

Project 44 — Crankshaft Project/Dave Glemming

Equipment

Lathe and Mill (Sherline) including;

- riser blocks, rotary table, mill vise, tilting angle table, wood tool rest,
- small wood turning tools, wood file, metal file, sandpaper, sealer and paint.

Why These Crankshafts

I once owned a used Porsche 911S years ago. Very remarkable car. I started the design based on engine details from the web. There was a lot of data, dimensions and pictures for Porsche crankshafts. Getting data for the Ferrari was harder until I found a picture of a Ferrari V-12 model 812 7-liter crankshaft (6496 cc).

I picked the Ferrari V-12 to have something quite different from the Porsche boxer engine crankshaft. Future crankshaft model thoughts are a standard V-8 and a flat plane crank V-8.

Approach

My Sherline mill and lathe are not CNC equipped. It would be very difficult to machine the crankshaft in one piece even with CNC. I opted for the modular approach and started with wood with the intention to make them out of Aluminum after experimenting with wood.

Material:

Hardwood dowels.

Design:

I often use Power Point to quickly lay out simple designs. It's quick and easy to design parts. I have also used design software, but it was overkill for this project. The Ferrari webs were a more complex design process. These crankshafts are 1/4 scale.

Modular approach:

The crank webs were the most complicated parts to draw and machine.

Crank webs were turned from wood dowels to the design diameter, center drilled for the crankshaft journal location pin, then offset drilled for the connecting rod journal location pin. I then cut them on a bandsaw and finished them to the correct thickness.

They were then stacked on a center bolt (1/4-20) and a 10-32 offset bolt (connecting rod journal) to hold them all together. The center bolt was placed into a three-jaw chuck attached to a rotary table to do the web profiling on the mill. I used a machinist jack on the free end of the center bolt to support the webs while doing the machining.

I roughed out the shape using an end mill and did the final shaping with hand files and sandpaper.

NOTE: I made two Aluminum templates for making the complex Ferrari crank webs. These templates were placed on both ends of the stacked webs to use as a guide.

The crank and connection rod journals were turned to diameter, cut to a rough length, faced to the correct length and then center drilled. Drill for 10-32 machine screws for the rod journals and 1/4-20 bolts for the connecting rod journals.

Location pins to go into the rod journals were turned and faced to length. The crank journal pin was turned to .245" diameter and cut to a rough length for assembly. To be trimmed at final assembly.

Extra connecting rod journals were made to use as spacers during assembly to keep the crank webs parallel.

Both crankshafts required gears for the cam chain drive. I tried an Oak dowel first but it split. I tried Delrin but it had ragged edges from machining and melting (see Figure 4).

I then made the final three gears out of Aluminum. I could not make the correct number of gear teeth with my available 1/16 end mill, but the gears were close to the correct diameter and looked decent.

I turned the flywheel mounting hub, drilled the flywheel bolt pattern and center drilled for the crank shaft locating pin using the rotary table.

I turned the end piece for each crankshaft and center drilled for the crank shaft locating pin

Assembly

I glued up two webs with the connecting rod journal, locating pin and spacer using a clamp until set. Note that the locating pins should be flush with the outside

Using the long crankshaft locating pin (length of the crankshaft – cut long). First glue on the end piece. Next slide the first web set assembly onto the locating pin and glue. Keep the extra web spacer in place to aid the assembly and maintain proper alignment. This starts the reference for the next web location. Slide on a crank journal and glue. I used the locating pin held in the three-jaw chuck to rotate it 120 degrees for the next web set. Follow this same order until the last web set is in place.

Use a sealer, re-sand and then paint. I used 'Steel' color hobby paint.

It would be inviting damage or breakage if the crank shafts were left to lay around unprotected.

I made a display stand per the attached picture (see Figure 11).

I will repeat this process using Aluminum.

When doing the research for the crankshaft dimensions, I was curious about the relationship of crank shaft firing order to crankshaft throw. I spent some time using mock ups on the rotary table to be sure I understand the relationship. It's an easy way to check the for the proper angular orientation of each of the web sets.

