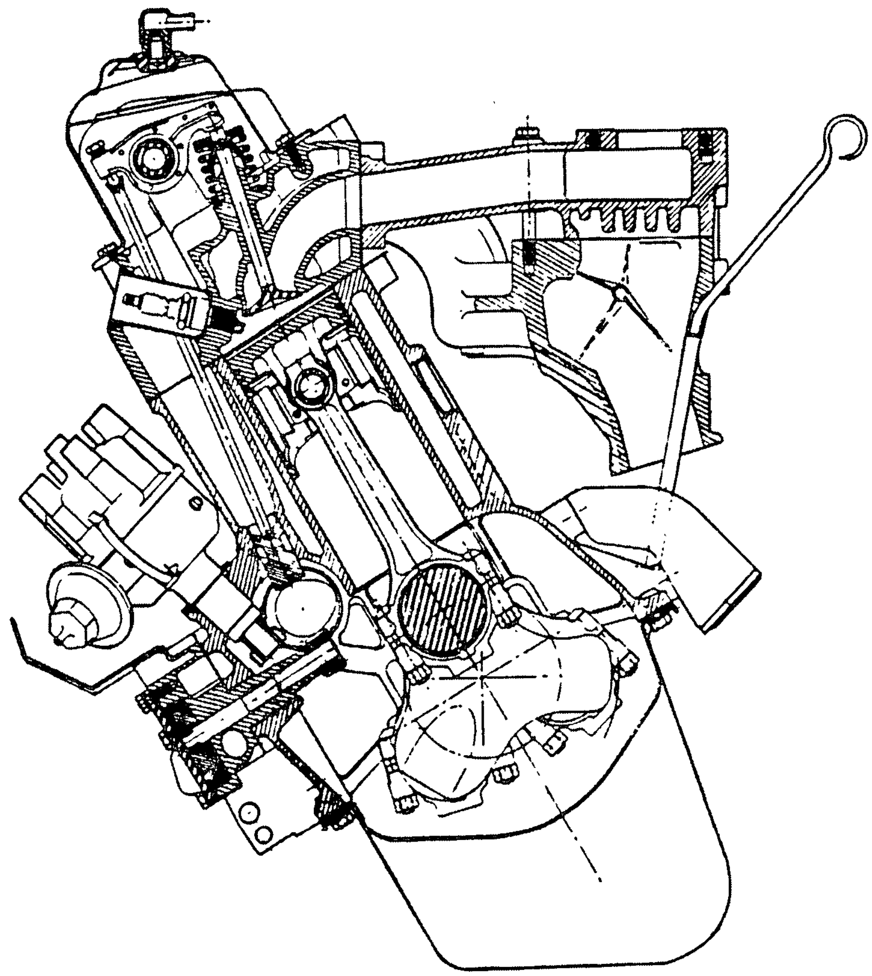
A History of Chrysler Corporation's

Slant-Six Engine



Volume I - Text

Introduction

The Slant-Six engine produced by Chrysler Corporation from 1959 to 1991 became one of the most enduring and best recognized engines produced by Chrysler. It earned a reputation for exceptional durability. The material below is presented as the story of the original design and development of the engine, of its many variations and of its changes over the years. Information on Slant-Six engineering programs that never reached production status is also included.

Part 1

Preliminary Concepts, Initial Design. Development and Launch

Initial Considerations - Need for a Valiant Engine

The Valiant car program was initiated at Chrysler Engineering in 1957 as Chrysler's entry into the new compact car market. Both Ford and Chevrolet were know to be working on entries – the Falcon and the Corvair respectively.

Chrysler did not have any engine in production at the time that was suitable for powering the Valiant. The 230 CID L-head six cylinder engine being used in the Plymouth and Dodge cars had inherently poor fuel efficiency and low power. Its manufacturing equipment was obsolete. The 277 CID small block V-8 recently launched at Chrysler's Mound Road Engine Plant was a modern design with very advanced manufacturing equipment, but was much too large to be considered as the standard power plant for the vehicle.

Of interest, the Valiant vehicle was designed by a separate engineering team split off from the main engineering organizations. The Valiant team was housed in a building located in a different part of Detroit from the Central Engineering complex. The building was called the Midland Annex after the name of the street where it was located. The engine task was not split off however, but was done by the Engine Design and Engine Development Departments already in place at Central engineering.

Low vehicle cost and excellent fuel economy were two high priority goals for the Valiant so that it would be very competitive in this compact car market. This in turn placed emphasis on making the vehicle a very tight design but with 6 passenger capability. We, in engine design, were asked by the vehicle designers to be creative in making the engine as low and as short as possible so that the entire front of the vehicle could be much shorter and lower than the standard size vehicle. All this was aimed at reducing the vehicle weight and frontal area so that fuel economy and performance would be enhanced.

In the early stages of the Valiant vehicle layout, preliminary designs were prepared of several different types of engines for consideration. By January 1958, advance designs were in process of a 150 CID cast iron in-line 6-cylinder engine, an aluminum in-line 6-cylinder engine and an aluminum V-6 engine to support the vehicle packaging studies. Later a 150 CID four cylinder engine and in-line 6-cylinder engines up to 170 CID were also being studied.

