually and not snap. I pull the clutch cable out of the engine casing boss and move it up out of the way for safe-keeping.

To help reduce the likelihood of tearing the rubber boot at the back of transmission, I loosen the screw on the clamp that holds the boot onto the transmission. There is a coil spring inside the boot which will push it outward as soon as the actuating arm is removed, but if the clamp is loose the entire boot can move and may be less likely to tear. However, one must be ready to catch things if they decide to "fly". Remove the nut and bolt that the clutch actuating arm pivots on, and carefully remove the clutch arm, catching the boot and spring. It the boot is torn, you will have to replace it upon reassembly. You might be able to grasp the back end of the pushrod assembly here and pull the pushrod back a bit to withdraw the tip of the rod back into the input shaft to facilitate removing the transmission (the pushrod goes through the transmission and exits through the center of the transmission's splined input shaft to press against the diaphragm spring in the clutch assembly). But if you cannot do this now, don't worry about it as we can get to it later.

There are (4) bolts holding the transmission to the engine case: (2) are toward the top and revealed/removed when we remove the air box. The remaining two are Allen bolts on the lower left and right hand side of the transmission case. Remove these (2) bolts, noting that the left and right side bolts are different lengths. The transmission may remain somewhat "stuck" against the engine case, or it may pull easily back. A tap or two with a rubber mallet may free it. You may need help in holding the transmission (it is heavy) as you slide it slowly straight back for an inch or so, then rotate it slightly clockwise so that the neutral switch on the left underside is exposed. Disconnect the (2) wires from the switch and be careful not to damage the tabs on the switch. When you do remove the transmission be careful to not set it down where the switch may be damaged.

<insert Clutchjob13.jpg>

To get the transmission out, we have the transmission slid backward between 1-2 inches and slightly rotated clockwise. This will get the transmission input shaft splines free of the clutch assembly. But, if you didn't pull the pushrod back already, use some long-nosed pliers to reach in there and grasp the pushrod, and use them to slide the pushrod back toward the rear of the transmission. Have a helper ready to catch the actuating piston and throwout bearing which may be forced out the back of the transmission when the tip of the rod goes into the input shaft. It is hard to see the pushrod in this pic, but it does exit the center or the splined shaft and may extend another 1-2 inches into the clutch assembly at this stage. It was a bit challenging holding the transmission with one hand and taking a pic with the other, but you'll get the idea. Once the pushrod tip is back inside the input shaft, carefully lift and rotate the transmission slightly so that it exits the left side of the frame.

<insert clutchjob14.jpg>

Now you have the transmission out, it should look something like this, if you have an 1981 or later airhead:

<insert clutchjob15.jpg>

Now, if you are just going to do a spline clean and lube you can skip the next sections and resume with the section on “Putting it back together”.

The earlier models airheads have a different type of clutch disk assembly and heavier flywheel, but most of the procedure and locations of parts are very similar. Note that there may often be a red or yellow paint line along the outermost edges of the disk assembly parts indicating factory alignment. Because there are manufacturing tolerances with all the large, round metal parts that make up the flywheel and clutch assembly, often BMW would mark the inner face of the items with a yellow or white paint mark indicating the heaviest section of the part. The goal for the assembler was to orient the marks on these parts (flywheel, clutch pressure plate, housing cover) so the marks were as close to 120 degrees apart from each other as possible. By distributing the heavier sections of the largest rotating pieces as far apart as possible, less engine vibration is the result. Once the parts are aligned, a line across the outer edges is often made to help with re-aligning the parts later on (like during subsequent friction plate replacements, which we are about to do).

There are (6) hex head bolts around the circumference of the assembly. BMW sells extra long metric thread bolts as a kit to be used to carefully dis-assemble the clutch pieces, as there is pressure from the diaphragm spring. There is force, but I don’t think that it is life-threatening. But, it is also good to gradually relieve the spring pressure evenly so that we don’t distort or damage the spring (or any other bits). So, remove every OTHER bolt (3 total) and install the (3) long bolts in there place, screwing each long bolt in until the head touches the surface of the cover plate. Then remove the other (3) normal bolts, and GRADUALLY loosen the (3) long bolts in a criss-cross fashion until the bolts are removed. We will use these long bolts again during re-assembly.