- Firing order for the Porsche Boxer 6-cylinder: 1, 6, 2, 4, 3, 5,
- Firing order for the Ferrari V-12, 65 degrees: 1,7,5,11,3,9,6,12,2,8,4,10.
- Both have 120-degree phasing between major crank throws. (0, 120, 240)

Thank you,
Dave Glemming
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Ferrari

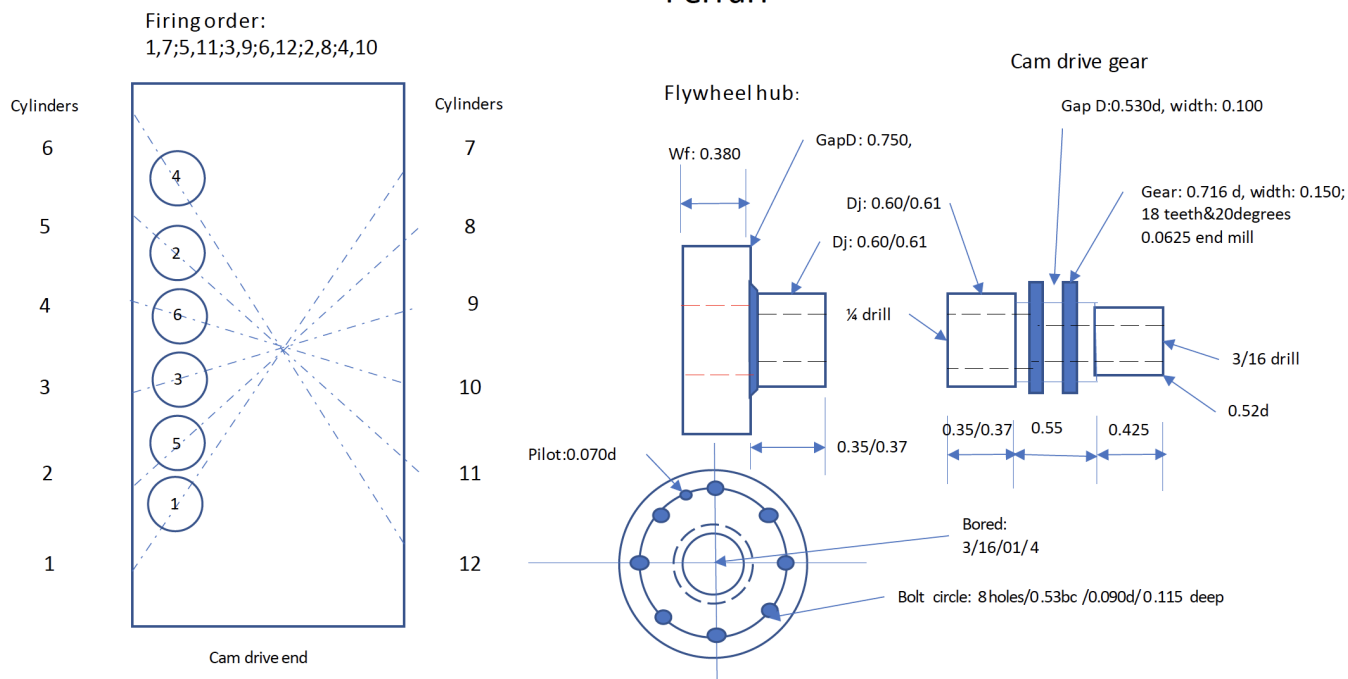


FIGURE 1—Ferrari flywheel hub and cam drive gear.

