# *To Laycock or not to Laycock??*

Trials & Tribulations of TR6 Clutches

Brent Kiser
BSME, Purdue University, 1980

NOTE: This article can be found on the Minnesota Triumphs web page.
http://www.mntriumphs.org/

Our wonderful TR-6s have a notorious reputation of troublesome clutches, which is not without merit but may not be deserved.

The symptoms of a troublesome clutch are an overly firm force required to push the clutch pedal to the floor, release bearing failure, shearing of the clutch operating fork tapered pin, seal failure in the master and slave cylinders, bursting of the hydraulic line and excess wear of the clevis pins. Also, the car can be difficult to shift due to the clutch not fully releasing. But the most common problem is that the clutch pedal sticks and will not smoothly move from the floor to the clutch engaged position.

I have unfortunately experienced most of these problems. I have replaced the clutch release bearing at least four times, the clutch master cylinder twice, rebuilt the clutch slave cylinder twice, replaced the clutch disk twice, replaced the release bearing pilot twice and installed four pressure plates, two of which were brand new aftermarket Borg & Becks. On the bright side, I can now replace a clutch in only four to five hours!

Not wanting to improve my record setting time for clutch replacement, I decided to get to the bottom of these problems. Being an analytical nerdy type, I started the investigation by observing who was or wasn't having these problems -- whether the racers who abuse these clutches were having problems or whether the Sunday drivers were having them too. Was it happening in early or late 6s or all of them? Most importantly, what common problem could cause all of the ills?

Having had the pleasure of working on several club members' TR-6s, I noticed the cars with the original clutches never experienced any problems. In fact, Jo Ann Broom, Jim Larson and Dave Swanson, who are the original owners of their cars, knew the clutch was original. All had wonderfully operating and reliable clutches. A coincidence? I think not!

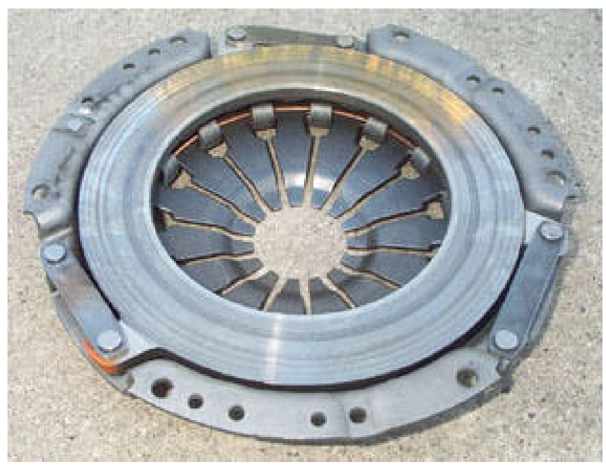
Then, I observed us TR-6 owners who were having problems: Ed Wirtz, Wayne Morris and, of course, me. What did we have in common? None of us had original clutches. We all had aftermarket Borg & Beck replacements. I also consulted a Web site called Listquest.com, which is now defunct but was an electronic gathering place for car nuts. Of about 1,500 Triumph listings, about one-third to half of these were related to clutch problems with one common thread: all had replacement aftermarket Borg & Beck plates.

I knew the only way to get more information was to get an original Laycock pressure plate and compare it with an aftermarket Borg & Beck. So out to my garage and collection of antiques (my wife lovingly calls junk) to get a 30-year-old original pressure plate made by Laycock and an aftermarket Borg & Beck.

Original Laycock Cover Side

Aftermarket Borg & Beck Cover Side

Original Laycock Plate Side



Aftermarket Borg & Beck Plate Side

Looking at them, I noticed the two biggest differences were the spring diaphragm and the diaphragm pivot point.

The original Laycock has a solid, one-piece plate for all of the fingers of the spring diaphragm to pivot about when the clutch was released. Plus, the pivot point was outside of the point where the fingers of the spring diaphragm joined. This design creates a solid, single plain for all of the spring diaphragm fingers to rotate about.

