

January, 1964

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P r o d u c t I n f o r m a t i o n B u l l e t i n

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CHRYSLER CORPORATION'S  
HEMISPHERICAL COMBUSTION  
CHAMBER  
MAXIMUM-PERFORMANCE  
ENGINES

ENGINEERING STAFF

Technical Information  
Section



**CHRYSLER**  
CORPORATION

CHRYSLER CORPORATION'S  
HEMISPHERICAL COMBUSTION CHAMBER,  
MAXIMUM-PERFORMANCE ENGINES

Hemispherical Combustion Chambers

The advantages of hemispherical combustion chamber design are widely known among automotive engineers everywhere. This design is ideal for high-output racing engines because more fuel and air can be inducted on each intake stroke, in proportion to total cylinder volume, than with any other chamber design used in normally aspirated engines. Thus, the hemispherical-chamber engine has high volumetric efficiency. Other advantages are low surface-to-volume ratio and ability to accommodate very large valves.

Chrysler Corporation originally introduced a hemispherical-chamber engine with a dual rocker shaft arrangement in 1951. Although designed and built for production passenger cars, this engine, in modified form, established an enviable reputation for outstanding performance in racing events.

Now, a worthy successor is being introduced in the form of a new double-rocker hemispherical-chamber engine based upon the well proven 426-cu in. design.

Chrysler Corporation's hemispherical-head, maximum-performance engines are scheduled for 1964 production on the same basis as earlier competition-type power plants. They are offered exclusively for the serious competitor who wants to enter supervised racing events. Their highly tuned, racing camshafts preclude the smooth, even idle found in ordinary engines. Manifold heat is sacrificed for maximum power, and thus, warm-up is slow. Cold weather starting is not the same as would be expected of family-type passenger cars. These engines are not recommended for everyday driving.

The 1964 hemispherical-chamber, maximum-performance engines are available in two versions. One is designed for use in contests of acceleration. The other is

developed for racing in closed-circuit track events. Both engines have a bore of 4.25 inches, and a stroke of 3.75 inches, for a total displacement of 426 cubic inches.

These two engines incorporate many mechanical and structural innovations for increased durability and high-speed output. Although they appear similar in many respects to earlier 426-cu in. maximum-performance engines, parts are not interchangeable with former models.

#### The Acceleration or "Drag" Engine

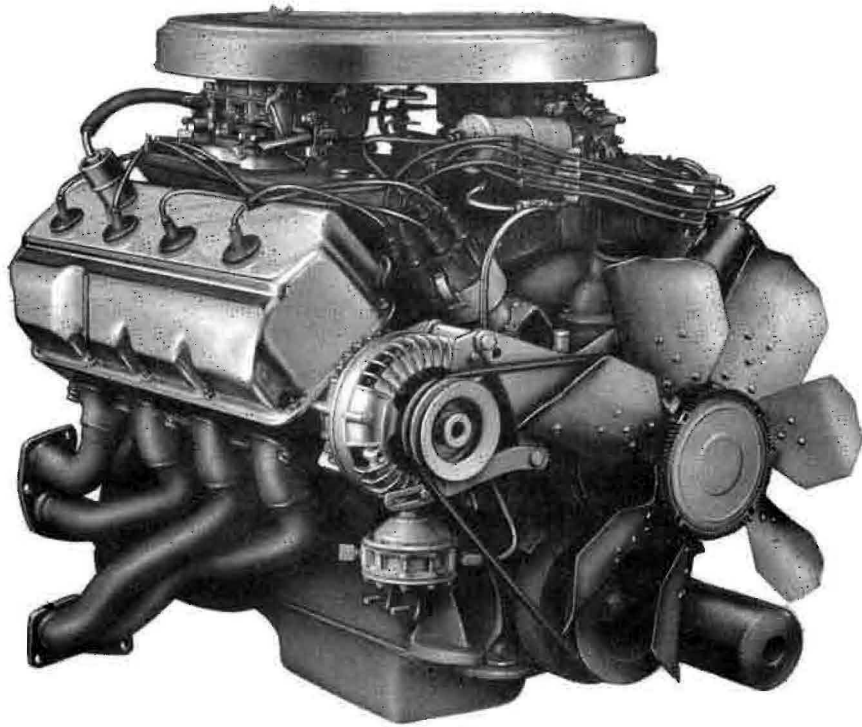
The acceleration version of this engine is equipped with twin, four-barrel carburetors and a ram-tuned induction system. This model was developed especially for competing in sanctioned, timed quarter-mile trials (drag races). It is available in two compression ratios, as shown below:

