Triumph 4-Speed Gearbox Changes 1968–70

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Table of Contents

Introduction

The Triumph 4-speed gearbox of the late 1960s has been much maligned through the past 50 years. But, in it's day it was a solid workhorse that survived years with very little change. In 1968, 69 and 70, Triumph made a variety of incremental changes. These changes, the first to these parts since 1963, replaced the index plunger spring, index plunger holder, camplate index plunger and gear selector camplate.

Without Service Bulletins, the factory's intent will remain a mystery. Everyone who loves these old bikes knows mysteries are plentiful and stories as to the what and wherefore are even more abundant.

This research and analysis originated from my simple desire to be able to tell one plunger from the next and one spring from another.

It evolved into a quixotic quest to understand what is the best combination of parts to make a rebuilt 4-speed gearbox run and, specifically, shift best.

At some point, I found myself fascinated by why the factory changed the index plunger spring each year during 1968, 69 and 70, when they had made no change to that spring since 1963. What I found doesn't answer the "why," but it is no less useful.

If you read on, there are two things I can offer:

1. A good photographic reference of all of these parts; and,
2. More information about springs, spring rates, and spring force than anyone should be subjected to.

As an aside, I was surprised to find that the spring you think you are purchasing today, from reputable suppliers, are *quite-possibly to very-likely* not what the factory specified. Read on, and at least you will know what to look for. Suffice it to say, you can't judge a spring by its coils.

What follows first is a photographic chronology of the changes year-by-year so you can familiarize yourself with the parts. Then, it's time to jump ahead to what I found. Following that are pages of photo comparisons of one part to the next and tables of calculations used to get to the conclusions I reached.

Parts Used In 1968

From 1963 through 1967 the index plunger spring, camplate index plunger, and gear selector camplate remained the same. The camplate was new for 1968.

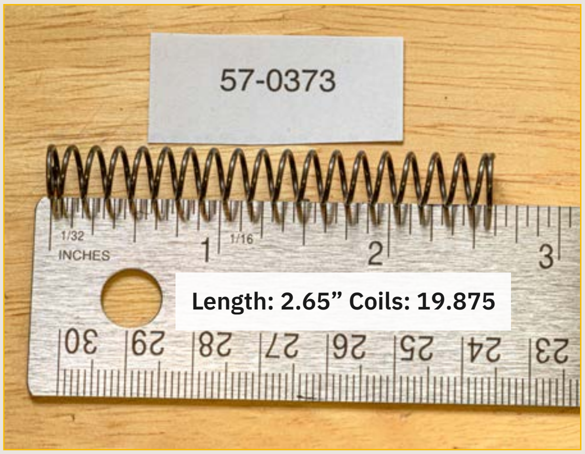


Figure 1: Spring 57-0373 was used for 1963-68 model years

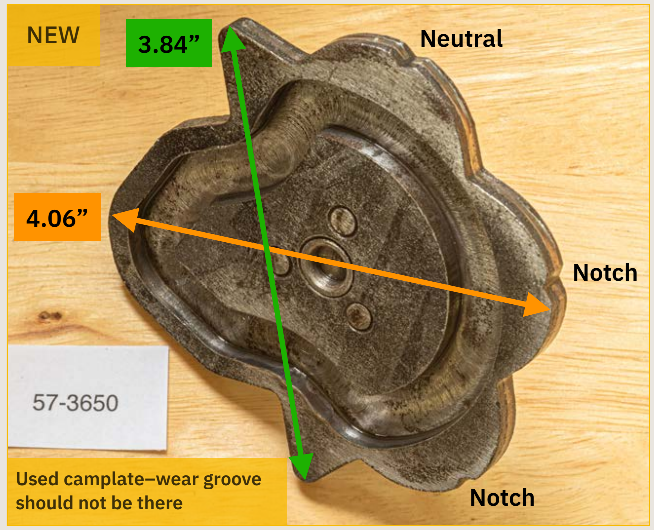


Figure 2: Camplate 57-3650 was new for 1968 and was used part way through 1969 only–notches between gears was unique to this camplate

