Sticky Clutch

I had a sticky clutch in my TR250 and after I mentioned it to some of the Buckeye Triumphs members I found Murry Mercier had a similar problem. I've also seen a number of references to the problem on the Triumph and 6-PACK email lists.

The symptoms are that the clutch sticks and then jumps when engaged. As the pedal is released, the back force on the pedal decreases to zero and hangs briefly and then jumps back. The clutch goes from not engaged to nearly fully engaged. We've dubbed this the binary clutch. This makes for jump-starts like those of a beginning driver. Another symptom observed by Murry (and others) was a "squeal" or "chirping" except when the clutch pedal was depressed.

History: The problem on my TR250 first showed up about 10 years after a new clutch was installed but after only a couple thousand miles or less of operation. The clutch disk and pressure plate are Borg & Beck with the standard release bearing. The gearbox was pulled a couple years ago to free the clutch disk. At that time everything in the clutch area was inspected and fresh grease applied to the release-bearing sleeve. The clutch operated smoothly when the engine was cold and then started to stick after about 20 minutes of operation. After the engine was hot, the clutch disengagement also seemed a little rough; when the pedal was pressed it felt like there was an abrasive somewhere in the system.

Murry was using the TRF "Magic Clutch" with the upgraded release bearing and sleeve and new clutch fork and operating shaft. As in my case, his clutch hung up as the pedal was released and then let go causing the clutch to go from released to engaged instantly. His problem showed up about 500 miles after the clutch was installed and was sticking all the time, even when the engine was cold. He also pointed out that his operated smoothly when the engine was not running. I found that hard to believe. I then ran my TR250 till it was hot and the clutch stated to stick, then shut it off and found the clutch was then smooth. Still not believing it, I repeated the test several more times with an even hotter engine ---- same results.

Find the root cause: Most folks, when they encounter a clutch problem and go to the effort of pulling the gearbox, replace everything in sight. In my case, I wanted to fix the clutch so that I could use the car occasionally for the next year of so at which time I plan to pull the engine in conjunction with a new paint job. Since the clutch components had little wear, I decided to try to find exactly what was going on, fix only the source of the problem, and change nothing else. Murry was on his third clutch with each exhibiting the same symptoms. Numbers 1 and 2 had less than a few thousand miles on them before they were replaced, so he was not anxious to replace parts for a fourth time. The replacement of new parts with #3 included the magic Clutch Kit and all related parts including: bushing, shaft, fork, pin, arm, and pilot bushing, which was "staked" and pressed into place.

Expert Advise: In the fall of 2000 I stopped at TRF on my way back from vacation. I asked the "technical expert" about the sticky clutch. He suggested the sticky clutch was caused by the release-bearing sleeve hanging up on the gearbox front end cover (the piece it slides over). I readily accepted this since I had reached the same conclusion. The explanation of why it shows up after use was that there is insufficient clearance between the sleeve and front end cover and with wear, particles from the clutch surface mixed with the lubricant making it sticky and prone to grab rather than slide. The explanation for my clutch sticking only after it is hot was that the sleeve and front end cover change dimensions differently as they get hot causing the clearance between the two to reduce.

I've heard several stories of people cutting large holes in the bell housing so they can lubricate the front end cover to keep the sleeve from hanging. At first I thought that was pretty dumb. However, if one has pulled the gearbox several times without finding a permanent fix, a lubrication access port might be considered an innovative solution. The point here is that fresh lubrication of the front end cover stops the sticking for a while indicating that the problem is indeed caused by the sleeve hanging up on the front end cover.

The solution to these problems suggested by the TRF expert was to make sure that the cold clearance between the sleeve and the front end cover is .015 inches.

Sleeve Clearance Measurements: Shortly after my visit to TRF Ryan Miles, another Buckeye Triumpher, was ready to install the clutch in his '74TR6. We decided to do a little research on the sleeves and front end covers we had before he did the installation. We measured several sets of sleeves and front end covers. The outside diameter of the several front end covers were within .001 inches of the same size. We measured several old and one new sleeve. The old sleeves (all of which were thought to have worked well) gave a clearance of between .005 and .010 inches while the one new sleeve was smaller and gave a clearance of only .002 inches. We also noted that the new sleeve was hardened whereas the old sleeves were not. At the time Ryan and I thought the .015-inch clearance was over kill and decided that a clearance of .008 to .010 inches should be OK since I was convinced that the problem with my TR250 was that I had installed a new sleeve that was too small.

Inspecting the TR250 Parts: I finally got around to pulling the gearbox and checking out the TR250 clutch in late January, 2001. After the clutch was removed it was checked for wear; there seemed to be little or none --- not surprising since it had only a few thousand miles of use. It was the old style Borg & Beck, the one that is much stiffer than the wimpy Laycock clutches used on the later TR6s.

