Retrofitting a Roller Cam into a Vintage Block (Part 2)

(by Joe Randolph, 9-5-2016)

Introduction

In Part 1 of this article, I explained that it is possible to install a roller cam in a vintage Corvette engine that originally used a flat tappet cam, but it is more expensive and more complex than simply using an OEM-style flat tappet cam. Most of Part 1 was focused on explaining the performance advantages of roller cams. The performance benefits are subtle, and for most owners of vintage Corvettes these advantages may not justify changing to a roller cam.

For those who decide they want to make the change to roller cam, there are some installation details that need to be addressed. These were described briefly in Part 1, and will be discussed in more detail here in Part 2.

Installation Details

There are three installation details that need to be carefully addressed when retrofitting a roller cam:

1) The retrofit kits require that you install what is called a “cam button” in the center of the cam gear. The purpose of the cam button is to prevent “cam walk”, which is the possibility for the cam to move fore and aft in the block along the cam’s axis of rotation.

2) Most roller cams are made from a harder material that makes the cam’s distributor drive gear incompatible with the standard cast iron driven gear on a vintage distributor.

3) If your roller cam is an aggressive performance cam, the faster ramps on the cam lobes will add stress on the entire valve train. You may not be able to stick with the vintage valve train components.

Installing a Cam Button

The conventional wisdom is that for flat tappet cams, the lifters and lobes are ground in such a way that there is an inherent rearward thrust on the cam that prevents the cam from walking forward. If you have ever replaced a flat tappet cam in a vintage Corvette engine, you may recall that there is nothing obvious that prevents the cam from walking forward until it hits the timing cover.

Aside from unwanted contact with the timing cover, cam walk affects the position of the distributer shaft and hence, the ignition advance. If the cam walks forward in the block, it advances the ignition timing. So, the conventional wisdom states that a cam button must be installed in order to maintain stable ignition timing.

After studying the concept of cam walk and reading what I could find on the topic, I think this alleged problem is overstated. Even without the rearward thrust created by flat tappet lifters, the resistance of the oil pump also creates a rearward thrust on the cam. I cannot think of anything going on in the engine that would counteract the oil pump resistance enough to make the cam walk forward. There are a few contrarians on the internet who claim they never use a cam button and they never have problems. These folks are greatly outnumbered by those who claim that leaving out the cam button, or putting it in but with too much clearance, will lead to dire consequences.

I tend to side with the view that the cam button is not as important as most people say, but I was not sufficiently confident about this to take chances with my engine. So, I went through the steps to install a cam button and adjust its length to achieve the desired .005” clearance between the cam button and the timing cover. Figure 2 shows the nylon cam button installed in the center of the cam gear. Steel cam buttons with roller tips are also available.