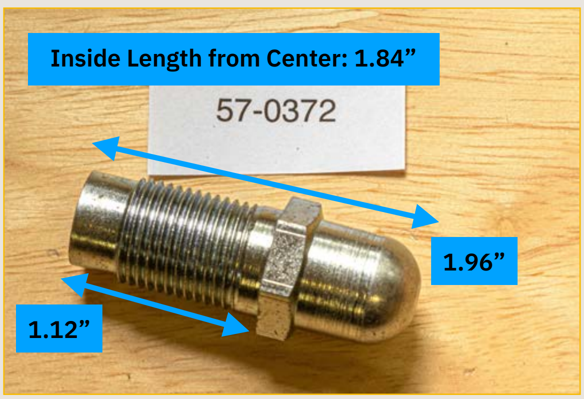


Figure 3: Holder 57-0372 used throughout the '60s was replaced after 1968

1968

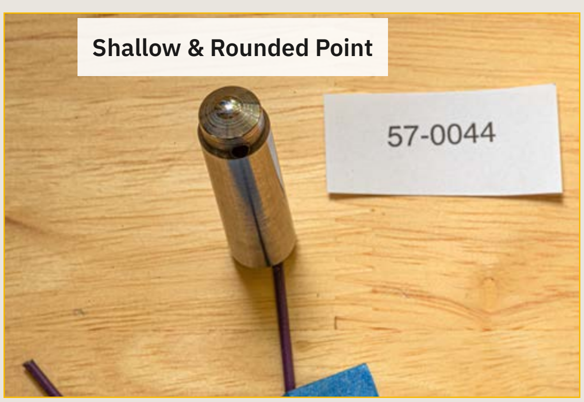


Figure 4: Plunger 57-0044 was used throughout the '60s and replaced after 1968

Figure 5: The deeper machined area and shallow tip distinguish this plunger

Parts Used In 1969

Changes in 1969 saw the introduction of a new spring, holder, plunger and, sometime later in the model year, a new camplate.[1]

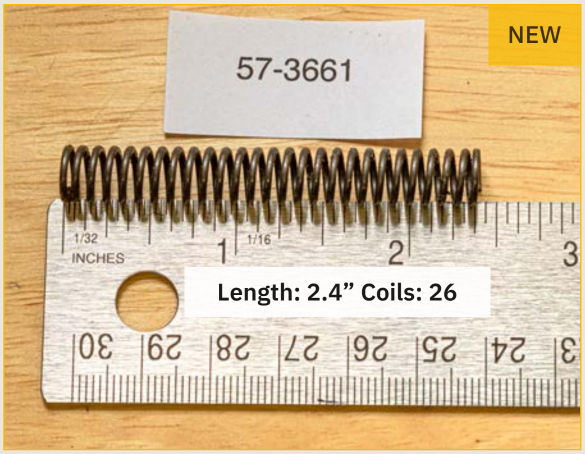


Figure 6: Spring 57-3661 was used in 1969 only

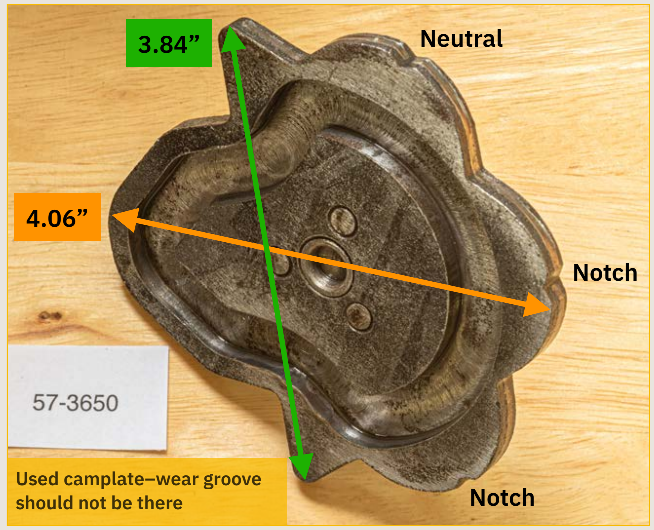


Figure 7: Camplate 57-3650 was used in 1968 and part way through 1969 only–notches between gears were unique to this camplate (see 1970 page for camplate introduced later in ’69)

1969

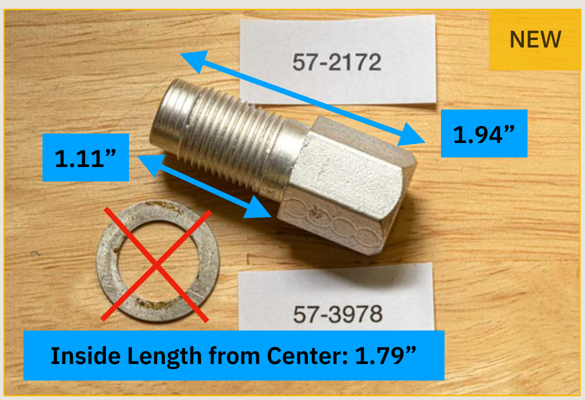


Figure 8: Holder 57-2172 was new for 1969; the washer was not introduced until 1970 models

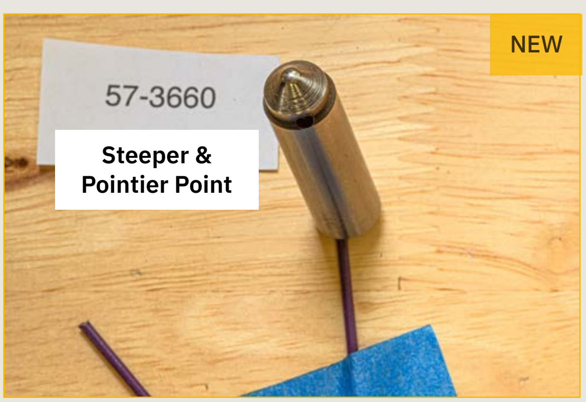


Figure 9: Plunger 57-3660 was new for 1969 and used in 1970

Figure 10: This plunger is the same outside & inside length as the plunger used in 1968

Parts Used In 1970

Changes in 1970 saw the introduction of a new spring; a washer between the holder and the case; and, the carry over of the new camplate introduced late in 1969.