Rated Output	<u>11.0 :1 Compression Ratio</u>	<u>12.5 :1 Compression Ratio</u>
Horsepower	415 at 6000 rpm	425 at 6000 rpm
Torque	470 at 4600 rpm	480 at 4600 rpm

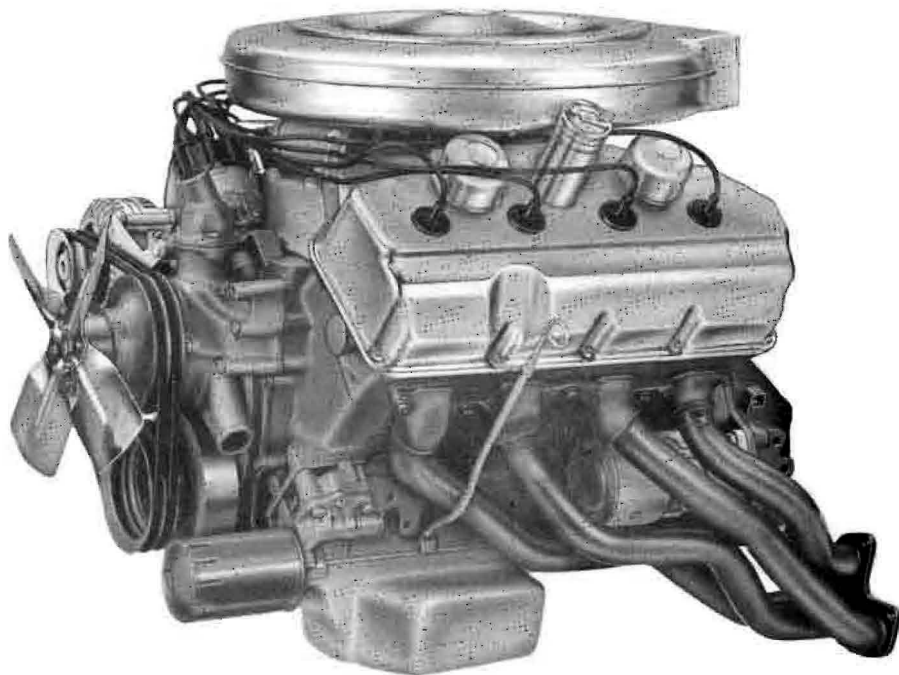
#### The Circuit-Racing Engine

The second version described is adapted specifically for closed-circuit racing. It is equipped with a single, four-barrel carburetor, a two-level intake manifold, and other conventional engine components to comply with existing racing specifications. This 1964 model is available only with a 12.5 to 1 compression ratio.