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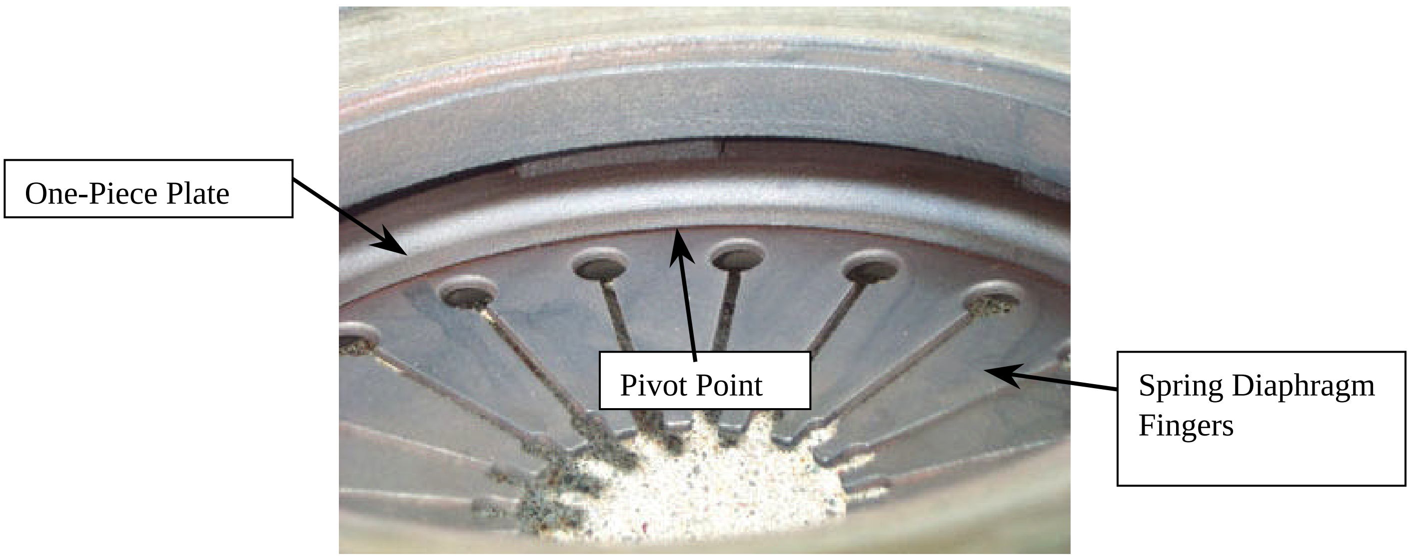
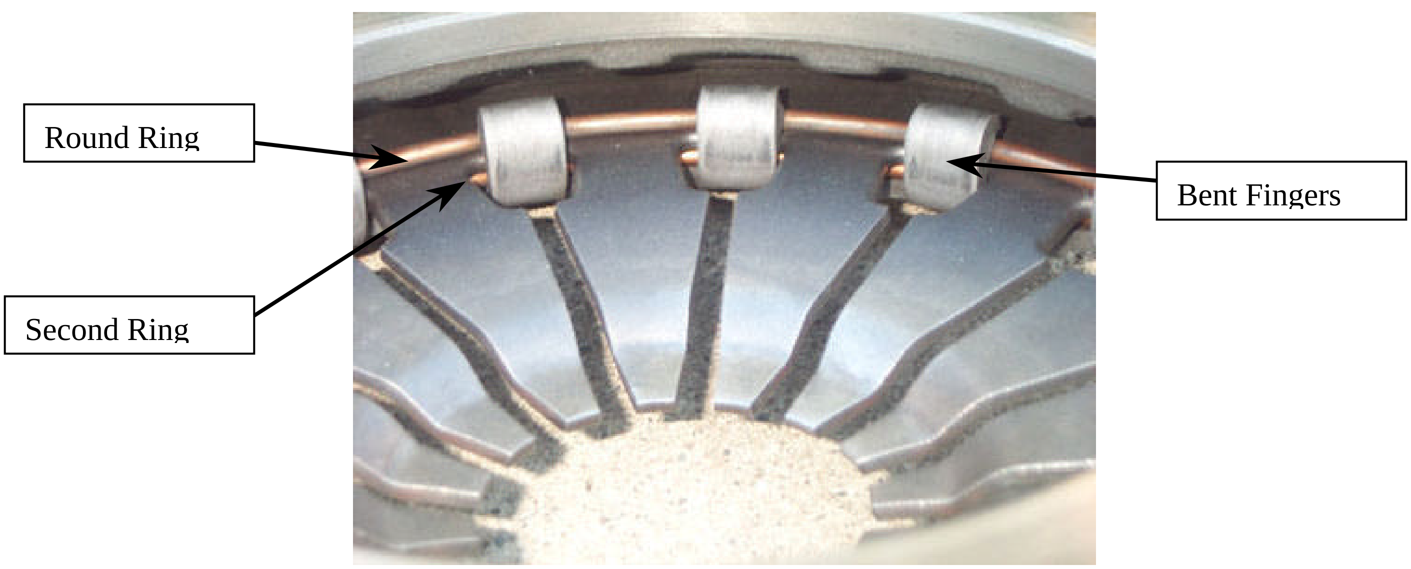



Original Laycock Pressure Plate

The aftermarket Borg & Beck has two round rings held in place by several bent fingers on the cover plate as the fulcrum point for the diaphragm spring fingers. Plus, the fingers joined outside of the round ring.




Aftermarket Borg & Beck

Bottom line: The aftermarket Borg & Beck design would be almost impossible to mass produce with the exacting tolerances required to assure all of the fingers pivoted about the same plain. Having multiple pivot points at different plains would cause the binding and sticking seen on engagement of the pressure plate.

The other observation was the force required to push the spring diaphragm. In other words, release the clutch. By standing and bouncing on fingers of the Laycock, I could get them to move. But on the aftermarket Borg & Beck, even by jumping on the fingers, I could not get them to move. If I would have to guess, I think the Laycock clutch probably has a release force of about 225 to 250 pounds, where the aftermarket Borg & Beck is probably over 400 pounds. No, the Laycock pressure plate is not worn out. It was in my car and worked great. Plus, my engine is modified to produce about 120 to 140 hp. Since then, I experimented with a "Magic Clutch Kit" Sachs pressure plate. More on that later.