In January 1958 the Valiant was assigned the Engineering Program Number A-901. This number superseded the prior A-900 number that had been used for the initial studies of the car.

In a meeting held in the morning of April 10, 1958, Engine Design requested that Valiant and Engineering Management make a selection of the type and size of engine by May 1, 1958 so that the design could be completed and detail drawings could be started. Engine Design favored the in-line six cylinder engine with a maximum displacement of 170 cubic inches.

On the afternoon of the same day, Engine Manufacturing Division made a request to Engineering Management that, if possible, the new Valiant engine be designed to have a larger displacement version that could be used to replace the last of the 6-cylinder L-head engines still in passenger car production – the 230 CID engine used in the Plymouth and Dodge cars. As mentioned above, this engine was very obsolete in both design and manufacturing equipment and a replacement was needed.

Within five days, Engine Design determined that the 170 CID engine that they had been working on could have a raised deck version with the same bore but with the stroke increased by 1 inch. This gave a displacement of 225 cubic inches.

Even though this 225 CID engine would have a smaller bore size than desirable for its displacement, with correspondingly limited valve sizes, it was felt that the engine would have a substantial increase in performance over the L-head 230

The decision on the number of main journals allowed the exact bore centers to be determined. The engine had the cylinders arranged in three pairs. The distance between cylinders 1 & 2, 3 & 4 and 5 & 6 was 3.98 in. The distance between cylinders 2 & 3 and 4 & 5 was 4.00 in. The main journals were under the spaces between cylinders 2 & 3 and 4 & 5. The extra .020 in. (i.e. the difference between the 4.00 spacing and the 3.98 spacing) was needed for the length of the main bearings to be used.

The slanting of the engine came about by the need to make the engine as short as possible for vehicle packaging. Someone in the Advance Design Section of Engine Design got the idea to place the water pump alongside the cylinder block rather than in front of the block to shorten the length of the engine. Then, to keep the water pump shaft centerline reasonably close to the center of the car, the block was tilted 30° to the right (as viewed from the driver's seat).

The need for the water pump shaft centerline to be kept close to the centerline of the car was due to the fact that the engine cooling fan mounted to a hub on the water pump shaft and the fan had to be located at the center of the radiator which was placed on the centerline of the car ahead of the engine.

The tilt to the right was chosen because the steering shaft was located to the left of the engine. By tilting the engine away from the steering shaft, both we in Engine Design and the steering engineers had more room for our respective components.

Advantage was taken of this room in the design of the intake and exhaust manifolds which could use much longer branch lengths than if the engine had been upright.

A patent was issued on the overall configuration of the engine with the lead designer, Fred Rose, and engineers John Hurst, Ray Latham, Don Moore and John Platner listed as co-inventors.. The first page of the patent is shown on Figure 3. The entire patent is attached as Attachment 1.

The 30° angle was selected because it resulted in a reasonable compromise of all the packaging that had to be done including the accessibility of the distributor and fuel pump on the right side of the engine (more angle would have made accessibility worse for these components). Less angle would have made a poorer location of the fan as noted above. Using exactly 30° simplified a lot of drafting effort and design calculations compared to the use of a less common angle.

The 30° slant also allowed the carburetor and air cleaner to be lower than if the engine had been mounted upright. This in turn allowed the hood to be as low as the vehicle designers wanted it to be.

The distributor and oil pump were located where they are for the following reasons:

> With the bulkhead arrangement of the 4 main bearing crankshaft, three locations were available along the camshaft to place a gear for the oil pump and distributor drive. The three locations were between cylinders 1 & 2, 3 & 4 and 5 & 6. In effect, the center of each crankcase bay was a candidate for the location for the drive gear. The center location (i.e. between cylinders 3 & 4) was selected as the best of the three.
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> The center location was the best because the distributor and the oil pump could share the same camshaft drive gear and, with the oil pump also centrally located, the oil galleries would be equal in length from the front and rear of the block. This was very important to the die cast aluminum design since these galleries would be formed by long pins in the die that had to be retracted before the casting could be ejected from the mold.

During this initial design layout, the lead designer, Fred Rose, ran into problems trying to get enough room for the tappets that had to align in a row above the camshaft - two for each cylinder. In his first design attempt, Fred used the mushroom type tappets that had been used on the L-head engines. These tappets had a large head diameter and a small body diameter as can be seen on both the transverse and longitudinal sections of the L-head engine (Figs. 2a & 2b). They had to be installed from underneath before the camshaft was installed in the cylinder block.

Bob Rarey, who was Assistant Chief Engineer - Engine Design, and I, Managing Engineer of Engine Design at the time, really wanted the engine to have the larger diameter cylindrical type tappets that were in use on the V-8 engines. These could be installed and removed from the top of the cylinder block with the camshaft in place. The three of us - Bob Rarey, Fred Rose and I -