Rated Output	
Horsepower	400 at 5600 rpm
Torque	465 lb-ft at 3800 rpm



1964 CHRYSLER CORPORATION HEMISPHERICAL-CHAMBER,  
ACCELERATION ENGINE



1964 CHRYSLER CORPORATION HEMISPHERICAL-COMBUSTION CHAMBER,  
CIRCUIT-RACING ENGINE

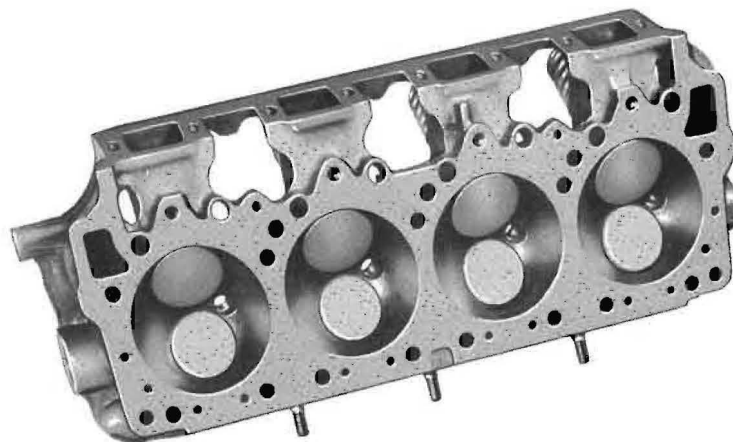
## MAJOR FEATURES

The major features which are introduced in these engines are discussed briefly in the following sections.

### Cylinder Heads

The hemispherical-chamber cylinder heads incorporate several advancements which contribute toward high volumetric and thermal efficiency. Because of its laterally inclined valve arrangement, this combustion chamber design provides inherently generous valve and port dimensions for greater air flow and optimum flame travel.

In addition, the valve and port locations minimize transfer of engine heat to the incoming fuel/air mixture.



HEMISPHERICAL COMBUSTION CHAMBERS —  
1964 CHRYSLER CORPORATION  
MAXIMUM-PERFORMANCE ENGINES

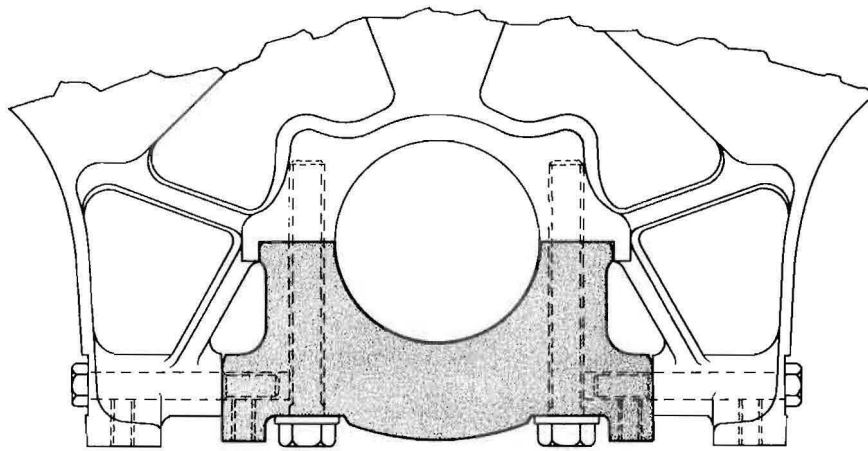
The cylinder heads are made of cast iron, and like traditional racing design, their appearance reflects considerable effort to eliminate unnecessary weight and yet retain sufficient strength for all imposed loads.

### Cylinder Block

The cylinder block is made from tin-alloyed cast iron, and its over-all design includes several structural improvements. Significant design features are evident in the construction of the cylinder block deck and main bearing webs and caps.

On each cylinder bank, the inner edge of the block deck is extended and reinforced to support four inboard cylinder head studs. These are tightened from inside the tappet chamber.

The walls of the cylinder block are reinforced in the vicinity of the main bearing web area. In the circuit racing block, each of the No. 2, 3, and 4 main bearing caps receive added support from a pair of horizontal tie-bolts which anchor the bearing caps to the sides of the cylinder block.