The gearbox front end cover and release-bearing sleeve were then examined. The sleeve was one of the older styles that had not been hardened. As mentioned earlier, about three years ago I started the car after it had sat for five or six years and found that the clutch plate was stuck to the flywheel. The gearbox was removed to free the clutch plate and the sleeve and front end cover were cleaned and lubricated. The clutch started sticking sometime after that. The car has been driven less than 1,000 miles since freeing the clutch.

The following photo shows the front of the gearbox with the release bearing, sleeve, gearbox front end cover and the operating shaft with clutch fork attached to refresh your memory. When the clutch petal is pressed, the operating shaft rotates such that the top of the fork moves toward the front (right) and pushes the sleeve and release bearing against the clutch pressure plate (that is not shown).

The next photo shows the gearbox front end cover and release-bearing sleeve (with bearing removed) in more detail.

The front end cover outside diameter measured the same as one on another transmission and the same as those we measured last September. The sleeve inside diameter was then measured and the clearance computed to be .008 inches agreeing with similar used sleeves measured last fall. Thus, the problem wasn't a too small sleeve as I had suspected.

Heating Test: Next, several front end covers plus this sleeve and two additional sleeves (one old and one new) were all measured again, data carefully recorded and then placed in a 250-degree oven for about an hour. (The spouse was in another part of the house when this was done. She was quite upset when she observed the pieces being removed. She claimed they stunk up the oven and would affect the flavor of food she prepared. All the food since has had great flavor so I guess she over reacted.)

After escaping with the hot pieces to the workshop all were measured several times and the data recorded. The data were then analyzed. All diameters increased slightly when heated ---- about .002 inches. However, since both the front end cover outside diameter and the sleeve inside diameter increased about the same amount, there was no detectable change in the clearance. These data disproves the theory that the clutch sticks when hot because the clearance is reduced. (Data often refutes excellent theories.)

Time to Rethink: Next, the two used sleeves and two front end covers were examined. All showed slight wear in the same areas. The sleeves seem to rub against the front edge of the front end covers in one spot (centered around the 7 o'clock position when viewed facing the front of the gearbox) and the rear part of the sleeves rub against the front covers at about the 1 o'clock position (opposite from the front). The second contact area is a little over halfway back on the front end covers. These data indicate that the front of the sleeves are pitched up and to the driver's side slightly (1 o'clock position) when the clutch is operated.

The points where the clutch fork pins engage the sleeve were not worn excessively. The clutch fork pins and clutch operating shaft bushes also appeared to be in good shape.

From all these data it was concluded (better make the speculated or guessed) that the clutch hangs because the sleeve pitches up slightly and digs into the front end cover. The next photo shows an exaggerated view of this. The sleeve was pulled toward the front much more than in normal operation to get it to tilt as much as shown. (It was found that the sleeve binds when a large tilting force is applied even when the front end cover is nearly fully inserted in the sleeve.) If this is the cause

of the sticking, then the fact that it first starts to stick after many hours of operation may be attributed to the lubrication thinning at the points of contact. The remaining lubricant may be less effective at elevated temperature causing it to be more prone to hang up when hot.

Some tilting of the sleeve is not surprising since the pins of the clutch fork sweep through the front end cover center line, but are either above or below the centerline during part of the sleeve travel. Also, the pressure plate is probably not aligned perfectly with the front cover. If the bearing aligns with the pressure plate, then the sleeve will be tilted. The fact that the sleeve hangs under the more than 200 lbs clutch pressure plate spring force is however surprising.

Possible Solution: To minimize the binding it was decided to smooth the contact surfaces and edges. The front cover was placed in the lathe and the entire surface polished. The front edge was smoothed with a file. (The previous two photos were taken after this was done.) Next, the inside edges of both ends of the sleeve were smoothed with a file (in the lathe). If the diagnosis is correct, the rear edge of the sleeve is the most likely point causing the problem. This edge has a 45^{o} bevel but is still fairly sharp.

The same front end cover, sleeve, clutch-operating shaft and fork were reinstalled my TR250. The same parts were used as a test to try to determine if smoothing the edges and surfaces fixed the problem. The mating surfaces were lubricated with high temperature wheel bearing grease during assembly. [After everything was assembled I remembered the time the clutch disk stuck to the flywheel. Maybe I should have lubricated both sides of the clutch disk too. (That was a feeble attempt at a joke.)]

Since the surfaces were smoothed, the TR250 had been driven for over 1,000 miles and the clutch still operates very smoothly.

Inspection of Murry's Clutch: We pulled Murry's gearbox in early September, 2001. He wanted to get it all fixed up before the ~2,000 mile roundtrip to the 2001 6PACK Trials in Oklahoma. Murry has a '73 TR6 but the gearbox with A Type OD is from a TR4A. As mentioned earlier, he has a relatively new Magic Clutch Kit and all related clutch system parts.

The first thing was to inspect everything. We noticed right off that there was an unusual wear on the pressure plate diaphragm spring fingers. Murry had noted that the clutch had a steady squeal when engaged. The squeal stopped when a light pressure was applied to the clutch pedal. The Magic Clutch uses a Koyo release bearing that is much larger than the stand RHP bearing that is the cause of the usual wear. This issue is discussed in the accompanying note "Release Bearing Woes".