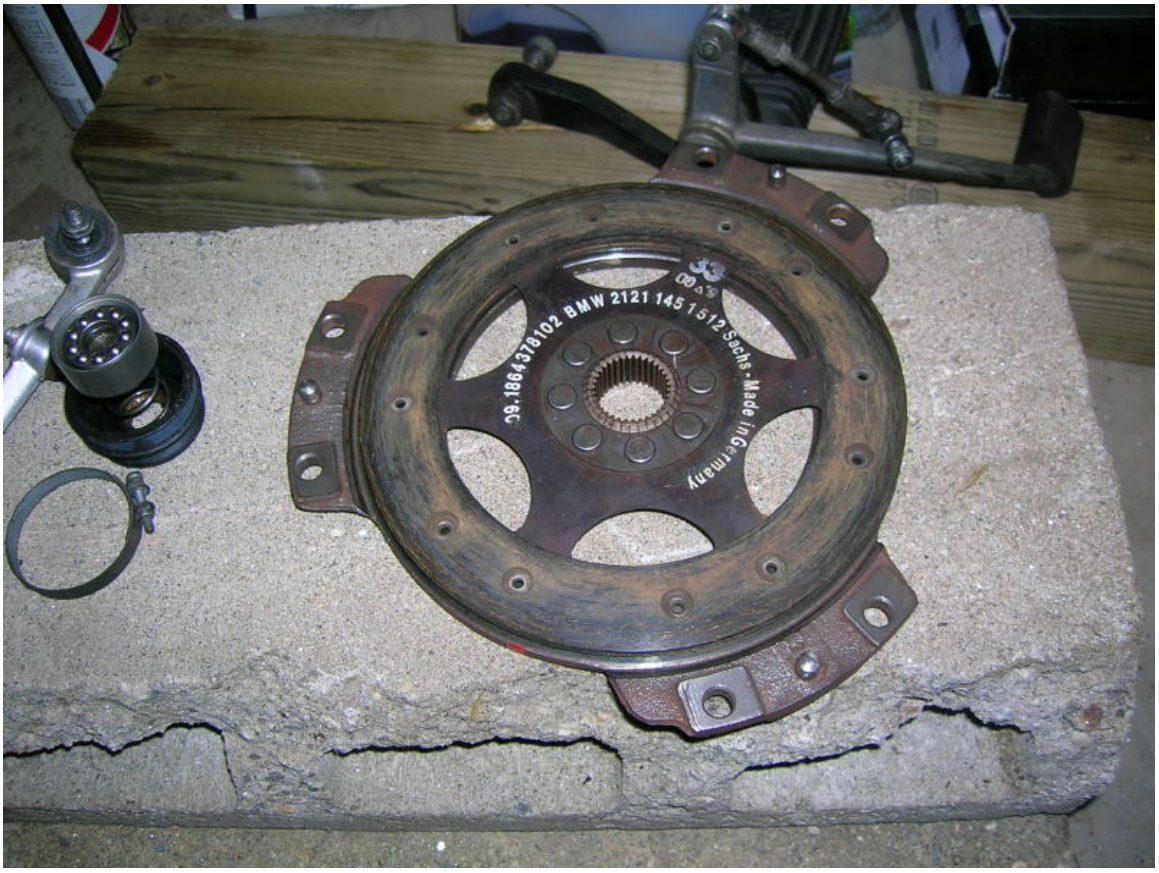
The (very rusty, clutch assembly with destroyed friction disk splines that came off:


<insert clutchjob16.jpg>

While we have the transmission and clutch assembly out, we have good access and view around the flywheel and bell housing. Look carefully for signs of oil leakage from behind the flywheel. Oils leaks can come from either a leaking rear main seal (seal goes around the end of the crankshaft) or from the oil pump cover (the cover is immediately below the end of the crank). If there is an oil leak we must remove the flywheel (which has some other important ramifications) to work on it – fortunately, this isn't needed at this time.

<insert ClutchJob17.jpg>

I cleaned up the various parts, took some measurements and determined that the spring, clutch plate, and cover were all still perfectly serviceable (and had less than 15K miles on them), but of course, the friction plate/disk HAD to be replaced. I had acquired another set of lightly used clutch parts with less than 10K miles on them and the friction plate had good clean splines, so I decided to use my original parts with the “new” friction plate.