**MAIN BEARING CAP WITH HORIZONTAL TIE-BOLTS**

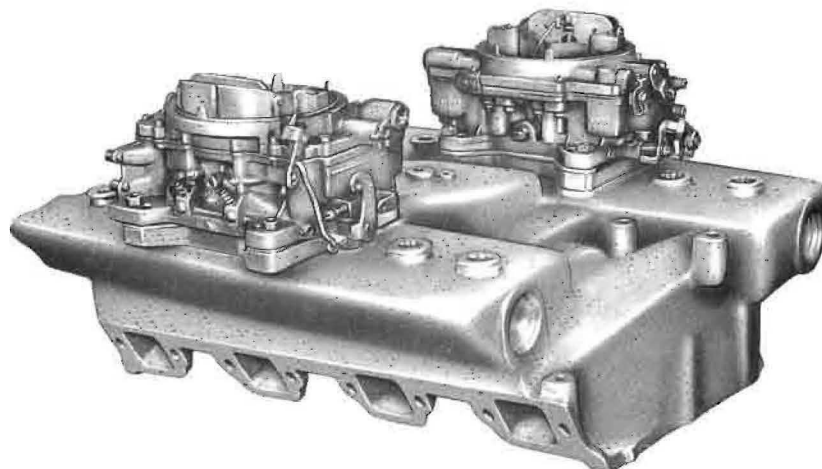
#### New Intake Manifolds

The acceleration engine is equipped with a ram-tuned intake manifold. It is similar in appearance to the one developed for the earlier "426" and, likewise, it has no provision for carburetor heat.

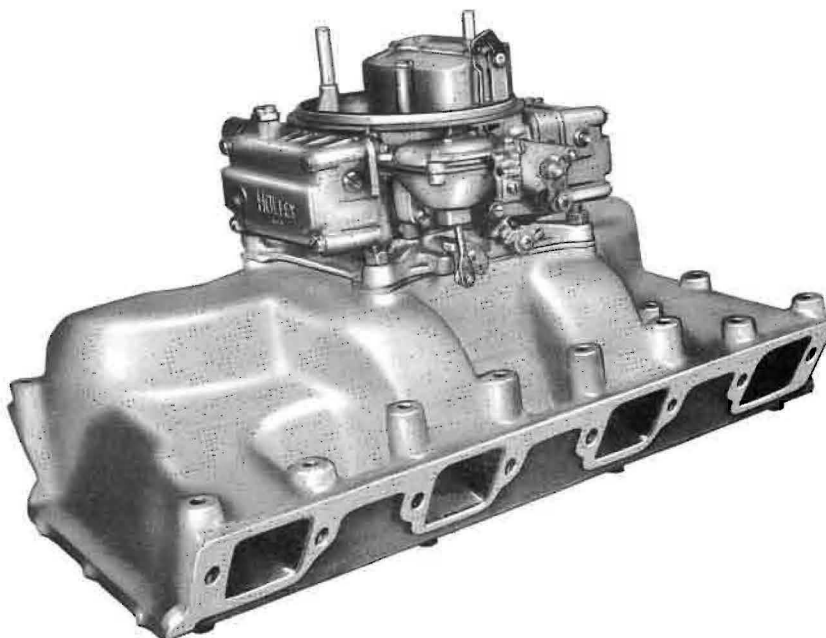
Intake passages are larger than in previous types because of increased engine breathing requirements.

The circuit-racing engine uses a two-level intake manifold which resembles the conventional passenger car design, except for the absence of an exhaust crossover passage. It has no provision for carburetor heat or automatic choke.

The bottom of the intake manifold also serves as the tappet chamber cover; a special shield underneath insulates the manifold branches against hot oil splash.



RAM INTAKE MANIFOLD AND CARBURETORS —  
1964 CHRYSLER CORPORATION  
HEMISPHERICAL-CHAMBER,  
ACCELERATION ENGINE



INTAKE MANIFOLD AND CARBURETOR —  
1964 CHRYSLER CORPORATION  
HEMISPHERICAL-CHAMBER,  
CIRCUIT-RACING ENGINE

### Carburetors and Air Cleaners

The acceleration engine is equipped with dual, four-barrel AFB carburetors having 1-11/16 inch primary and secondary bores and progressive throttle linkage.

The single, oval-shaped air cleaner surrounds both four-barrel carburetors.

The circuit-racing engine uses a single, four-barrel carburetor with vacuum-operated secondary throttle valves. The diameters of both the primary and secondary bores have been increased from 1-11/16 to 1-3/4 inches.

The novel, rear-intake air cleaner design takes in relatively cool outside air from the plenum chamber at the base of the windshield. It is larger in diameter than the earlier version, and the area of the rectangular opening is correspondingly greater to accommodate the increased air flow.