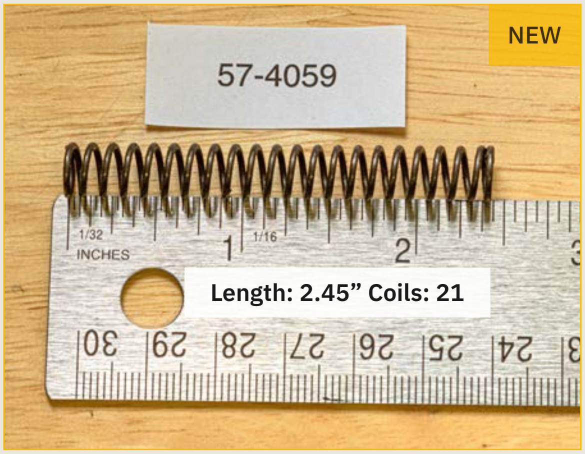


Figure 11: Spring 57-4059 was new for 1970

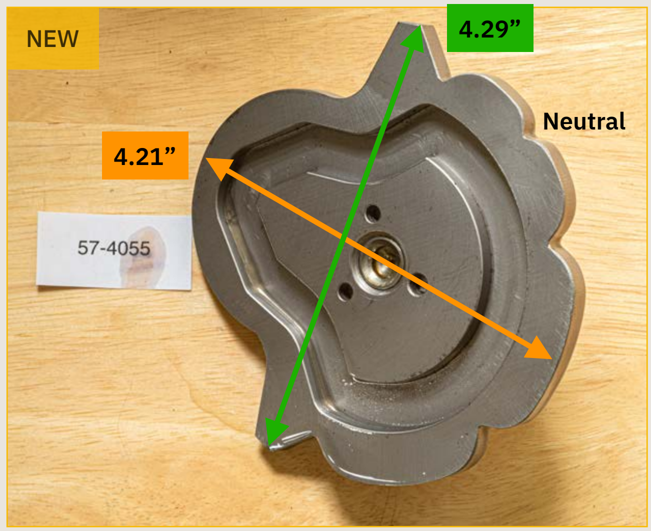


Figure 12: Camplate 57-4055 was new part-way through the 1969 model year; it is larger than its predecessor and does not have notches between the gears

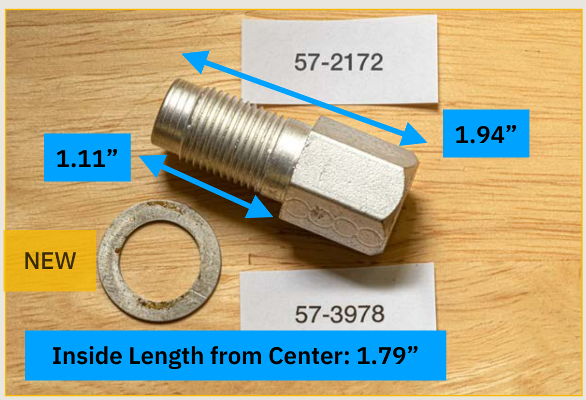


Figure 13: Washer 57-3978 was added in 1970

1970

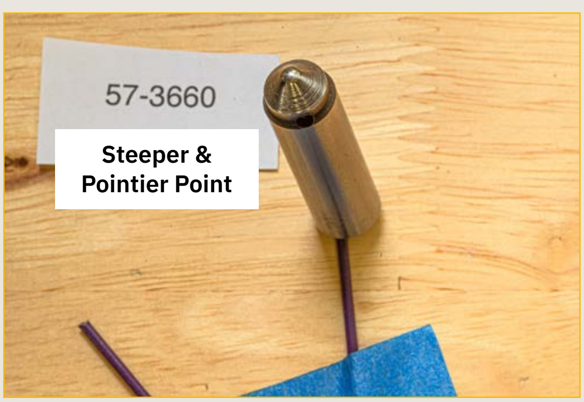


Figure 14: Plunger 57-3660 carries over from 1960

Figure 15: This plunger has a steeper point and a more positive connection with the camplate

A number of knowledgable *old-timers* have graciously helped me with this research. One person, Bruce Miller, aka hermit.cc, has been a great sudo-editor and has implored me to jump ahead, cut to the chase and “spill the beans.”

To that end, what I learned is that when we know a thing called *spring force*, we can make meaningful comparisons. I had thought that just knowing the spring rate would give insight into what the changes were accomplishing. Not so. And, the trouble with spring force: it’s determined by how the spring is operating with the other parts. Consequently, it’s a bit more effort to calculate.

Before reviewing the findings it’s important to understand what spring rate and spring force are.

Spring Rate vs. Spring Force

Spring rate is a common measurement of springs and is defined as *the amount of weight needed to compress a spring one inch*. Spring rates for the springs used in 1968 though 1970 are presented in the table on page 14.

Spring force, in the case of a compressed spring, is *the force exerted by the spring outward*. Spring force is equal to spring rate times the difference between the free length of the spring and the operating length of the spring. The operating length of a spring is its maximum working load. Figure 16 shows the point at which the spring is in its maximum working load.

The table on page 16 shows the calculation of spring force in the different configurations of camplates, holders, and plungers for the four springs used in 1968 through 1970. This can be useful if you want to mix and match parts.

