Supercharge! Chapter 5

SUPERCHARGING YOUR VOLVO CHAPTER FIVE: "HOLY PULLEYS, BATMAN!"

by Greg Sievert

In the last instalment, I discussed the process of plumbing the intake system for the supercharger. At this point, basically the only thing keeping us from having a boosted engine is the fact that there is nothing driving the supercharger. Unlike a turbocharger, the supercharger is powered by a belt drive off the front of the engine crankshaft, just like the rest of the engine accessories (A/C compressor, power steering pump, alternator, etc.). This chapter explains how the belt drive for the original accessories was modified, and how the supercharger drive pulley, belt and tensioner were developed.

On all 240-model Volvos, the belts are "Vee" belts that run in single-groove pulleys. In the case of the later 240-series Volvos, the accessory drive provides redundant belts (ie. 2 belts) for the alternator and water pump/cooling fan. Being the most critical components for operation of the car, this was a wise set-up that Volvo chose, and obviously driven by the engineer's desire for improved reliability. A third belt runs from the crank pulley to the A/C compressor, and a fourth belt drives the power steering pump off the A/C compressor pulley. See Figure 1 for a schematic of the standard 1988 Volvo 240 belt routing. Effective with the B230E and F engines, the accessory mountings were modified to enable easier adjustment and replacement of the belts. On earlier engines (B21 & B23), adjustment for the A/C belt was done via adjusting shims on the crankshaft pulley. This was a rather poor method of adjustment, and quite cumbersome. The newer engines provide full adjustment of each accessory via a slide mechanism controlled by a screw. Tensioning the belts is as easy as slackening a bolt or two and winding in or out the adjustment screw for the accessory. The newer Volvo engines switched to a ribbed vee belt (often called a serpentine belt) similar to most modern cars. In this case, all accessories are driven by one long belt that is usually self tensioning via a spring-loaded tensioner pulley. Unfortunately the 240's never saw this set-up. Or maybe it was fortunate, as the redundancy of the 240 belt drives probably makes it more reliable than the single serpentine belt system (if the belt breaks - you lose everything and walk home!)

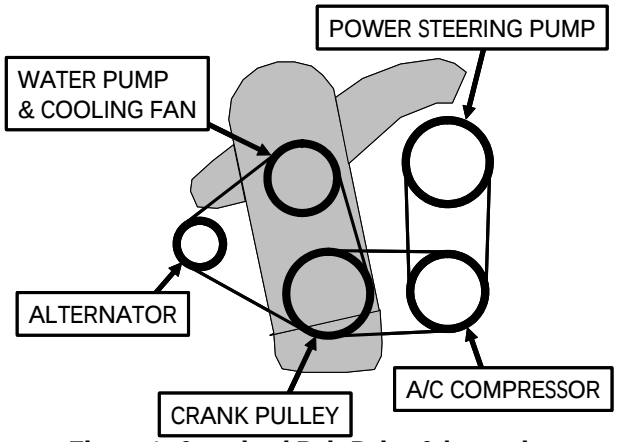

Figure 1: Standard Belt Drive Schematic, 1988 240 with B230F Engine

In Chapter 3, I detailed the mounting of the supercharger, and I described how I had moved the power steering pump over to the exhaust side of the engine. The supercharger is positioned where the A/C compressor normally resides, and the A/C compressor was moved into position above the supercharger. In this case, there is still redundancy of belts for the alternator and water pump/fan. The only difference is that one of the belts now also wraps around the power steering pump pulley. The A/C compressor is still driven by its own belt, albeit longer than the original belt due to the new position high on the inlet manifold side of the engine. See Figure 2 for the new schematic.