Cable-actuated manual chokes are used on both engines.

### Heavy-Duty Valve Train

The dual rocker shafts are positioned on top of the cylinder heads and held by five "V"-shaped malleable iron support brackets. The entire rocker assembly is secured by the five center head bolts.

The rocker arms are made from forged steel, with extra wide bushings for maximum load-bearing capacity. The push-rod ends are equipped with simple, jam nut-type adjusting screws.

### Larger Valves

Both the intake and exhaust valves have larger head diameters than earlier maximum-performance designs. The intake valve head diameter is increased from 2.08 to 2.25 inches. Stem diameter is also reduced approximately .060 inches to help reduce valve train inertia. The exhaust valve head diameter is increased from 1.88 to 1.94 inches, and its valve stem diameter is also reduced for similar reasons.

The intake and exhaust valves used in the acceleration engine continue to incorporate conventional passenger car materials. The intakes are made from SAE 1041 carbon steel, and the exhausts are made from aluminized 21-4N chrome-manganese alloy.



On the circuit racing engine, the intake valves are made from XB material as developed for earlier competition designs. Likewise, the exhaust valves feature the same 21-4N Stellite-faced construction as used before.

The special, heavy-duty outer and inner valve spring arrangement and valve spring dampers are used, similar to earlier maximum-performance applications.

#### High-Lift Camshaft

The camshaft design integrates high valve lift and long valve duration, along with other high-performance characteristics to ensure peak engine operation.

The camshaft is made from hardenable cast iron, with integrally cast fuel pump cam and distributor drive gear. Furthermore, it is Lubrited for antiscuff protection.

A special, roller-type timing chain ensures high speed durability.

#### New Connecting Rods and Piston Pins

Connecting rods are entirely new and much stronger than earlier types. Center-to-center distance is greater, and the rod is equipped with a bushing in the small end. The full-floating piston pin is retained by lock rings.

The large end has split halves held together by two 7/16-inch diameter connecting rod bolts having special washer-faced nuts.

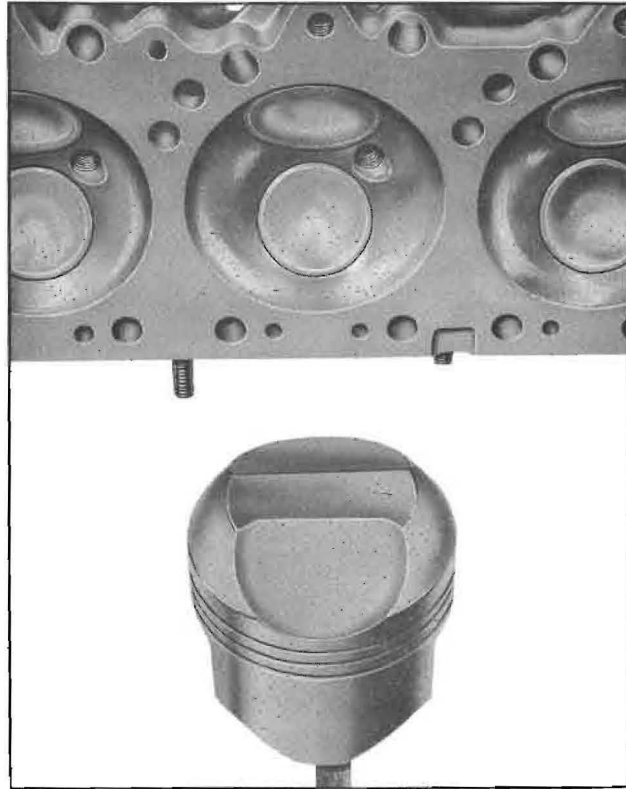


CONNECTING ROD ASSEMBLY —  
1964 CHRYSLER CORPORATION  
HEMISPHERICAL-CHAMBER,  
MAXIMUM-PERFORMANCE ENGINES

#### Dome-Shaped Pistons

The new dome pistons are impact-extruded and tin-plated for scuff resistance and durability. Two cast-iron compression rings and one oil ring are used, similar to

earlier designs. However, the oil control ring is made up of three pieces: two chrome-plated rails and a steel expander.