Even after all this research, I still was not ready to conclude the problem was the aftermarket Borg & Beck pressure plate. So, back to the World Wide Web.

I discovered the aftermarket Borg & Beck pressure plate is made by a firm in England called AP Automotive Supply and that they had an office in the U.S. Time to let my fingers do the walking at (248) 377-6999. I reached a fine chap named Paul who was interested in my problem, especially when I explained there were more than 92,000 TR-6s produced and I had cause to believe his product was a major pain for us owners. Well, he patiently listened to my observations and wrote down the Borg & Beck part number (HE5132Q) from the pressure plate, which I recently purchased from The Roadster Factory (TRF P/N 214321).

Paul did not have the technical resources for these foreign cars, so he had to call England to search for answers. As promised, he called back a few days later and confirmed my suspicions. The pressure plate I had was recommended ONLY FOR TR-6s WITH ENGINES WITH INCREASED HOURSEPOWER. Personally, I think this is a bunch of crap. This pressure plate was designed for a Saab, not a TR-6 and should not be used for any Triumph. My guess is some guy thought a higher spring force is always better, but did not think about the rest of the clutch system (i.e. release bearing, taper pin, hydraulics, etc.).

My belief that a higher spring force is not required is confirmed by the Triumph Competition Preparation Manual. The manual states:

> "The majority of our testing was accomplished with the standard clutch and flywheel units. The standard clutch is of the diaphragm type and completely adequate for the job of racing with increased power."
>
> From *Triumph Competition Preparation Manual*, Jaguar Rover Triumph, Inc., 2nd Edition, 1980, page 17.

The pressure plate AP Automotive had listed for the TR-6 was a P/N **HE4787Q,** which has a lower spring force than the plate I had.

There was only one thing left to do to close the book on this mystery. Form a hypothesis for each problem and see if the problems can be related back to the pressure plate.

1. An overly firm force required to push the clutch pedal to the floor.

   Yes, an excessive spring force on the pressure plate will cause the clutch pedal to be difficult to push.

   From driving several original, unmolested TR-6s, I believe the clutch pedal force should be around 15 to 25 pounds. This force is the about the same as my wife's 1991 Ford Probe or any other modern car. The aftermarket Borg & Beck required at least two to maybe even three times that force.

2. Release bearing failure.

   Yes, if a bearing is overloaded it will fail. Boy, real rocket science here.

3. Shearing of the clutch operating fork tapered pin.

   Again, not real difficult to see the correlation with the increased pressure plate force to the failure of the tapered pin. If more force is required to release the clutch, more shearing forces will be placed on the pin as the operating fork rotates.

4. Seal failure in the master and slave cylinders.

   Seals are designed for specific operating pressures by varying the thickness and fit of the seal support. The higher the pressure the more solid the seal support. Also, smaller clearances between the piston and cylinder are required to prevent the seal from being squeezed into the clearance. If the operating pressure is doubled or more and the seal is not designed for it, it will fail.

   Also, the length of the piston must be considered in higher pressure applications, since high side loads will increase piston to cylinder bearing stresses. If the bearing stresses reach the yield strength of the piston and cylinder, excessive and rapid wear will occur. This is the cause of the brake fluid turning black when the aftermarket Borg & Beck pressure plate is used (aluminum oxide from the master cylinder).

5. Bursting of the hydraulic line.

   Duh?? You mean a plastic line will burst if excessive pressure is placed upon it? Enough said.

6. Excess wear of the clevis pins.

   Let me see, the shear or bending forces on the pin double or even triple. Nobody ever greases these things like the maintenance manual requires and then they fail.

7. Difficult to shift due to the clutch not fully releasing.

   This is the most difficult problem for us car nuts to understand.

   The increased spring force of the pressure plate requires a greater effort on the clutch pedal and subsequently increased hydraulic pressure. Well, the only way to get greater hydraulic pressure is to push on the clutch pedal.

   When the pedal is initially moved, the hydraulic pressure is zero. Then, as the pedal continues to move, the pressure increases until it equals the force required to overcome the clutch disk spring.

On an original Laycock clutch pressure plate, the pedal does not have to move very far to create the pressure required to release the clutch. Subsequently, the clutch releases farther.

But on an aftermarket Borg & Beck, the clutch pedal must be moved significantly further to create the pressure required to start releasing the pressure plate. By the time the clutch starts to release, the clutch pedal is only about 1/2” away from the firewall and cannot be moved any more to fully release the clutch.

Since the clutch cannot be fully released, the transmission is difficult to shift.