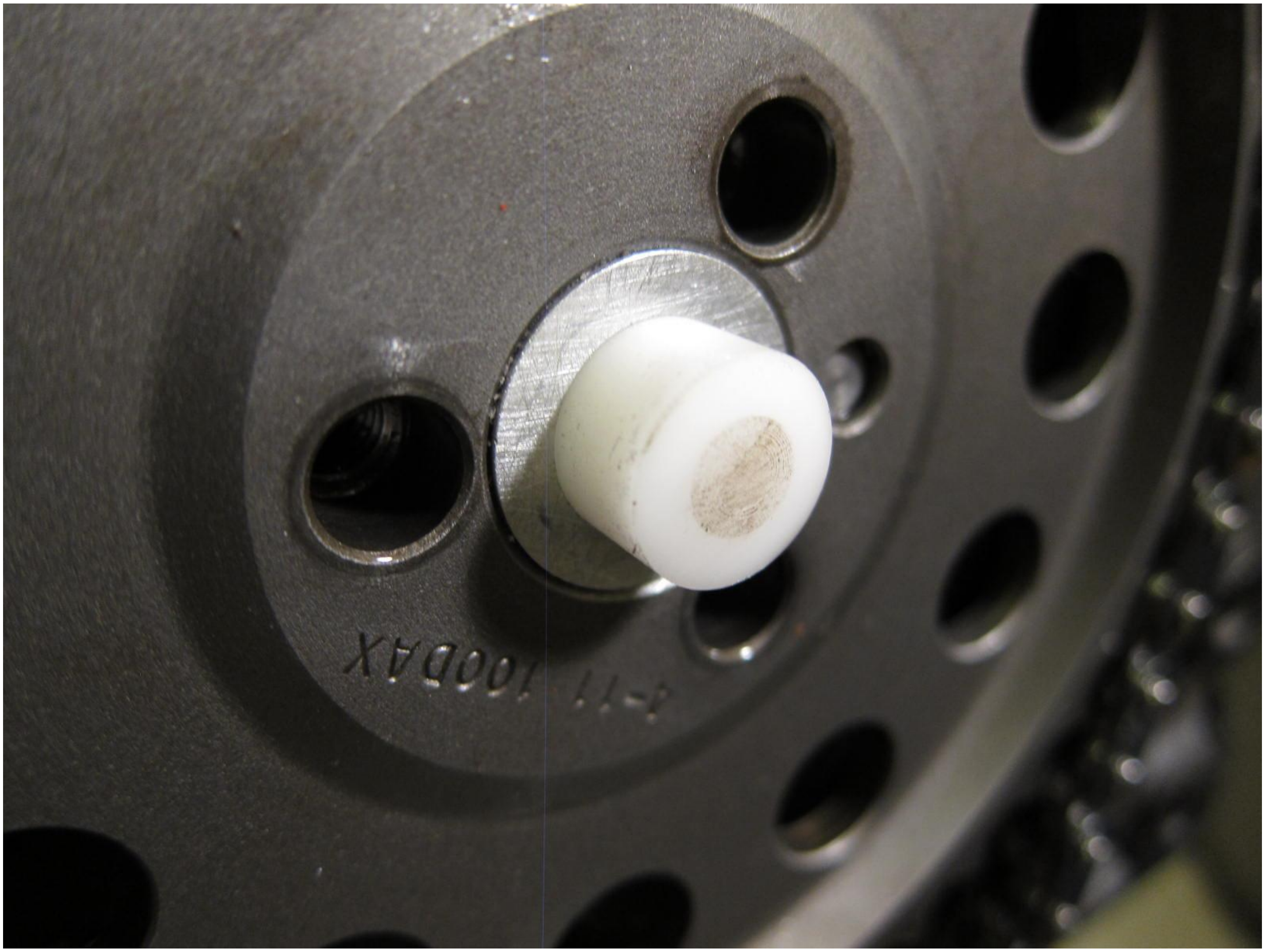

Figure 2: Cam Button Installed

In the process of fitting the cam button, I made a series of careful measurements and gathered the following information that may be of interest to anyone considering the cam button problem:

1) For every .010” that the cam walks forward in the block, the ignition timing advances about two degrees.

2) If the cam walks forward and the cam button presses against the OEM stamped steel timing cover, the timing cover will bow outward, allowing more cam walk than expected. I found that pushing the cam forward with a force of about 50 pounds flexed the timing cover out by .030”.

3) To reduce this potential flexing, I designed a three-legged stiffener that was as large as I could fit into the recesses of the timing cover, and had it water-jet cut from a piece of 1/8” steel plate. Figure 3 shows this part welded into the timing cover.

4) This stiffened the timing cover so that the deflection with a 50 pound force on the cam button only deflected the cover by .010”, as opposed to .030” without the reinforcement.

As described at the outset, I am not convinced that any of this was necessary. And, if it is necessary because of some unknown force on the cam that I have failed to take into account, I'm not convinced that what I did was sufficient to counteract this unknown force.

All I can say is that a lot of people think stiffening the timing cover is important, and I stiffened my cover to be equal to or better than most of the stock-appearing solutions I have seen. The entire effort may have been a waste of time, but having the stiffener there does no harm.

Note that if NCRS-correct appearance is not required, there are aftermarket timing covers made from cast aluminum that flex very little. Some of these also have an external adjustment for setting the cam walk clearance. This saves considerable time compared to the tedious process of fitting a cam button.

Figure 3: Timing Cover Reinforcement

Distributor Gear

Another issue with roller cams is potential incompatibility between the distributer drive gear on the cam and the driven gear on the bottom of the distributor. This is another area where there is a lot conflicting information.

Apparently, OEM vintage cams were made from a particular type of cast iron, and this same material was used for the gear on the distributor. This combination worked fine with both gears showing little or no wear after 100,000 miles. Most aftermarket flat tappet cams are made from a similar cast iron material.

Unfortunately, most aftermarket roller cams are made from a harder steel alloy. The harder alloy drive gear can rapidly chew up the OEM cast iron gear on the distributor, especially if the distributor is driving a high-pressure, high-volume oil pump.