HEMISPHERICAL COMBUSTION CHAMBERS  
AND PISTON ASSEMBLY —  
1964 CHRYSLER CORPORATION  
MAXIMUM-PERFORMANCE ENGINES

### Heavy-Duty Crankshafts

The crankshafts have shot-peened fillets and are given a special chemical-dip surface treatment.

Both the acceleration and the circuit-racing engines have crankshafts with an eight-hole flange design to ensure maximum torque-transfer capacity. The materials used in the crankshafts are different, however. The crankshaft for the acceleration engine is forged from SAE 1046 carbon steel, and the crankshaft for the circuit-racing engine is made from SAE 4340 high-strength alloy.

Both crankshafts require special balancing to compensate for the new pistons and connecting rods.

### Heavy Duty Bearings

The tri-metal, heavy-duty main and connecting rod bearings are similar to the earlier "426" design. The bearings are composed of a lead-tin surface, over a copper-lead intermediate layer, with a conventional steel shell backing.

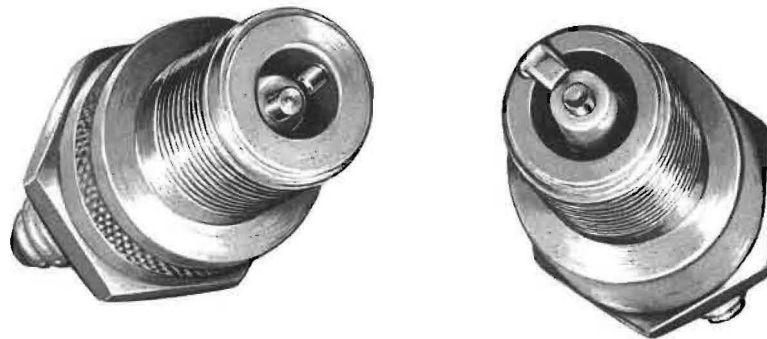
The oil grooves are extra wide and extend around the lower shells as before for increased high-speed lubrication.

### High-Speed Ignition System

Both the acceleration and circuit-racing engines use a centrifugal-advance distributor, equipped with special, dual short-arm breaker points.

In addition, these engines incorporate a heavy-duty transistorized device for increased voltage at the spark plugs.

Several types of spark plugs have been developed for use with these engines. Among them are the Champion N58R, a special variety with buried-type electrodes, and the Champion N61Y, released especially for the acceleration engine. The latter has a projected-nose design to help prevent fouling under light loads.



Buried Tip

Projected Nose

SPARK PLUG DESIGNS —  
1964 CHRYSLER CORPORATION  
HEMISPHERICAL - CHAMBER,  
MAXIMUM - PERFORMANCE ENGINES

### Tuned Exhaust Headers

The dual exhaust headers are made up of separate lengths of steel tubing welded to cast-steel port flanges, and are "tuned" to provide maximum cylinder scavenging.

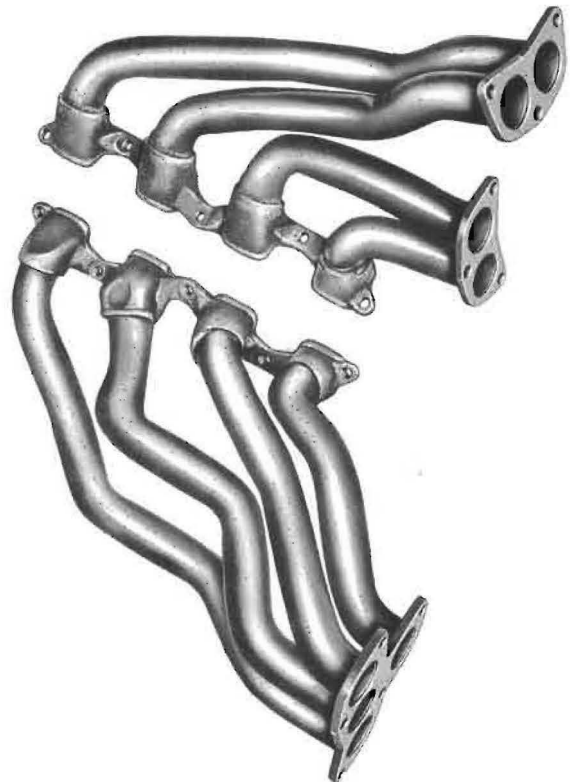
In the acceleration vehicle, the exhaust headers merge into a single outlet on each side of the car. For track operation, both exhaust headers are routed to the right side of the chassis.