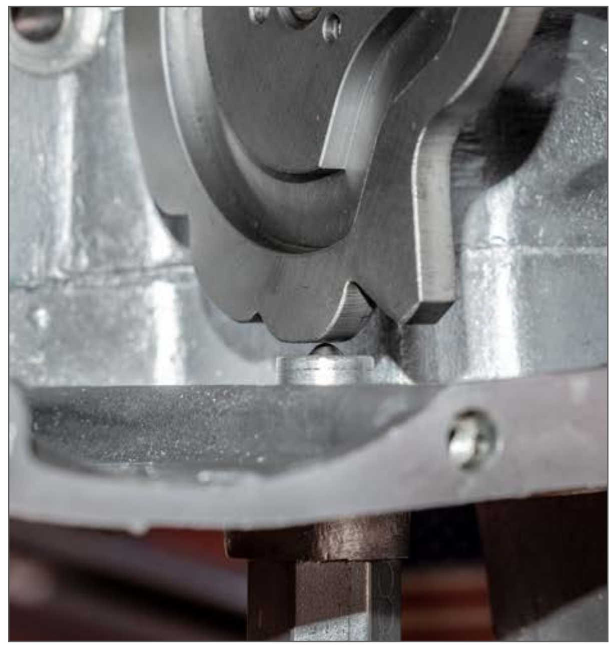


Figure 16: The point at which the camplate is between gear detents is the point at which the spring is at its most compressed state; this is the point of the maximum working load of the spring

In summary, spring rate tells us about the specifications of the spring whereas spring force tells us the effect of the spring working in conjunction with the camplate, plunger and holder.

What follows is a comparison of the configuration of parts for 1968, 69 and 70.

Spring Force for 1968, 1969 and 1970

It seems simple to conclude that spring force of approximately 8.50 to 9.00 is what the factory considered optimal. What is less clear is why they changed the spring again in 1970 and introduced a thin washer between the holder and the engine case. It may be that the washer was to eliminate leaking and the new spring was to compensate for the depth of the washer and the effect it has on spring force (see Appendix 5).

1968	Part No.		Spring Force
Camplate	57-3650	New	
Holder	57-0372		
Plunger	57-0044		
Spring	57-0373		5.01
1969			
Camplate	57-3650		
Holder	57-2172	New	
Plunger	57-3660	New	
Spring	57-3661	New	8.58
Mid-1969			
Camplate	57-4055	New	
Holder	57-2172		
Plunger	57-3660		
Spring	57-3661		9.09
1970			
Camplate	57-4055		
Holder	57-2172		
Washer	57-3978	New	
Plunger	57-3660		
Spring	57-4059	New	8.66

Summary

Fifty years ago engineers at Triumph were undoubtedly after much needed improvements when they made a variety of changes to gearbox parts for the 1968, 1969, and 1970 model years. Without Service Bulletins we are left to draw our own conclusions and here is a summary of mine.

First, the change to the index plunger holder in 1969 seems obvious. The wrench surface on the holder used prior to 1969 was prone to rounding. It was too shallow. A wrench would not get a good purchase and a socket wouldn't go all the way onto it.

Second, when the factory made the top of the camplate index plunger more pointed, it seems likely that they were trying to reduce or eliminate the problem of the false shifts.

Third, and perhaps the most significant was the change to the gear selector camplate. The new plate is larger. This increases the distance between gear detents and it increases the spring force. Additionally, the detents between the gears were removed. And, finally, the detents for each gear are deeper allowing the new camplate index plunger to fit snugly (see page 10). These changes to the new camplate seemly could have the biggest impact on improving the shifting of the 4-speed transmission.

Lastly, the yearly changes to the springs seemed to be an attempt to "dial in" an adequate amount of spring force. The factory appears to have settled on an optimal spring force range of 8.5 to 9.0. Of course, it might be that Triumph engineers skipped the calculations and just tried the springs on test rides until the found the best spring for the job. In that case, this forensic analysis of spring force is really just a way to compare and make sense of the changes.

If you are aren't sure what spring you have, the table on page 14 will help you to measure the spring and even calculate spring force.

The table on page 16 can be useful if you are inclined to mix and match springs with the other gearbox parts. Using the new camplate and plunger with either of the holders will be an improvement and the table shows how spring force changes with different combinations.

Footnotes

[1] David Gaylin, *Triumph Bonneville & TR6 Motorcycle Restoration Guide 1956-1983 Revised Edition,* (Octane Press, 2016), 126.

[2] J R Nelson, *Bonnie The Development History of the Triumph Bonneville 2nd Edition,* (G.T. Foulis & Company, 1998), 190.

Appendices

Appendix 1 – Side-By-Side Comparison – Camplates

Everything about the new camplate looks to provide more positive shifting with less chance of false neutrals.