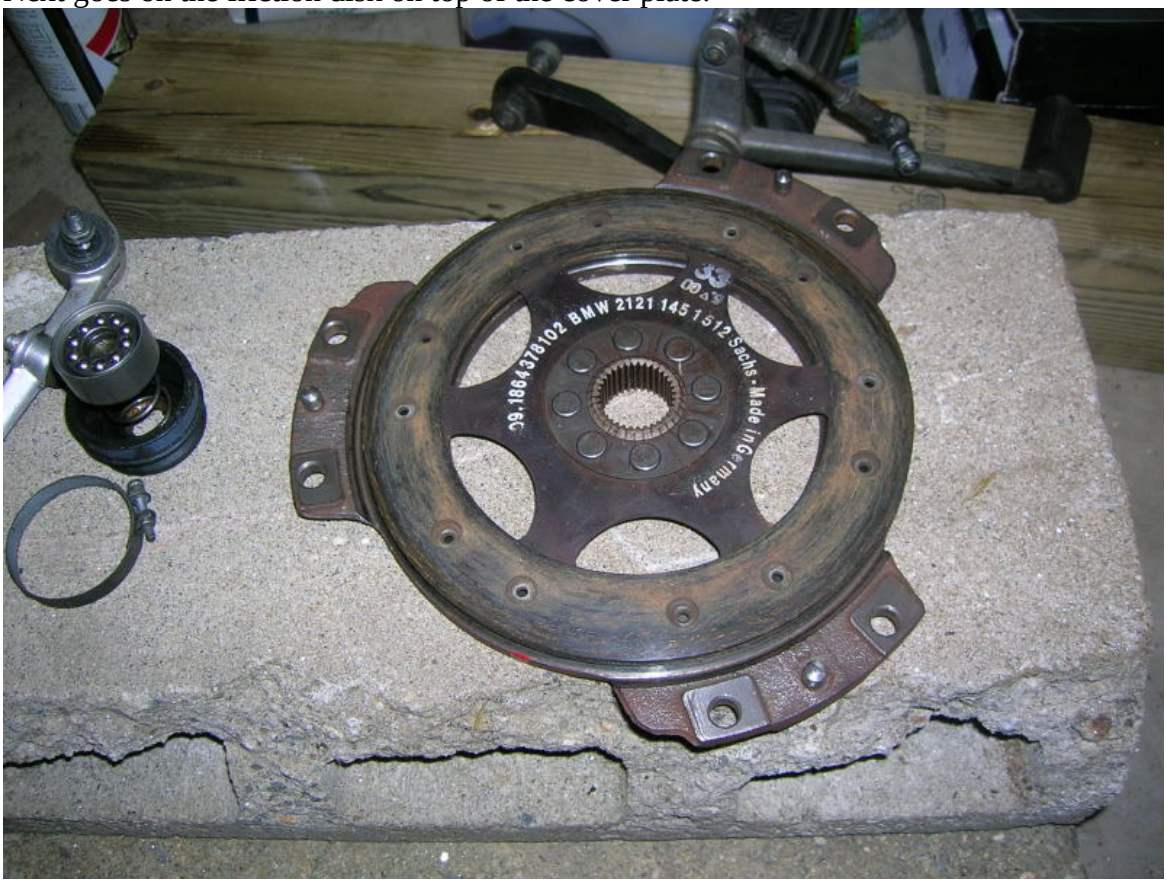
<insert ClutchJob18.JPPG>

Before installing the new clutch, there are some recommended areas to apply a bit of grease to, and I like to ensure that everything fits together well before bolting it up. So, the next few pics show the test assembly of the clutch parts. I use and recommend a Honda-labeled moly-based grease, Moly-60 for this application. It sticks well to surfaces and seems to be long lasting, and the high molybdenum content assures good lubrication under high load/pressure applications. Use what you prefer, though keep in mind that whatever you use has to be sticky so it won't fly off and contaminate the friction disk, and the grease has to last a long time.

Here is the clutch cover plate (you see the clutch actuating arm, piston, throwout bearing and pushrod parts on the left – we'll get to that later.


<insert Clutchjob19.jpg>

Next goes on the friction disk on top of the cover plate.



<insert Clutchjob20.jpg>

Here is the clutch friction or pressure plate, which will go on top next –

<insert Clutchjob21.jpg>

And “fitted” together, but without the diaphragm spring on yet:

<insert Clutchjob22.jpg>

The areas which show up as a bluish color are areas where BMW recommended a very light application of grease. These areas are where I applied a THIN film of Honda Moly-60, which shows up as blue in flash pictures, but which doesn't have this shade under normal lighting. Note that the red paint alignment marks are again in proper orientation from factory.