We examined the front cover next and found it had deep scratches. There was also a small lip at the bottom edge of the front cover, as if the front had been driven back or 'peened' over. Some of this is shown in the next photo as viewed from the bottom.

We also found the front cover sleeve length was 3.375 inches typical of the TR4 rather than 2.97 inches required by the TR4A through TR6. The longer sleeve will interfere with some pressure plate spring fingers. The hole in Sachs pressure plate used in the Magic Clutch as well as the standard Borg & Beck pressure is large enough so that there will be no interference. The hole in the earlier Laycock pressure plate is smaller and will likely interfere with the longer front cover. The following photo shows the TR6 front cover (left) with the longer TR4 cover.

Murry's Fix: We decided to replace the front cover because of the depth of the scratches. We mounted another TR4 front cover in the lathe, cut off 3/8 inch, smoothed and rounded the end and then polished the outer surface.

Next, we used an air die grinder to smooth the inner edges of the release-bearing sleeve. The inside of the sleeve was a little rough so we mounted the sleeve in the lathe polished the inner surface with oiled emery cloth.

A thick layer of high temperature grease was applied to front cover before the release-bearing sleeve was installed.

The clutch operated perfectly during the first tests. It is still operating perfectly after ~ 3,000 miles.

Final Thoughts: I'm pretty sure we've found the root cause --- rough inner edges at the release bearing sleeve hanging up on the front cover. We'll continue to monitor Murry & my clutches and let you all know if either starts to stick.

I don't know whether this has always been a problem or is just a recent phenomenon. One thing different is the recent use of hardened sleeves. The sharp edge on the older sleeves tended to wear smooth. The hardened sleeve is less likely to wear, so it's possible the problem is more prevalent now. The sleeve in my TR250 was not hardened. I think Murry's sleeve was hardened but I forget to check it for surface hardness so I can't be sure.

It's interesting that many folks suggest that the sleeve clearance should be increased from the normal .008 inches to .015 to .025 inches. If the problem is due to the sleeve tilting, then the larger clearance will allow a greater tilt and hence increase the likelihood that the sleeve will stick. On the other hand, if this enlargement is done by a machinist, it's likely those inner edges are smoothed, which will likely fix the problem.

Feedback: After this note was posted I received about a dozen responses from folks who had similar problems that they cured in a similar way. No one responded (yet) that these techniques failed to fix a sticky clutch.

Phil Brzozoski responded that he found the new sleeve in his sticky clutch was about 1/4 inch longer than the sleeve in his parts car. He replaced the new sleeve with the shorter one from his parts car and now has about 4,000 miles on it and the stickiness is still gone. Phil reasoned that the extra length allowed the sleeve to hang over the end of the front cover and possibly increasing the probably it would grab or stick.

I have a newer sleeve that is longer and thought it was a good idea since the added length would reduce the amount the sleeve can tilt, thus reducing the attack angle of the sharp edge. The next photo shows the longer sleeve beside an old short sleeve. Murry's clutch had one of these longer sleeves. I examined my longer sleeve

more closely and found the edges are really sharp, much more than a used sleeve I have. So there's two possibilities, the longer sleeve sticks because it hangs over the end of the front cover or the longer sleeves have extra sharp edges. One thing seems pretty clear, it's probably foolish to replace a working sleeve with a new sleeve. However, even an old sleeve should be inspected carefully to make sure there are no sharp edges.

More on long front cover: I recently purchased an old TR4 gearbox to obtain spare parts. The front cover, a long one, had the same lip around the open end similar to that noted on Murry's. Close examination of the TR4 sleeve and release bearing indicated that the front edge of the sleeve seems to stop just before the front edge of the front cover. The lip seems to be formed due to wear. This lip might cause problems if the front cover is used in a TR250/TR6 with the longer sleeve. From this I conclude one should always cut down the longer sleeve if used in a TR250/TR6, even if there is no interference with the clutch pressure plate spring fingers. The edge should be smoothed to avoid hanging up the sleeve. New front covers are no longer available, so one should not throw out a usable front cover.

A possible cause for the tilt: While doing research on the accompanying article on overhauling the operating shaft I studied the the clutch fork very carefully. I noted that the two fork pins that engage the the release bearing on a new fork had been ground flat but not very carefully, one was deeper than the other. That could cause unequal forces on the two sides of the bearing resulting in a tilt. Once I started to think about that, the fact that the shaft to fork pin is on one side jumped out --- it might allow the side furthest from the pin to flex a little more then the side next to the pin . If that were the case, there would be a greater force on the right side and the back of the sleeve would tend to dig in on the left side. This is exactly what I've observed in every front cover I've examined. Can this be fixed by pinning the fork on both sides, making sure the pins at the top are identical etc? I don't think so, the system is not designed or manufactured to insure perfectly balanced forces. Probably the best way to deal with it is to make sure there are no sharp edges that might grab.