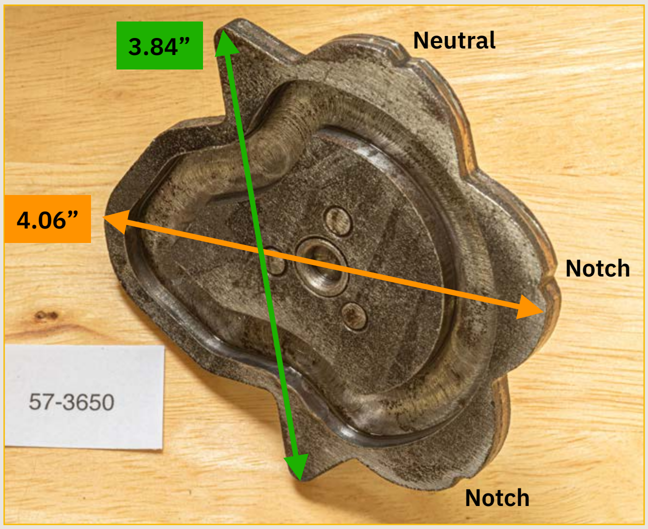


Figure 17: Camplate 57-3650 was used in 1968 and part way through 1969 only–notches between gears were unique to this camplate

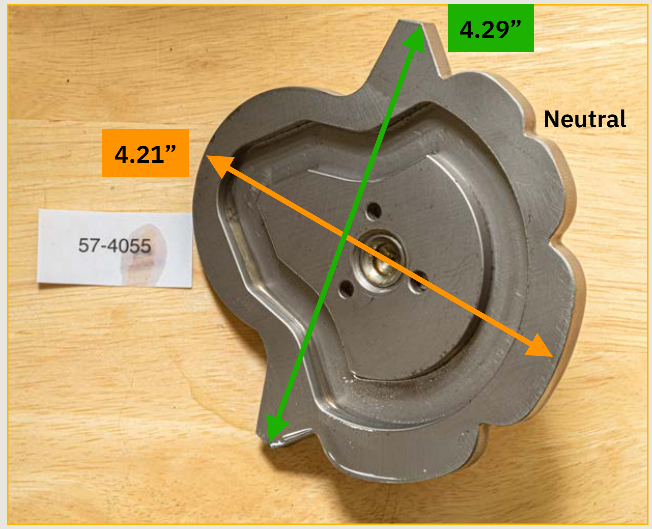


Figure 18: Camplate 57-4055 was new part-way through the 1969 model year; it is larger than its predecessor and does not have notches between the gears

Distance Between Gears
The distance between 2nd and 3rd gear for camplate 57-3650 is 2.14."

Distance Between Gears
The distance between 2nd and 3rd gear for camplate 57-4055 is 2.29." The distance between gear detents and the shape of the camplate must have been part of the attempt to create more positive shifting.

Appendix 1 – Side-By-Side Comparison – Camplates (cont.)

Plunger fit to the camplate detents was an improvement the factory achieved with the introduction of the new plunger in 1969. Figures 18 and 19 below demonstrate that the old plunger fits well in the detents of the old camplate, but fits poorly in the new camplate. The new plunger could be used with either camplate. The new camplate, with its deeper detents, seems to be designed to make the shifting more positive and the gears less likely to jump from one to the next.

Figure 19: Old camplate with new plunder on the left and old plunger on the right; old plunger fits the gear detent better

Figure 20: New camplate with new plunger on the left and old plunger on the right; old plunger *does not* seat well in the gear detent

Appendix 2 – Side-By-Side Comparison – Holders

The old style may look better, but it was difficult to get a spanner on and so it seems plausible that the change to a new holder was to eliminate this problem.

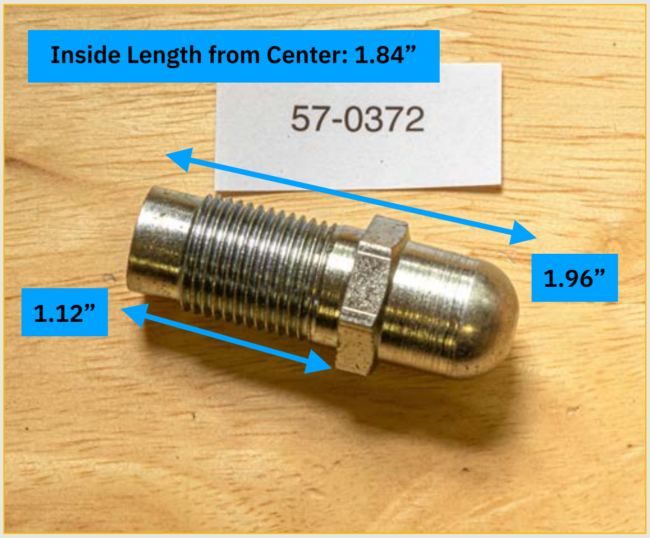
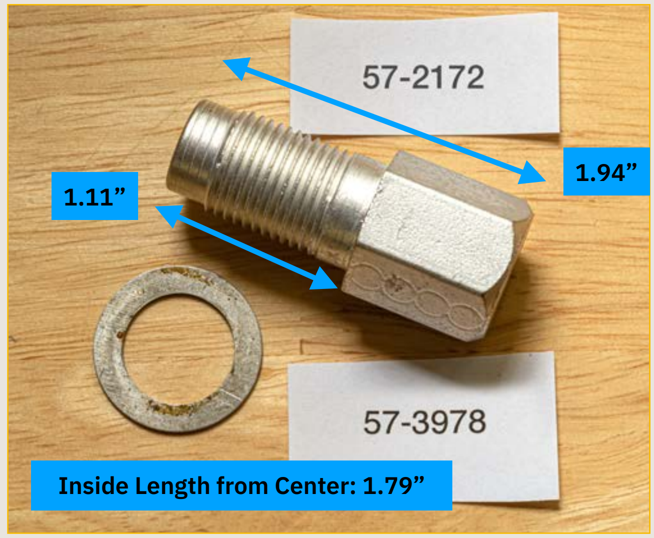