8. Clutch pedal sticks and will not smoothly move from the floor to the clutch engaged position.

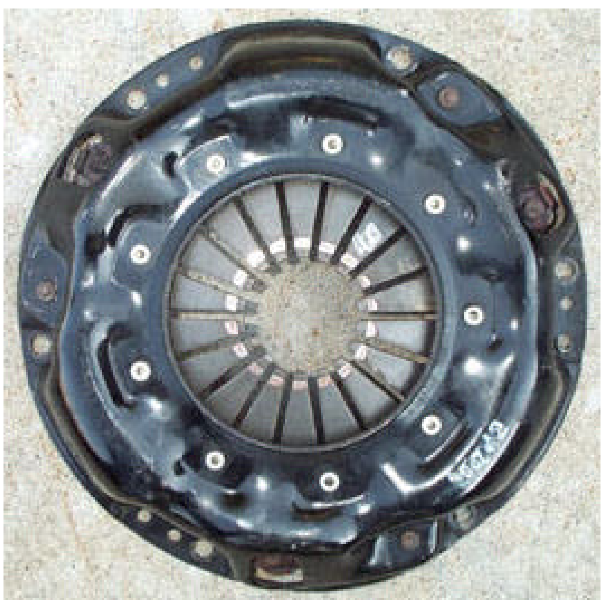
   The sticky engagement of the clutch, I believe, is due to the pivot point of the spring diaphragm not being along the same plain.

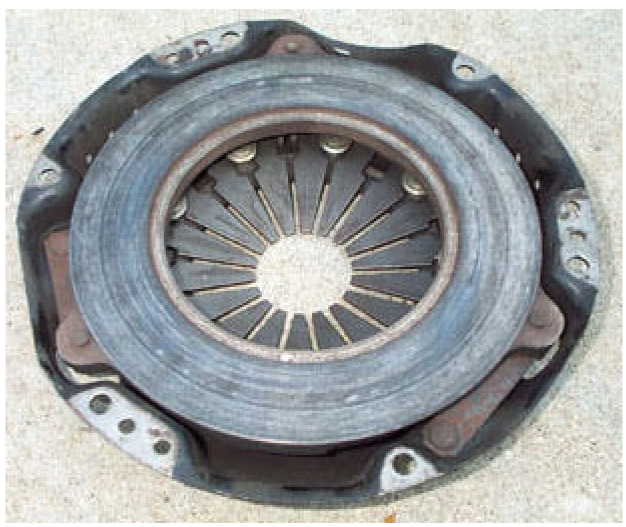
My recommendations to any TR-6 owner who has an original clutch assembly and is considering replacing their clutch is to replace only the release bearing and clutch disk. Keep the original Laycock pressure plate.

**Update, Summer 2001**

<u>Original Borg & Beck Pressure Plates</u>
Since writing this article a year ago I have had several people tell me the Borg & Beck pressure plate was an original piece of equipment and theirs works wonderfully. Well, this was a mystery to me so I did some more investigation.

I got a hold of an original Borg & Beck Pressure Plate and observed the following.





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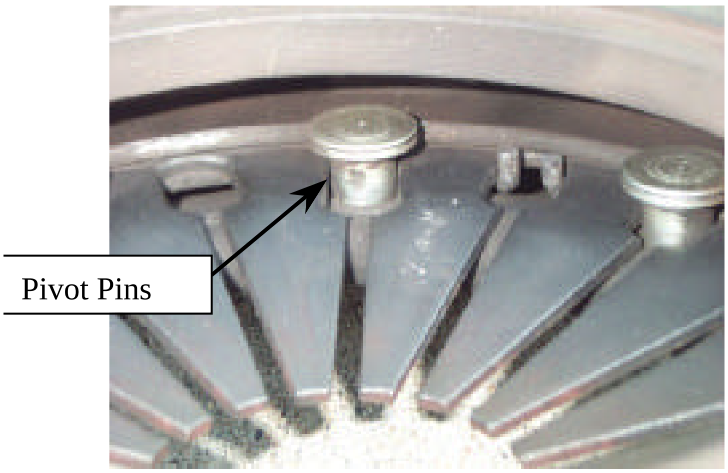
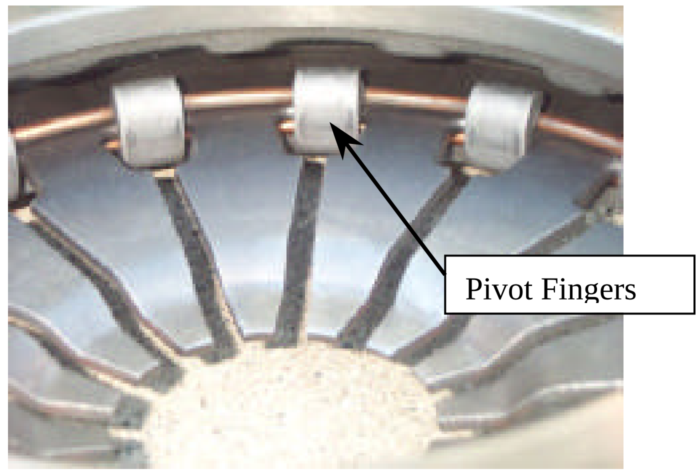
Original Borg & Beck Cover Side | Original Borg & Beck Plate Side

It became obvious at first glance that the original and aftermarket Borg & Beck pressure plates are not even close to the same design. The original Borg & Beck is what I call a "Pin Design" pivot point versus a "Bent Finger" pivot point.