And now, the diaphragm spring. Per recommendation, a very light film of grease is applied to the outer edge which will go against the flywheel. Now, with the flywheel design of the '81 and later airheads, the flywheel won't contact all of this area, but we'll do it anyway, just be sure to only use a little bit of sticky grease!

<insert clutchjob23.jpg>

OK, Time to bolt things back together!

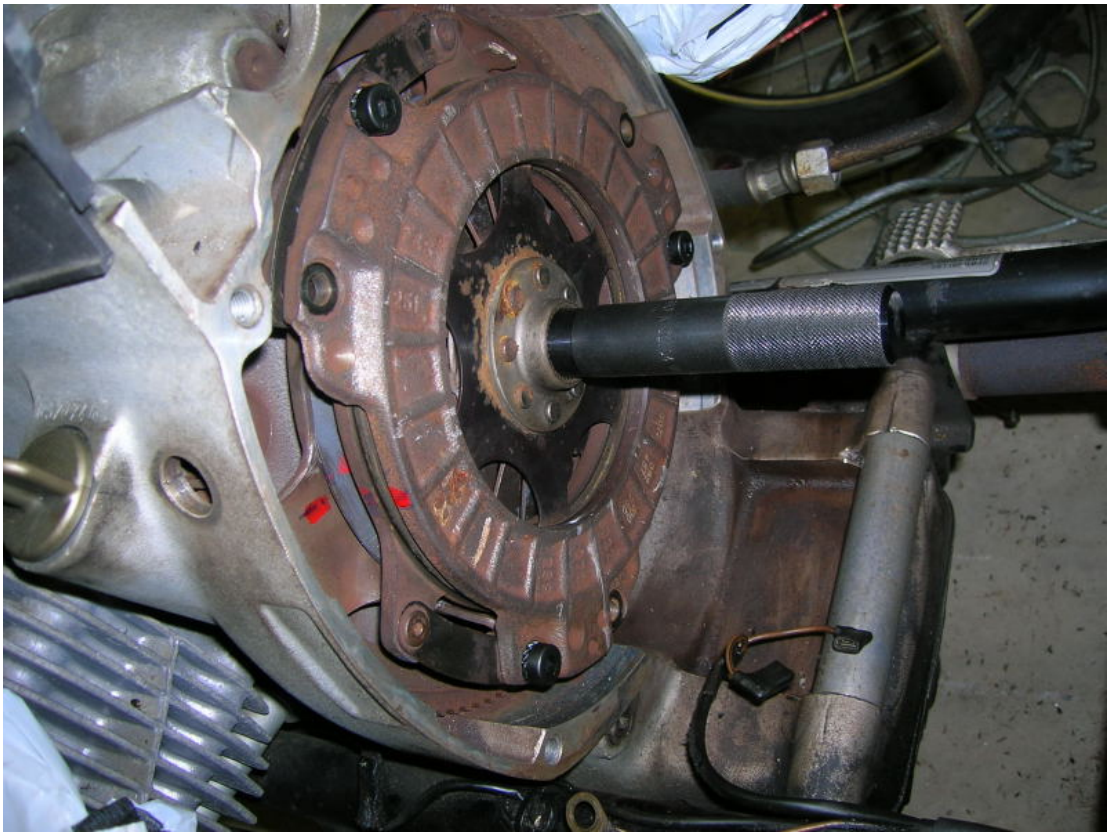
We will put the parts back in place, using a special tool – a "Clutch Centering Arbor". I have heard that there is a VW automobile arbor tool which will also work, but I sprang for the official BMW one to be sure. It is possible to put everything back together without one, but if things aren't centered well enough you won't know that you have issues until you are trying to get the transmission back on – not a good time to find that things don't quite slide together. I would recommend using the tool – everything went back together perfectly for me and I was doing this job alone. Someone handy with a metal lathe could also turn out one of these tools easily, I think.