Figure 21: Holder 57-0372 was replaced in 1969–one of the problems was the difficulty to get a wrench or socket on it



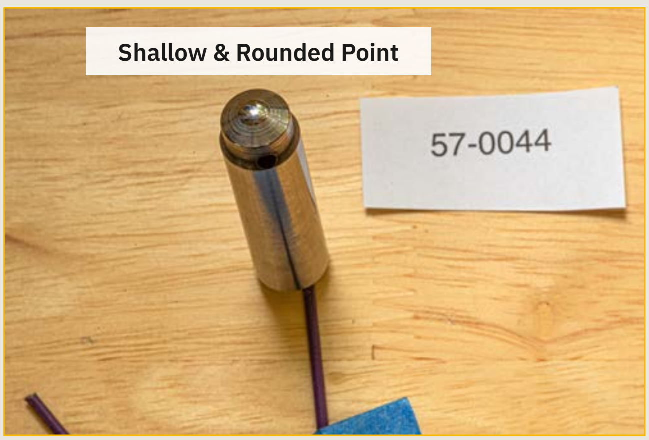
Figures 22: Holder 57-2172 was introduced in 1969 and a companion washer 57-3978 was added in 1970

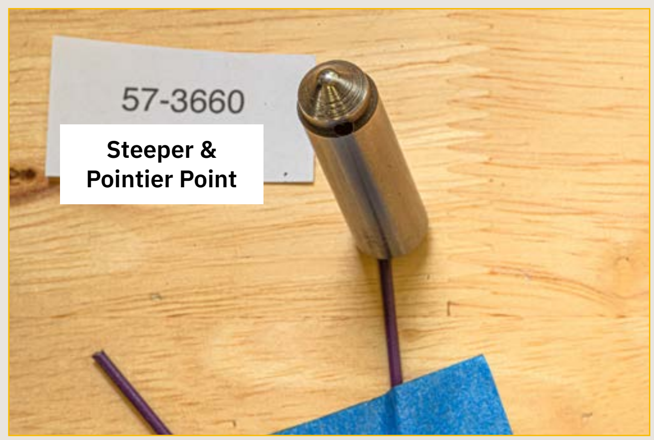
Appendix 3 – Side-By-Side Comparison – Plungers

The machined point is what is different about these two plungers with the newer plunger's deep point improving positive shifting.

Figures 23: Plunger 57-0044 was used in the ‘60s through 1968–it has a deeper machined groove and shallower, more rounded point

Figures 24: Plunger 57-3660 was first used in 1969 and has a shallower machined groove and a steeper point





Appendix 4 – Side-By-Side Comparison – Springs

Springs create the outward pressure needed to make positive shifting possible and to reduce instances of slipping out of gear. It would be easy to assume that “beefier” and more coils is better. Measurements and calculations of spring force is the only way to evaluate one spring to the next.