Original Borg & Beck




Aftermarket Borg & Beck

As you can see in the pictures, there is a great difference between the original and aftermarket units. It is no wonder that people have been telling me their original Borg & Beck work great and I have claimed the Borg & Beck does not work. We were talking about two different designs!!

Since discovering this difference, I have installed over six rebuilt original Borg & Beck pressure plates and have not had any problems. I strongly recommend the rebuilt original Borg & Beck pressure plate.

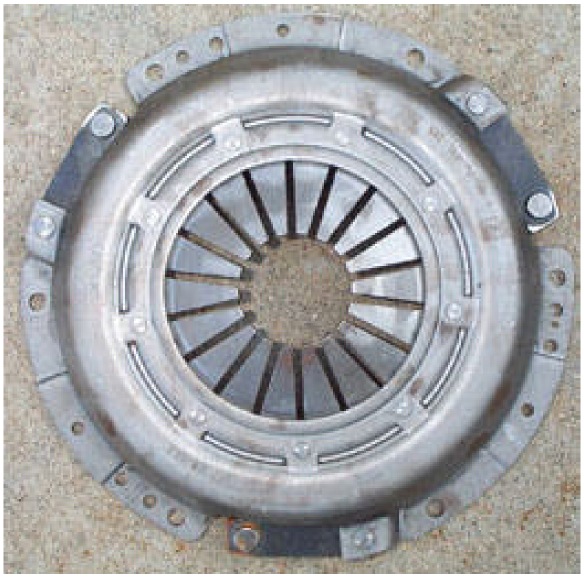
<u>The "Magic Clutch Kit"</u>

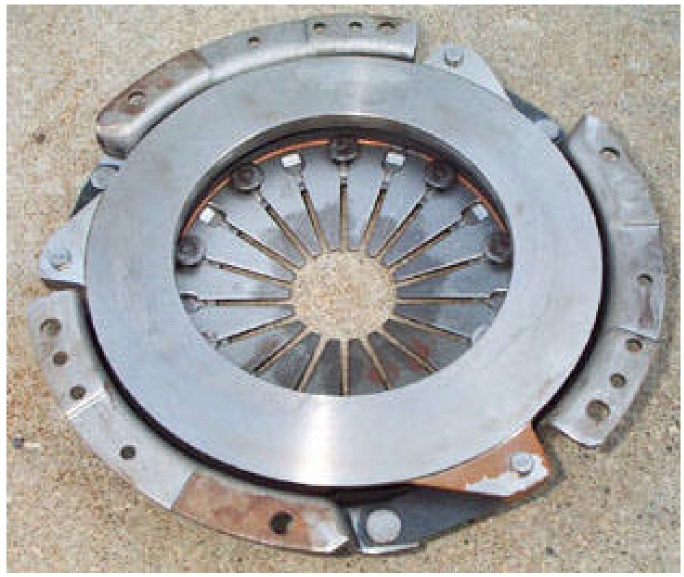
One day I decided to replace my good old original Laycock pressure plate since it was 30 years old. Besides, there is not much to do during the winters here in Minnesota and I wanted to do something with my car. What a big mistake!

I tried one of the "Magic Clutch Kits" with a Sachs pressure plate, Borg & Beck disk and a Toyota release bearing. It had the same problems as the aftermarket Borg & Beck!!! It had an overly stiff feel and when engaging the clutch, the pedal sticking returned. In addition to the pressure plate problem, a new problem occurred. The Toyota "heavy duty" bearing "squealed" during the initial engagement of the clutch. The car was driven this way until I could find a NOS Laycock clutch assembly and bearing.

In addition to my own problems with the Sachs pressure plate, I have replaced a Sachs pressure plate in another car with an original rebuilt Borg & Beck pressure plate due to excessive pedal force and the car could not be shifted.

When you look at the Sachs pressure plate you will see it is like the original Borg & Beck design with the pin type pivot point.

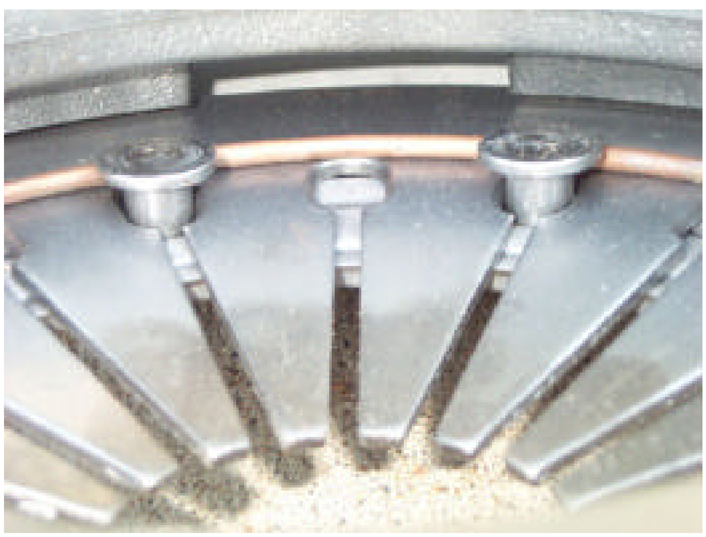




"The Magic Clutch"

Sachs Cover Side

Sachs Plate Side



Sachs "Pin Type" Pivot

The design of the Sachs is the better than the aftermarket Borg & Beck it still has too strong of spring. I cannot recommend the Sachs unit.