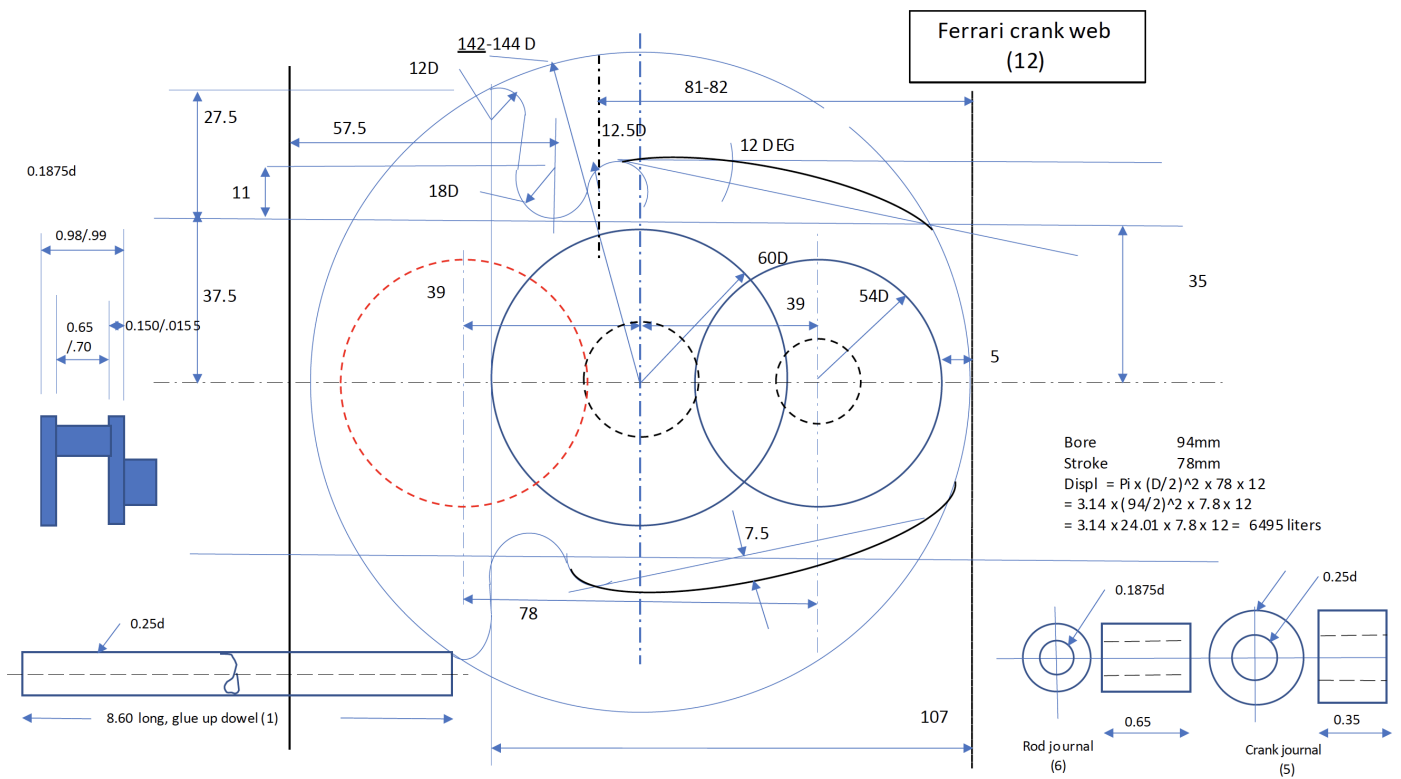


FIGURE 2—Ferrari web drawing, rod journal, and crank journal.

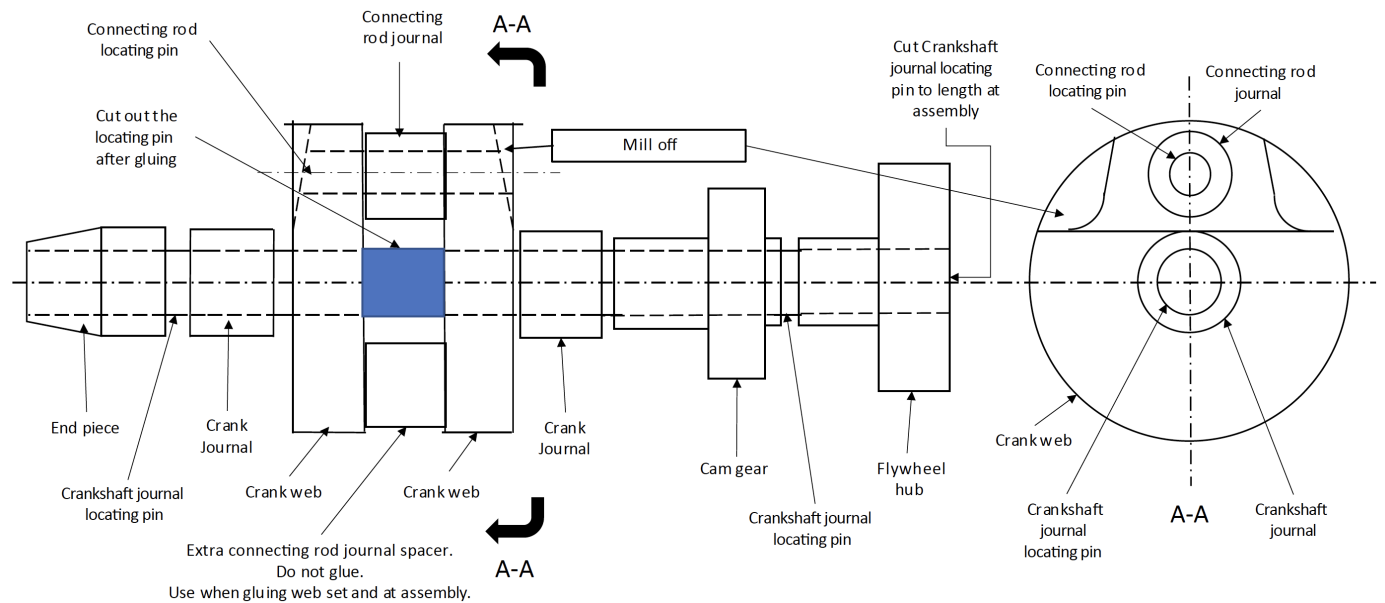


FIGURE 3—Typical crankshaft assembly.