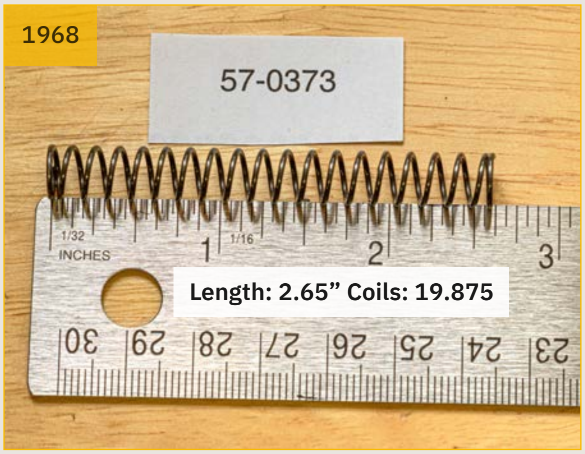


Figure 25: Spring used in 1968–looks weak and submissive

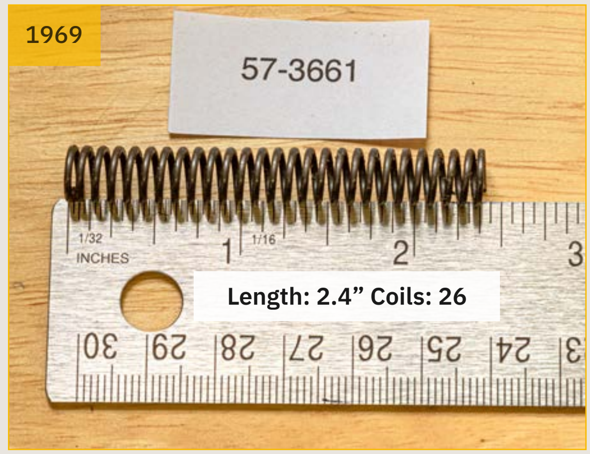


Figure 26: Spring used in 1969–beefy and substantial presence

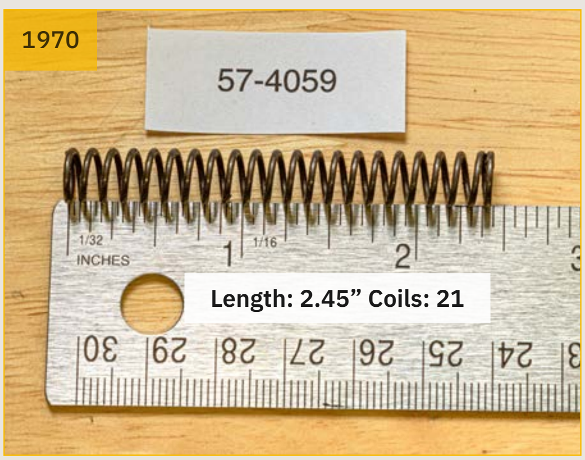


Figure 27: Spring used in 1970–looks a bit like a cross between '68 and '69....

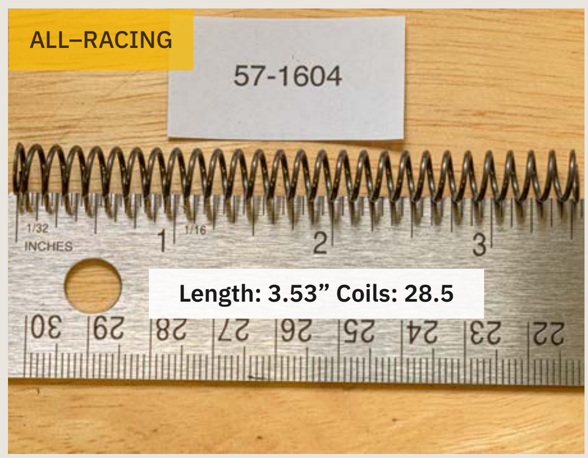


Figure 28: “Stiffer” spring used in all three years (for racing applications)

The stiffer, race-application 57-1604 was the specified spring for 1960, 61 and 62. This is an interesting aside that I am not going to attempt to understand in this analysis. Before 1960 and after 1962, the specified spring was 57-0373 (until the change in 1969).[2]

Appendix 5 – Calculating Spring Rate and Spring Force

The ultimate goal is to know the spring force and to calculate that we need to calculate the spring rate and the operating length of the spring. This table shows the spring rate calculations for the sample group of springs.

SAMPLE GROUP SPRING RATE MEASUREMENTS										
	FREE	SPRING		WIRE	MEAN	SOLID	END	TOTAL	ACTIVE	**SPRING**
PART	LENGTH	OD	ID	DIAMETER		LENGTH	FINISH	COILS	COILS	**RATE**
57-0373	2.6500	0.3380	0.2630	0.0365	0.3015	0.7619	CLOSED	19.875	17.875	**5.2080**
57-0373	2.6100	0.3295	0.2550	0.0350	0.2945	0.7306	CLOSED	19.875	17.875	**4.7247**
NEWLY PURCHASED 57-0373:										
57-0373	2.4350	0.3350	0.2515	0.0390	0.2960	0.8580	CLOSED	21.000	19.000	**6.7490**
57-0373	2.5100	0.3295	0.2510	0.0390	0.2905	0.8580	CLOSED	21.000	19.000	**7.1350**
57-3661	2.4000	0.3350	0.2400	0.0450	0.2900	1.2150	CLOSED	26.000	24.000	**10.0705**
57-3661	2.4535	0.3335	0.2400	0.0450	0.2885	1.2150	CLOSED	26.000	24.000	**10.2220**
57-4059	2.4225	0.3230	0.2360	0.0415	0.2815	0.9130	CLOSED	21.000	19.000	**10.0603**
57-4059	2.4510	0.3250	0.2370	0.0415	0.2835	0.9130	CLOSED	21.000	19.000	**9.8489**
57-4059	2.4760	0.3250	0.2360	0.0405	0.2845	0.8910	CLOSED	21.000	19.000	**8.8340**
57-1604	3.5300	0.3355	0.2490	0.0400	0.2955	1.1400	CLS GRD	28.500	27.500	**5.2822**
57-1604	3.3200	0.3300	0.2470	0.0400	0.2900	1.0800	CLS GRD	27.000	26.000	**5.9172**
CALCULATIONS DEFINED:										
MEAN DIAMETER = OD - WIRE DIAMETER										
ACTIVE COILS FOR CLOSED = TOTAL COILS - 2										
ACTIVE COILS FOR CLOSED & GROUND = TOTAL COILS -1										
SOLID HEIGHT (UN-GROUND) = (1 + TOTAL COILS) * WIRE DIAMETER										
SOLID HEIGHT (GROUND) = TOTAL COILS * WIRE DIAMETER										
SPRING RATE = POUNDS/INCH TO COMPRESS SPRING 1"										

Appendix 5 – Calculating Spring Rate and Spring Force (cont.)

The operating length of the spring is the length at the spring's maximum working load (see Figure 16). Maximum working load is the point at which the spring is depressed as far as it will be depressed by any movement of the camplate.