Magic Clutch Kit Release Bearing

When the Toyota bearing was removed from my car the cause of a squealing which occurred when the clutch was initially engaged became obvious. It was caused by the contact between the bearing and pressure plate. Both parts showed excessive wear for having only a couple of thousand miles. I noticed the original bearing was a SHIELDED bearing the Toyota bearing was a SEALED unit. The additional friction drag of the seal did not allow the bearing to turn with the pressure plate when the clutch was engaged. Therefore, when disengaging the clutch, the bearing had to be sped up to match the speed of the pressure plate. This differential speed caused the squeal and excessive wear.

By pure luck, I found a NOS Laycock clutch assembly and it is now in my car and has well over 10m miles on it. I drove the car to Colorado from Minnesota for the 2001 VTR convention with the Laycock assembly. It still works beautifully, is smooth with a light pedal feel and has NEVER slipped even in the mountains of Colorado.

Final Recommendations

Since writing this article I have had the pleasure of replacing at least six other TR6 clutches. ALL, every one of then, were experiencing the problems described here and ALL problems have been solved on EVERY car. All cars had the aftermarket Borg & Beck pressure plates for the Saab.

I can strongly recommend using the following to fix your clutch. They are listed in order of preference.

1. Somehow, get a NOS Laycock clutch assembly. These are VERY RARE and may take some time to find. In the last three years, I have only come across two NOS assemblies. One is on my car and the other I put on another Minnesota Triumphs member's car. I know he paid about $300 for that assembly on Ebay but, has not had a lick of problems since.

   IMPORTANT!! If you do find a NOS Laycock assembly the pressure plate must be disassembled and all moving surfaces greased with silicone brake grease. I've seen clutch chatter problems due to old grease not allowing the pivot surfaces to move.

2. Find an **<u>ORIGINAL</u>** rebuilt Borg & Beck. NOTE I said ORIGINAL not an aftermarket Borg & Beck for a Saab. These are difficult to find but occasionally can be found on Ebay for about $100 or less.

3. Lastly, reuse your old Laycock or ORIGINAL Borg & Beck pressure plate. I would rather reuse an intact original pressure plate than any aftermarket Saab pressure plate. To date, I have not had a problem with just replacing the clutch disk and release bearing only in several cars.

Alternate Opinions

Mr. Nelson Riedel of the Buckeye Triumphs (buckeyetriumphs.org) is a wealth of knowledge and writes very precise and easy to understand technical articles on lots of TR6 and TR250 stuff. He has written at least nine articles concerning the clutch. The link below is just one of the articles.

http://www.buckeyetriumphs.org/technical/Clutch/ReliableClutch/ReliableClutch.htm

Mr. Nelson believes the clutch problems are due to the fit between the release bearing pilot on the transmission and the ID of the bearing sleeve. He also believes the aftermarket pressure plates are acceptable. Please read his articles and decide for yourself.

**Update – October 2003**

Thanks to Mr. Thomas Fremont, another mechanical engineer; University of Cincinnati, 1987; there is another theory to the sticking clutch problem. Tom's theory is that the misalignment between the engine and transmission causes the sticking clutch. He solves the problem by using two 21/64" drill bits as temporary dowels to align the transmission to the engine. His theory is backed-up by the fact that all but four bolts holding the transmission to the engine are 5/16" diameter. Four bolts are 3/8". Two of the 3/8" bolts hold the starter on and the other two are at about the 4:00 and 10:00 positions. These two 3/8" bolts fit tightly and are often not reinstalled because they won't fit.

Could it be all of the clutch problems are because of two lousy 3/8" bolts and can be solved by two 21/64" drills? Maybe. This theory would explain Mr. Nelson Riedel's theory of the dragging release sleeve on the transmission input housing and maybe the excess drag between the sleeve and housing causes a stiff clutch.

Here is the complete e-mail dialog between Mr. Tom Fremont and myself about this alignment problem. Enjoy!

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Hello Brent,

Just came across your article - what a piece of work!

Further to same: I've got a couple of '250s, one of which I've had since 1976 and have put 120,000 miles upon. Been through a few clutch replacements myself, needless to say...

A couple of years ago Triumph World published my "tech tip" article detailing what I believe is a common bugaboo in our now antique cars. The gist of it is that the alignment of the gearbox input shaft to the crankshaft degrades with each successive removal/replacement of the gearbox, as there are no locating dowels and it depends therefore on the fit between the bell housing holes and the bolts. As the holes (aluminum) wallow out, the gearbox drops and the misalignment can get pretty bad eventually. Mine caused (I think) input shaft bearing failure. My solution was to use (2) 21/64" drill bits as temporary dowels during installation, using holes in the 2:00 and 8:00 positions (these are relatively unmolested).