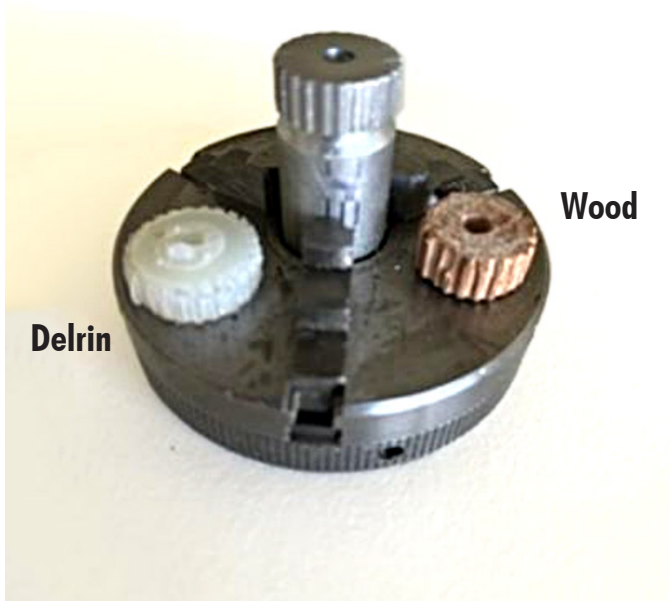


FIGURE 4—Gear making trials.



FIGURE 6—Balance hole in webs.



FIGURE 5—Parts of the Ferrari crankshaft.



FIGURE 7—Assembled Porsche crank.



FIGURE 8—Milling the Ferrari webs.



FIGURE 9—Milling the Ferrari gears.



FIGURE 10—Finished cranks.

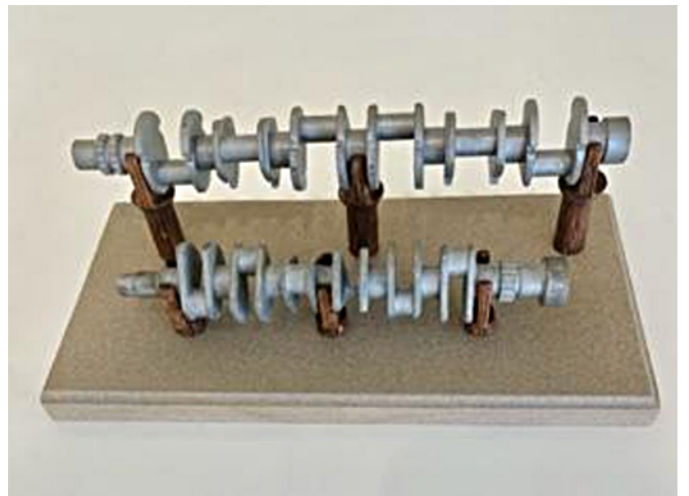


FIGURE 11—Display stand.

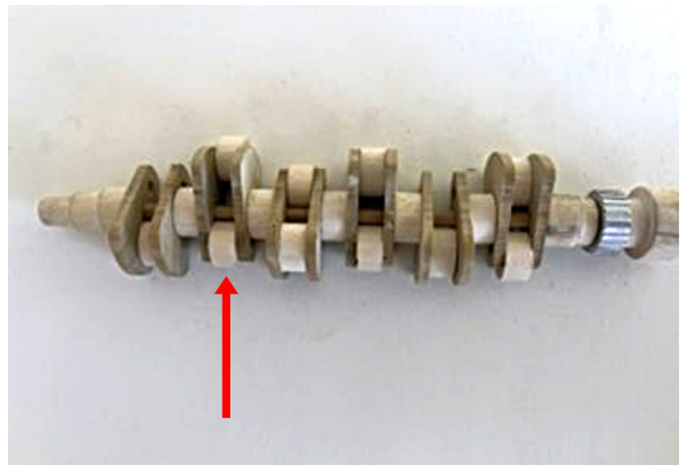


FIGURE 12—Temporary web spacers in place during glue up.