### Clutch and Transmission

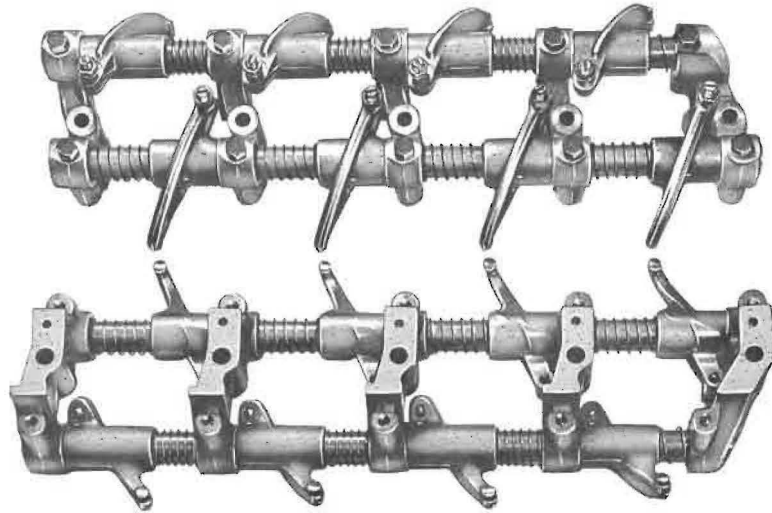
Both versions of the hemispherical combustion chamber, maximum-performance engines are available with either a new extra heavy-duty 3-speed TorqueFlite automatic, or the new Chrysler-built 4-speed manual transmission. The former has 10-3/4 inch diameter torque converter with stall speed higher than the standard torque converter.

The clutch used with the manual transmission has a 10-1/2 inch pearlitic malleable iron pressure plate and a high burst-speed clutch disc. A thick cast steel clutch safety housing eliminates the need for an additional fly-wheel shield.

Several additional refinements have been introduced for faster clutch action at high engine speeds. The clutch cover and lever assembly is stronger and clutch bearing life is improved. In addition, a new, high-capacity, low-inertia clutch damper section is available for use in circuit-racing operation.



EXHAUST HEADERS —  
1964 CHRYSLER CORPORATION  
HEMISPHERICAL-CHAMBER,  
MAXIMUM-PERFORMANCE ENGINES



ROCKER ARM ASSEMBLIES

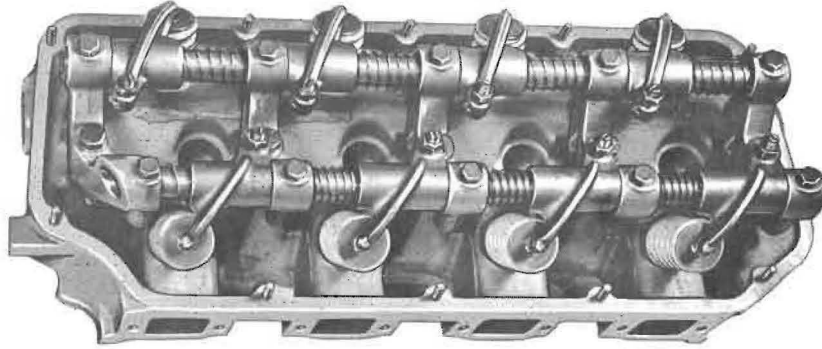
### Rocker Arm Assemblies

Rocker arms are lubricated by oil metered into the rocker shafts via drilled oil passages in the cylinder heads.