I've done about 30,000 miles since making that change, and it cleared up the sticking problem to boot; I figure the throwout sleeve was dragging on the snout in the gearbox due to misalignment.

FYI, I've had good luck with the Magic Clutch Kit. My other '250 has a Laycock (I'm told) and it's fine, too, but its engagement is a bit more abrupt.

Regards,
Tom Fremont

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Thomas,

Thank you very much for taking the time to write me about your experiences. I greatly appreciate you taking the time to let me know what you have done because it helps me rethink my theories and refine the article. There is nothing I would like more than for somebody to tell my I'm wrong and give me a firm reason or reasons why. Being a nerdy engineer, I want facts not beliefs.

I understand what you are saying and believe the installation of the pins did eliminate your problems. What I don't understand is why or how a very slight or small rotational change in the relative position of the transmission to the engine would cause the problems. The installation of the pins would not change the X or Y axes angular relationship between the engine and transmission, only the rotational. And, the rotational change would me minimal. Also, since the rotational relationship of the release bearing to pressure plate is not critical, what did the pins do to improve the assembly?

Lastly, before I understood the aftermarket pressure plate problems, I changed clutches on TR6s that were still owned by the original owners and they knew the engine/transmission had never previously been apart. After one engine/transmission disassembly, and the installation of the aftermarket pressure plates, the sticky clutch problem appeared.

Please keep the communication open and let's continue to discuss this.

Thanks again for writing.

Brent

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Brent,

Happens I'm a mechanical engineer, too!

The misalignment I referred to is what we call "parallel misalignment". Rotational is of no relevance here, I agree. When there are two shafts in bearings coupled to each other they must have the same center of rotation or else the bearings will experience radial loads; the stronger of the bearings will prevail (hands down this is the journal bearings of the crankshaft) and ultimately the weaker ones give way. In the case of TRs, I think the magnitude of this misalignment can easily be 0.040" or more after a dozen or so removal/replacements. As one who has had his nose rubbed into this condition (I sell industrial shaft couplings.) I'm impressed that the TRs are as forgiving as they are; you could never find a machine designer to "bless" this amount of misalignment in a design; he'd specify a flexible coupling to alleviate the radial loading.

Engagement of two misaligned shafts like this will cause orbiting of the one with more compliant bearings relative to the other. This has implications for the throwout bearing, also the throwout sleeve (which I seem to recall has about 0.015" clearance with the snout around the input shaft) and, more annoyingly, the input shaft bearing of the gearbox, as the input shaft gets slung around to the tune of twice the "drop" or misalignment value.

What the dowels achieve is to enable assembly only when the two sets of holes are lined up according to their original accuracy when new. The 21/64th" drill bits are the same size as the clearance holes originally machined in the bellhousing and engine adapter plate. They'll fit with no slop, and won't go in unless perfectly aligned. The result is a fit that is as good as the original accuracy of the two bolt circles. If the original gearbox lasted 50,000+ miles then I would say that the accuracy was good enough.

If in fact the throwout sleeve drags hard on the snout, this would aggravate the stiff clutch syndrome, though I think your finding about the variance between brands is far more significant, and likely the culprit of many a failed throwout fork pin, which I suppose is the Achilles heel of the setup.

Regards,

Tom Fremont

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Tom,

Phenomenal!!! Two nerds (no insult intended) e-mailing each other. Where did you graduate from?

Your hypothesis is something I had not considered.  I would like to counter your theory with the following:

You theorize the "radial misalignment" is the cause of the problem.  I'm defining your "radial misalignment" as the "X" or "Y" axes misalignment. I'm also assuming the "radial misalignment" you refer to is the clutch release to the crankshaft bearing radial misalignment.

I would agree with your theory if there was a solid link between the release and crankshaft bearings.  But let's think about the assembly.

1) the crank main bearings hold the crank.
2) the crank holds the flywheel
3) the flywheel holds the pilot bearing for the transmission input shaft.
4) The flywheel also holds the pressure plate.
5) the input shaft is attached to the transmission through the transmission input bearing
6) There is clearance between the transmission front cover and the release bearing sleeve
7) the release bearing has clearance

There are at least 7 fits between the crank and release bearing.  And, there is not a radial pilot between the release bearing and pressure plate.

Since the release bearing is allowed to radial float on the pressure plate, there is not any radial alignment between the release to crankshaft bearings.  If the release bearing is not on the same rotational center as the crankshaft, the release bearing would contact the fingers of the clutch pressure plate at a different rotational center.  The difference in rotational centers, would cause the pressure plate movement would not be parallel to flywheel surface.

Your theory has merit but,  I don't understand how that makes the clutch harder to push since the release bearing is allowed to radially float on the pressure plate fingers.  The lack of radial piloting between the pressure plate/flywheel/crank to release bearing would eliminate the drag of the release bearing pilot sleeve to transmission input housing.