You would think that by now the aftermarket cam industry would have conclusively solved this problem and it would be easy to just use their recommended solution. Unfortunately, the situation remains a bit murky. Some vendors happily recommend using a brass gear on the distributor, without mentioning that the brass gear is essentially a sacrificial part that wears out in a few thousand miles of driving. The main advantage of the brass gear is that it protects the drive gear on the cam. Another option is to use a distributor gear made from a high-strength composite plastic material. These reportedly last longer than brass gears, but there is not much information available on their longevity.

After much research, the solution I used was to purchase a GM part number 10456413 distributor drive gear. This is an iron gear with a special "Melonized" surface treatment that supposedly makes the distributor gear hold up when used with a roller cam drive gear. This is the drive gear that GM used for the generation of small blocks that had both roller cams and distributers. Time will tell whether this solution works with my aftermarket roller cam.

It should be noted that the aftermarket cam industry offers an extra-cost option of having a traditional cast iron drive gear pressed onto a steel roller camshaft. In theory, this completely eliminates the incompatibility between the drive gear on the cam and the OEM driven gear on the distributor. If I had it to over again, I think I would pay the extra cost for this option, just to avoid all the confusion and uncertainty that surrounds the topic of distributor gear compatibility.

Stiffening the Valve Train

An unavoidable side effect of having faster ramps on the cam lobe is that it creates more stress on the valve train. When opening the valve more quickly, the pushrod and rocker experience more stress from the rapid acceleration. To keep the valve in contact with the rocker as the valve closes, stiffer valve springs are required. This further increases the load for opening the valves.

If the roller cam ramps are not very aggressive, simply changing to slightly stiffer valve springs will usually be sufficient, and the OEM valve train can remain otherwise unchanged. However, the OEM pushrods and rockers will be working harder than they were originally designed to do.

If the ramps are very aggressive and the required springs are very stiff, some valve train upgrades will be necessary (note that this statement is also true for aggressive flat tappet cams). The pressed-in OEM rocker studs should be converted to screw-in studs, and the pushrods and rockers should be upgraded to handle the additional loads.

In my case I decided to be conservative and upgrade the entire valve train. I installed stiffer valve springs but used the so-called "beehive springs" that provide adequate valve control with less spring pressure than conventional dual valve springs. I also installed stiffer pushrods, pushrod guide plates, screw-in rocker studs, and full-roller rockers.

For converting to roller rockers, a key challenge was figuring out a way to make them fit under the stock valve covers. An easy solution is to use extra-thick aftermarket valve cover gaskets or aluminum spacers, both of which are readily available aftermarket parts. In my case, though, I wanted to maintain an NCRS-correct L79 appearance using the OEM aluminum valve covers and thin cork gaskets.

Some internet research revealed that the main reason roller rockers do not fit under stock valve covers is not due to the rocker itself. Rather, the tall rocker stud and associated adjustment nut are what hits the OEM valve cover.

I made a template of the 2.25" inside clearance of the stock valve cover and confirmed that the adjustment nut was the only problem. I reduced the overall height of the adjustment nut by making careful modifications to both the stud and nut.

When considering this type of stud/nut modification, it is very important to finalize the required height of the rocker before any changes are made to the stud/nut arrangement. The correct height of the rocker is dictated by the valve height, the cam, and the pushrod length. Pushrod length must be carefully selected to ensure that the contact pattern of the rocker's roller tip is centered on the tip of the valve stem. So, this setup procedure must be completed first, in order to determine how much the rocker stud can be shortened.

Figure 4 shows the end result. The template shows that the valve cover clears the rockers by a comfortable margin even with no gasket at all.

Summary

Converting a vintage flat-tappet engine to use a roller cam is possible, but it is more complicated than simply purchasing an aftermarket retrofit roller cam kit. None of the required installation steps are difficult, but some are time consuming and can be a bit tedious.

Other than possible concerns about continued access to oil that contains ZDDP, the only reason to convert to a roller cam is to maximize lift while maintaining low enough duration and overlap for good street manners. In general, you can get most of the potential performance gain by simply using an aftermarket flat tappet cam that has aggressive ramps, although this type of cam still requires upgrades to the valve train.

For maximum performance gain and elimination of the need for oil that contains ZDDP, a roller cam and roller rockers can be successfully hidden inside a vintage engine that is externally 100% NCRS correct.