Passages are also drilled in the rocker arms to direct lubricating oil to the valve stems and guides.

The oil passage in the intake rocker arm extends to the end of the valve tip. In the exhaust rocker arm, the oil passage emerges alongside the "I" section, next to the barrel.

Lightweight circular springs retain the rocker arms in position only while the valves are closed. As the camshaft lobes begin to lift the valves, the push rods hold the rocker arms against the support bracket for the duration of the valve cycle.



CYLINDER HEAD AND ROCKER ARMS ASSEMBLY

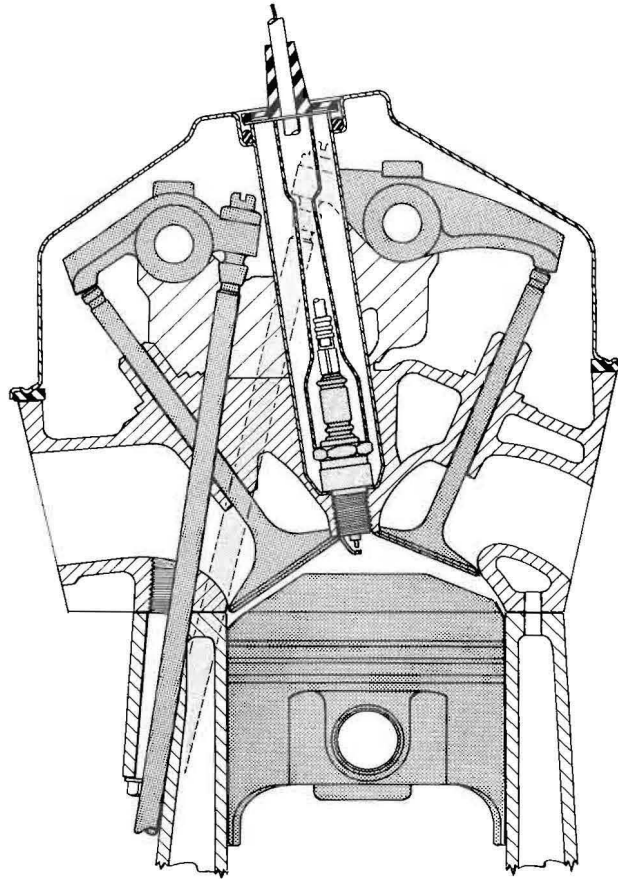
### Low-Inertia Valve Train

Rocker arms are long and narrow, with a lightweight cantilever construction, and equipped with bronze bushings. Because hemispherical heads have an "open chamber" design, the center line of the valve stem must align with the center line of the cylinder bore to obtain proper valve seating geometry. Consequently, the rocker arms are offset to allow the push rods to clear the intake and exhaust ports.

Push rods and valve tappets are of hollow construction to save weight.

### Sealed Spark Plugs

The long-reach spark plugs are completely enshrouded within a steel tube formed at the lower end to serve as a plug gasket. The tube projects through the cylinder head cover and is sealed against oil leaks. And like the earlier FirePower design, a long insulating connector slips over the ceramic portion of the spark plug to provide flash-over protection. It also serves as a means of attaching the ignition cables to the plug terminals. A special seal at the top of the insulating connector prevents infiltration of dust or moisture.



CYLINDER HEAD CROSS SECTION

Cylinder Heads Designed for Efficiency

The intake and exhaust ports are shaped to minimize changes in direction and permit unrestricted air flow through the valves.

Ports are widely separated to help keep the incoming fuel/air mixture as cool as possible. Intake valves are cooled principally by the incoming charge of fuel. Water cooling is provided around the valve seats for both intake and exhaust valves. In addition, the exhaust valve stem guides are completely water-jacketed.

Holes are provided between the cylinder block and cylinder head in the vicinity of each exhaust valve seat to circulate additional cooling water. The water squirts through, entering from the rear side of the cylinder block, then across the valve seat area and is carried away within the cylinder head passages.