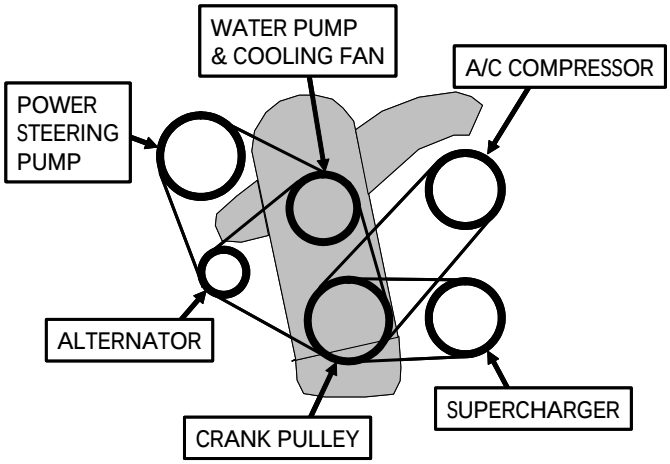

Figure 2: Belt Drive Schematic with Supercharger

Because of the supercharger pulley design and the load requirements to drive it, a 5-rib vee belt is used. The supercharger is rigidly mounted to the engine, so belt tension is done via a separate tensioner pulley. The first step in design of the pulley drive system for the supercharger is selecting the crank pulley diameter. The boost pressure is directly related to how fast the supercharger turns, therefore a larger crank pulley will result in more boost, and a smaller pulley less boost. Prior to starting this project, I purchased a book called Supercharged by Corky Bell. In the book, detailed equations are provided to help identify the correct pulley diameter based on engine size, supercharger displacement, efficiencies, desired horsepower, etc. I created an Excel spreadsheet to run through the calculations based on conservative boost pressures, and decided I needed to find a crank pulley that was about the same size as the supercharger pulley (eg. I wanted to drive the supercharger at about the same speed as the engine). So the search was on for a pulley, and of course I started at Pick-a-Part! What I needed was a 5-tooth vee belt pulley approximately 125 mm in diameter. I found that the Ford Telstar had a crank pulley of 130 mm diameter, and it was easily removed without a gear puller or special tools. There are 2 types of crank pulley on the Telstar, the first being a cast iron pulley and the second a pressed steel pulley. I chose the pressed steel pulley for lighter weight and I figured that it probably would hold up OK given the modest loads I was expecting. I also found that the Telstar had a simple screw-adjustable belt tensioner with a flat mounting plate, so

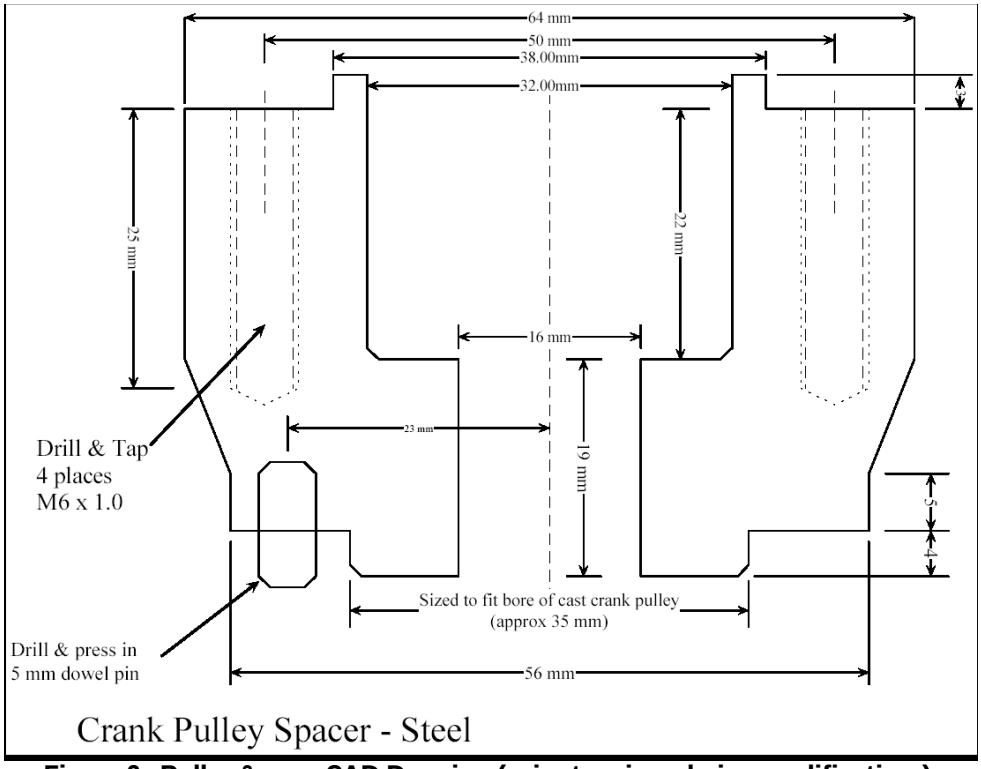

Figure 3: **Pulley Spacer CAD Drawing (prior to minor design modifications)**

I grabbed one or two of these to try out as well.