To calculate the operating length of the spring I measured from the outside edge of the case to the camplate (1). I added the amount of space inside the holder that sits below the outside edge of the case (2). From that I subtracted the point of the plunger where there is no spring (3). And, finally, for 1970, I added the depth of the washer that is positioned between the holder and the case (4).

CALCULATING THE OPERATING LENGTH OF THE SPRING						
PARTS CONFIGURATION:	1968	O/O/N	1969	N/O/N	MID-69	1970
CAMPLATE	57-3650	57-3650	57-3650	57-4055	57-4055	57-4055
HOLDER	57-0372	57-0372	57-2172	57-0372	57-2172	57-2172
PLUNGER	57-0044	57-3660	57-3660	57-3660	57-3660	57-3660
(1) CASE TO CAMPLATE	1.23	1.23	1.23	1.18	1.18	1.18
INSIDE HOLDER	1.81	1.81	1.75	1.81	1.75	1.75
OUTER LIP TO HOLDER TOP	1.12	1.12	1.10	1.12	1.10	1.10
(2) SPRING BELOW CASE	0.69	0.69	0.64	0.69	0.64	0.64
(4) WASHER 57-3978						0.03
PLUNGER LENGTH	1.59	1.59	1.59	1.59	1.59	1.59
INSIDE SPRING AREA	1.29	1.27	1.27	1.27	1.27	1.27
(3) NO SPRING IN PLUNGER	0.30	0.32	0.32	0.32	0.32	0.32
SPRING OPERATING LENGTH	**1.62**	**1.60**	**1.55**	**1.55**	**1.50**	**1.53**
PARTS CONFIGURATION "O/O/N" MEANS OLD CAMPLATE, OLD HOLDER AND NEW PLUNGER						

Appendix 5 – Calculating Spring Rate and Spring Force (cont.)

Calculating spring force is the free length of the spring less the operating length of the spring times the spring rate.

Knowing the spring force allows for the comparison of the changes to index plunger spring, index plunger holder, camplate index plunger and gear selector camplate for the 1968, 69 and 70 model years. Further, it provides the opportunity to see what combinations of these parts can be substituted to accomplish the desirable spring rate and shifting experience.

CALCULATING SPRING FORCE						
PARTS CONFIGURATION:	1968	O/O/N	1969	N/O/N	MID-69	1970
CAMPLATE	57-3650	57-3650	57-3650	57-4055	57-4055	57-4055
HOLDER	57-0372	57-0372	57-2172	57-0372	57-2172	57-2172
WASHER						57-3978
PLUNGER	57-0044	57-3660	57-3660	57-3660	57-3660	57-3660
57-0373 SPRING FORCE	**5.01**	5.12	5.34	5.36	5.59	5.45
RECENTLY PURCHASED 57-0373	5.91	6.06	6.37	6.40	6.72	6.52
57-3661 SPRING FORCE	7.91	8.12	**8.58**	8.62	**9.09**	8.80
57-4059 SPRING FORCE	7.82	8.02	8.45	8.50	8.93	**8.66**
57-1604 SPRING FORCE	10.10	10.22	10.47	10.50	10.75	10.59
SPRING FORCES IN **BOLD** ARE THE FACTORY SPECIFIED PARTS CONFIGURATION						
PARTS CONFIGURATION “O/O/N” MEANS OLD CAMPLATE, OLD HOLDER AND NEW PLUNGER						
57-1604 WAS A STIFFER ALTERNATE SPRING GENERALLY RECOMMENDED FOR RACING USE						

Appendix 6 – Picturing Spring Force

It's tough to picture spring force because under pressure a spring is encapsulated by something that is helping it to create force. In this case, the holder and the plunger are containing the spring with the plunger's movement being restricted by the camplate.

Spring force is the force being exerted by the spring under compression. To calculate spring force, spring rate is multiplied by the difference between the free length of the spring and the operating length of the spring.

Figures 29 below depicts the configuration of parts for 1968. This photo demonstrates how the operating length of the spring is greater than that pictured in Figure 30 which contains the specified parts for 1970. (Missing from Figure 30 is the washer that was specified for 1970.)

The operating length of the spring is determined by the available space within the holder and the plunger when they are depressed by some point along the camplate. So, as the operating length of the spring decreases, the spring force increases (for the same spring).

Figure 29: Old camplate, old holder, and old plunger

Figure 30: New camplate, new holder, and new plunger

Appendix 7 – Clearance of Index Plunger Holder

The Camplate introduced in 1970 (57-4055) is larger and shaped somewhat differently than the predecessor camplate (57-3650). Consequently, care should be taken to check that the new Camplate does not contact the top of the Index Plunger Holder. This is especially true when the the new Camplate is used in 1968 or 1969 cases. But, in all cases the Plunger, Spring, Holder Washer and Index Plunger Holder should be pre-fit. If contact occurs between the Camplate and the top of the Index Plunger Holder the top of the holder must be ground or machined down to provide adequate clearance.

Figure 31: Old camplate, old holder, and old plunger for reference of clearance

Figure 30: New camplate, new holder, and new plunger; holder edge may contact camplate and affect shifting