Since you are heavily involved in industrial shaft couplings, I think of the release bearing to pressure plate fingers contact is like a magnetic coupling.  Torque is transmitted but, the radial moment is almost nonexistent since the two are allowed to radially float.

Please keep up the conversations. I would love to have some holes shot in my theory since NOS or rebuilt pressure plates are hard to come by.

As you ponder this, please ask yourself; "Why do original, undisturbed clutches not have this problem?" I know of and have driven at least 6 TR6's with original clutches and NONE have the problems of TR6's that have replacement clutches. If your theory is correct, I would expect manufacturing tolerances as well as wear to cause the problems.

Brent Kiser

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Brent,

I agree about the tolerance stackup. Allowing a couple of 'thou for each gives a worst case of 0.014". Point is, if the gearbox is installed as much as 0.040" below the true centerline, this effectively triples the misalignment from the worst case when new....

Due to the pilot bearing in the flywheel, you are correct there is little misalignment at that point. Moving toward the input shaft bearing, however, we'll find it increases to the maximum value allowed by the slop in the bell housing holes - could be even as much as 1/16" I reckon. Now imagine the clutch disc: at midpoint between the input shaft bearing and the flywheel pilot bearing there would be a "drop" of half the above maximum value. If we now engage the disc it will locate off-center by that amount; let's say 0.020"-0.030". What happens when we now rotate it 1/2 turn? The clutch disc position goes from -0.020" to +0.020", and does so every 1/2 turn until disengaged. This action is detrimental to the input shaft bearing, for sure.

As for the throwout bearing: there is little, if any, radial play from new. Its clearance with the snout is what's available to cope with misalignment (I think this is only about 0.015" - check me on this). *Note that once forced into the pressure plate fingers, it is effectively located (off-center, as above) and will "orbit" to the extent of the misalignment*. If the clearance is exceeded, it will drag. When I first heard the whine of my input shaft bearing about (10,000 miles into service from rebuilt) and reflected on the possible cause, I proceeded to loosen the bell housing and jack the gearbox up relative to the engine as high as it would go; this in fact did eliminate the sticking problem for me. Thousands of miles later I replaced the gearbox with my spare and employed the dowel method. I've done it since a couple of times and never experienced problems like sticking or premature bearing failure.

I think the next time you see the condition of the top bellhousing holes on a TR6 gearbox that has seen a number of removals you may come away with new impression; in any event the dowel method has no adverse consequences. If you should ever employ it in the future I would like to know how it works out.

Regards,
Tom
University of Cincinnati '87

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Tom,

I have been giving considerable thought to your e-mail and I am becoming a believer. Your theory would explain why Nelson Riedel of the Buckeye Triumphs thinks it is the fit between the release bearing pilot and transmission input housing. If you have not seen Nelson's article it is very good.

http://www.buckeyetriumphs.org/technical/Clutch/StickyClutch/StickyClutch.htm

Your theory would also explain why I think it is a pressure plate problem. My theory is that the pivot pint is sticking. But, if it is misalignment, the weaker clutch would more easily align during engagement of the clutch.

If you would like to write something about your alignment theory, I would like to add it to the beginning of my article and get VTR to republish the article.

As you know, most of the bolts holding the engine and transmission together are 5/16" and four bolts are 3/8". Two of the 3/8" bolts go on the starter the other two may be for alignment. Do you think that installing the two 3/8" alignment bolts are as good as your pins? I doubt many people reinstall the two 3/8" alignment bolts. I know I didn't because I simply replace all of the bolts with new 5/16" except for the starter bolts.

Thanks for taking the time to send the original e-mail.

Brent Kiser

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Brent,

Thanks for your email. I could find the article published by Triumph World, scan and send it if you like. It doesn't have much of the theory but does OK in describing the procedure.

About the choice of holes, etc.: the method I've described relies on the factory accuracy of the bolt circles on the transmission bell housing and the engine adapter plate (which is doweled to the engine block). The engine adapter is steel and its holes don't degrade much. The idea is to find in the bell housing the best (2) holes at 180 degrees from each other and use them with the 21/64" drill bits. This size is apparently what was originally used as clearance holes for both the mating pieces (bell housing and adapter). As such, there is hardly any clearance when using the bits, and in fact some juggling may be necessary to enable pushing them through. I leave them in place until the rest of the bolts are tightened. If all the holes in the bell housing are trashed the method won't work. To save the bell housing it would have to be remachined and bushed (accurately with respect to the input shaft bearing bore) in a couple of places.

As for the 3/8" bolts, I was ignorant of the (2) you mention besides the starter bolts. In any case, using good bolts in good [clearance] holes will not give the accuracy we want. If the locations for the other 3/8" bolts are 180 degrees or at least 120 degrees apart and in good condition, bits of the size used to make the holes originally would be the way to go, i.e. 25/64" probably.

Best regards,
Tom

Please keep the feedback coming on this article. Without the feedback I would not have discovered the differences with the original and aftermarket Borg & beck. Thanks to all who took the time to call or e-mail.

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