The main difficulty in setting up the pulley was that I needed some way

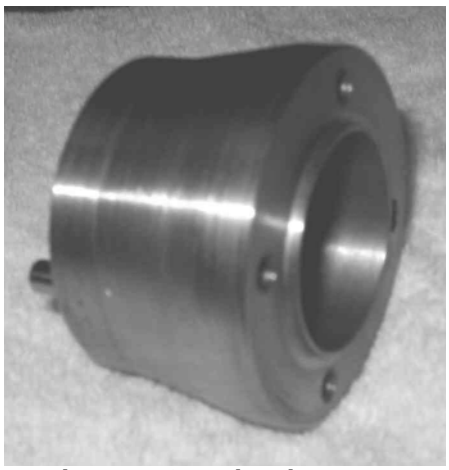

Figure 4: **Completed Spacer**

to mount it in front of the original Volvo crank pulley. For this, I designed up a spacer that could be easily fitted between the Volvo pulley and the Telstar pulley (See Figure 3). Unfortunately I don't have a lathe, so I contracted with a friend of a friend from work who did the job for 2 slabs of VB! The spacer came out perfectly (See Figure 4), and he even suggested a few revisions to my original design to simplify things. I mounted the spacer and the Telstar pulley to the original Volvo crank pulley and things were looking great (see Figure 5).

The next step involved bolting the whole pulley assembly back onto the Volvo crankshaft, then selecting a belt of the correct length. I measured the belt length approximately using a tape measure, and bought a length that was very close from Super Cheap (they have all the belts on display and you can choose your own to suit). I fitted the belt, which was of course loose on the pulleys because of the lack of a belt tensioner. I had planned to use the Telstar tensioner pulley from the start, so I had considered this when I designed the supercharger bracket. This made things pretty easy, as I only had to cut another small piece of thick aluminium to bolt to the bracket, then mount the tensioner in place. It took some mucking around, but I finally was able to find a suitable location for the tensioner that worked well (see Figure 6). Being lazy, I opted not to remove

Figure 5: **Crank Pulley Assembly**

the entire set-up to drill the mounting holes into the supercharger bracket, so I ended up purchasing a cheap right-angle drill attachment that allowed me to drill the holes in situ.

With all that done, it was time to try out the supercharger to see if it actually worked without making any strange noises. Because the supercharger has a magnetic clutch like an A/C compressor, I hot-wired the clutch to the positive battery lead and a fused switch. I started the engine and flipped the switch, hoping for the best. Being a Toyota part (no doubt designed for ultimate reliability), it came to life with only the faint whirring noise of the rotors spinning in the casing. Success!

I know the suspense is killing everyone, but I'll stop here and save some for the next chapter: The Fuel Pressure is On. In this chapter, I'll talk about the necessity for delivering more fuel to the boosted engine, and how this was accomplished by fooling the original computer. Until then, happy motoring! Any questions or comments, feel free to Email me at gsievert@tpg.com.au

Greg

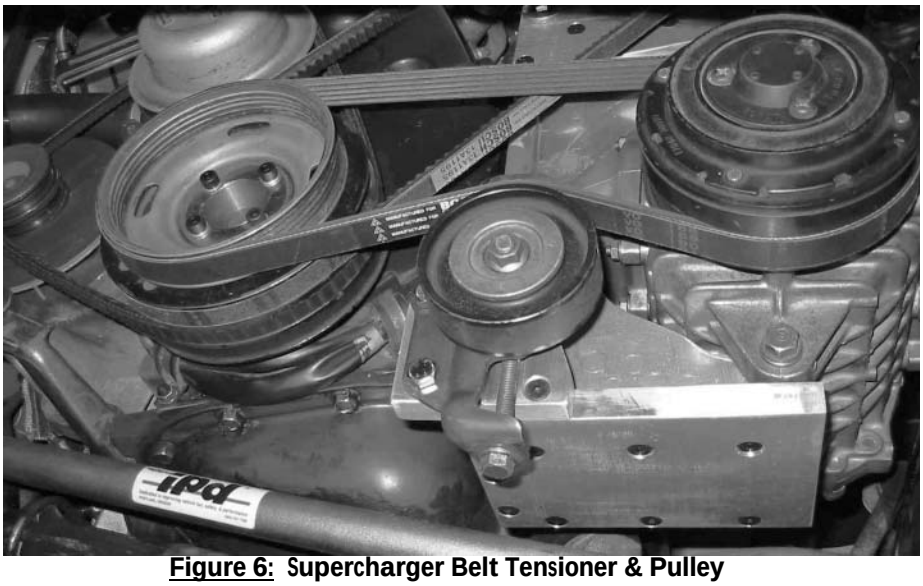

Figure 6: **Supercharger Belt Tensioner & Pulley**