<insert CenterArbor.jpg>

As previously mentioned, we use the (3) long bolts to start compressing the diaphragm spring and getting things positioned so we can start the NEW (short) regular bolts. These bolts are not stretch bolts and do have a special wave washer to go with them, but BMW recommends against re-use (plus the old ones do get rusty)

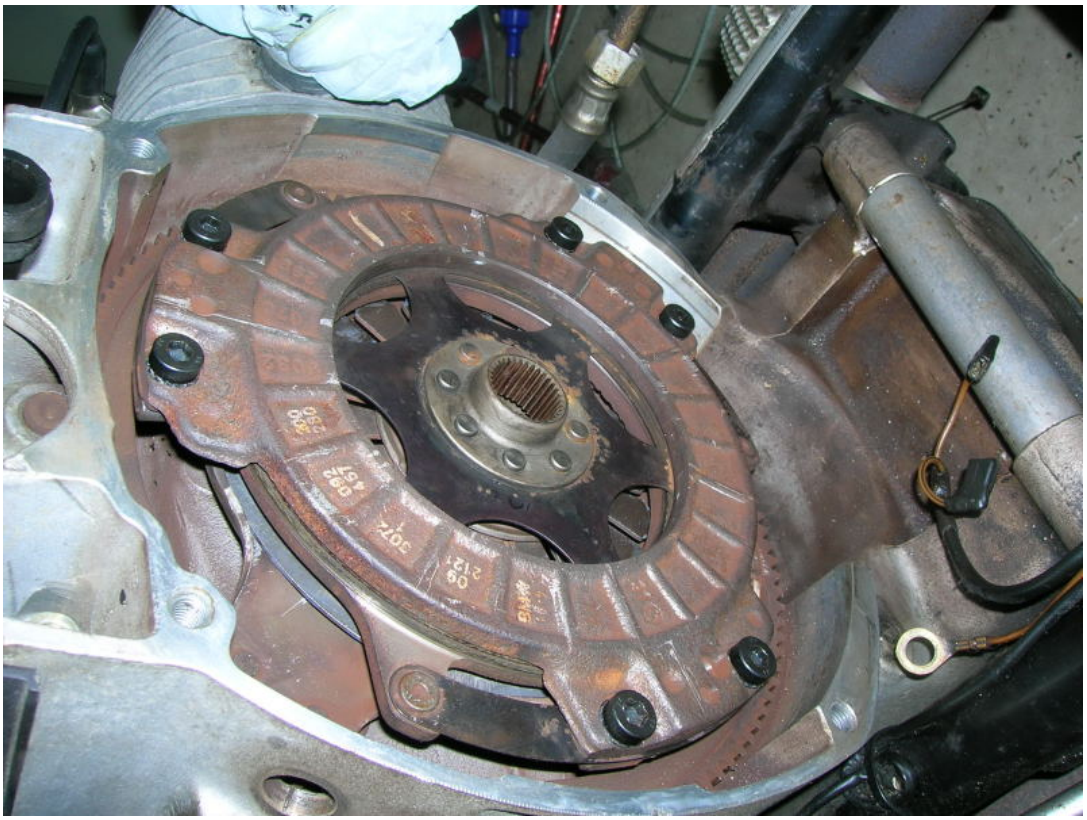

<insert Clutchjob24.jpg>

Here we have the assembly in place with the (3) long bolts. The centering arbor was inserted fully into the assembly before the bolts were installed to ensure that all the plates/disks/springs are centered. Note that we've positioned the red alignment marks to line up with the mark on the flywheel as it was originally.


<insert Clutchjob25.jpg>

We will install (3) new bolts&washers, and then remove the (3) long bolts and replace them with (3) new bolts and washers. Evenly tighten all bolts in a cross pattern to 20-22 N-m or 15-16 ft-lbs with a torque wrench, and I do this in (2) stages (first to 10ft-lbs, finally 15 ft-lbs) to ensure that I am evenly compressing the diaphragm spring fingers. Once all bolts are tight remove the centering arbor.

Assembled and waiting for us to prep the (replacement) transmission and install it:

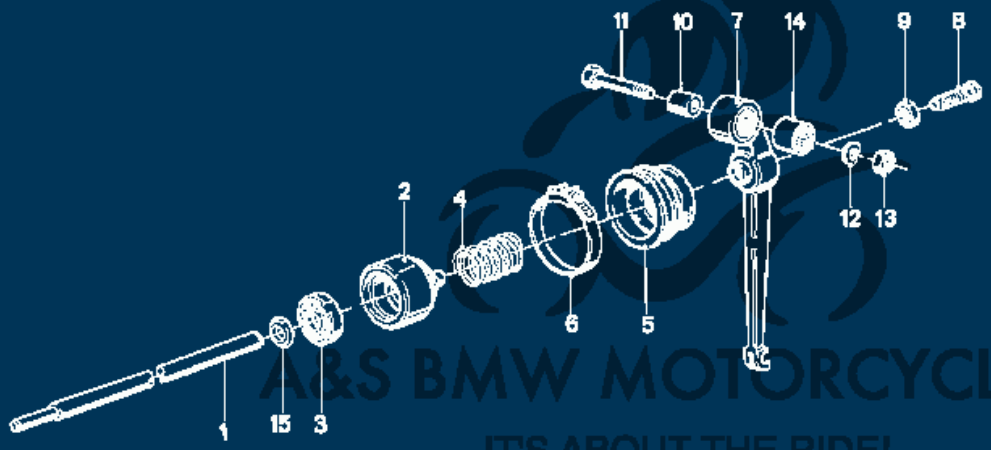


<insert Clutchjob26.jpg>

Now, we must carefully clean, inspect and relube the clutch pushrod and throwout bearing assembly. Unfortunately I had a camera problem at this stage and don't have any good pics of this, but I will at least include an exploded diagram of the parts. Clean everything in a good degreaser and blow dry with compressed air. We will lubricate the bearing (radial roller bearing on pre-81 models, captive ball bearing on 81-later models) and piston with 80W-90 Hypoid gear oil – or whatever you are using in your gearbox/transmission.

Diagrams 21_0086 CLUTCH CONTROL

Series: R45-R65LS..78-85



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No.	Description	Supplement	Qty	From	Up To	Part Number	AT	R	TI
1	ROD								
1	ROD		1	09/80		23 13 1 241 844		1	
	ONLY IN CONJUNCTION WITH								
--	PISTON		1	09/80		23 13 1 464 167		1	
2	PISTON		1	09/80		23 13 1 464 167		1	
3	GROOVED BALL BEARING	511 00	1	09/80	06/88	07 11 9 984 020			
4	SPRING		1	09/80		23 13 1 241 849			
5	CUP		1	09/80		23 13 1 338 731			
6	CLAMP	D=40	1	09/80		23 13 1 241 872			
7	CLUTCH LEVER		1	09/80		23 13 1 241 847		1	
8	SCREW		1	09/80		23 13 1 241 848			
9	HEX NUT	BM8	1	09/80		07 11 9 921 077			
10	BUSH		1	09/80		23 13 1 241 833			
11	HEX BOLT	M6X35	1	09/80		07 11 9 901 189			
12	WAVE WASHER	B6	1	09/80		07 11 9 932 099			
13	HEX NUT	M6	1	09/80		07 11 9 921 054			
14	NEEDLE SLEEVE	12X18X16	1	09/80		23 13 1 238 422			
15	BUSH		1	09/80		23 13 1 239 891	E		

<insert explode_throwout.gif>

Also, use a brush to clean and degrease the transmission input shaft splines.

I decided that I wouldn't put the whole throwout bearing/piston/spring/boot assembly back onto the transmission until after I had it bolted in to maximize my chances and clearance on getting the transmission back in without knocking things together. It IS important to at least get the pushrod (and its bushing, which is often well stuck on) inserted back inside the transmission as that would require a lot of clearance behind the transmission to insert it later, and we don't have so much with the swingarm merely pulled back. You can apply a light coat of gear oil on the pushrod but DO NOT put any near the tip which goes out the front of the input shaft and into the clutch area. Insert the pushrod into the transmission until the tip extends just beyond the input shaft. Take a small bristle brush (acid brush or an old toothbrush and put a THIN coating of the MOLY-60 grease on the tip of the pushrod that will extend into the clutch assembly. Use the brush to also apply a thing, uniform coat of MOLY-60 grease to the input shaft splines on the transmission. This will be enough grease – we do NOT want to also grease the mating splines on the clutch friction disk as excess grease will get forced out forward and end up contaminating the clutch. So, we leave the friction disk splines dry (carefully clean them with a brush and some degreaser and dry them, but be sure not to get any degreaser or crud into the clutch assembly where it may end up falling into and contaminating the friction material.

Here is the transmission input shaft and pushrod tip with Moly-60 grease applied:

<insert Clutchjob27.jpg>

If you have a bad/leaking neutral switch, shift lever seal, or any other service work to do to the transmission, NOW is the time to do it before you install it back into the bike !

<More to come – reassembly instructions continue, basically in reverse order of disassembly>