



INSIDE RICHARD PETTY'S PLYMOUTH

BY JON MC KIBBEN, CAR LIFE ENGINEERING EDITOR

*What makes Richard run?
A chassis that can take
the torture of Daytona and a
surprisingly stock Hemi*

“THESE RACING VICTORIES were won by Plymouths which were specially modified and equipped for supervised competition.” A statement similar to this invariably accompanies an advertisement proclaiming the success of a specific brand of automobile in organized racing. The gross understatement of such a sentence is graphically evident in an examination of Richard Petty’s spectacularly successful No. 43 Plymouth NASCAR stocker. This car can lap Daytona International Speedway at well over 180 mph. That is total performance. Handling and tremendous power characterize Petty’s Plymouth, the winningest NASCAR stocker ever, and one of the finest pieces of racing machinery in the world.

The Petty Plymouth is not resplendent in acres of chrome. It is not pin-striped or bathed in metallic paint. It does not feature fancy wire or spoked magnesium wheels. It *does*, however, display quality and workmanlike care at least equal to more show-oriented vehicles. It also has an air of precise construction and dependability which are the hallmarks of any successful NASCAR racing car. For high-banked super/speedways or for quarter-mile dirt “bull rings,” Petty’s Plymouth is one ride we wouldn’t refuse. Strong, safe and (perhaps most important) *fast*, No. 43 ran up a string of victories that broke all NASCAR records during the 1967 season. Richard Petty’s 1967 season will probably remain the classic, a victorious parade that will never be equaled. A total of 28 NASCAR Grand National wins in a single season, 10 of them in a row, netted Richard Petty over \$132,000 in prize money.

Even more impressive is the fact that Petty was running against hordes of



ALUMINUM HEADLIGHT replacements, wire mesh grille guard and down-to-the-left attitude all spell round-track race car.

Ford factory entries. Fords outnumbered Plymouths in every race on the NASCAR circuit, and Ford support money made Chrysler’s financial backing look like a bargain-basement effort. Plymouth had spent its money wisely, however. In the Petty combine, Chrysler had the aces, the top runners in this arena of pros.

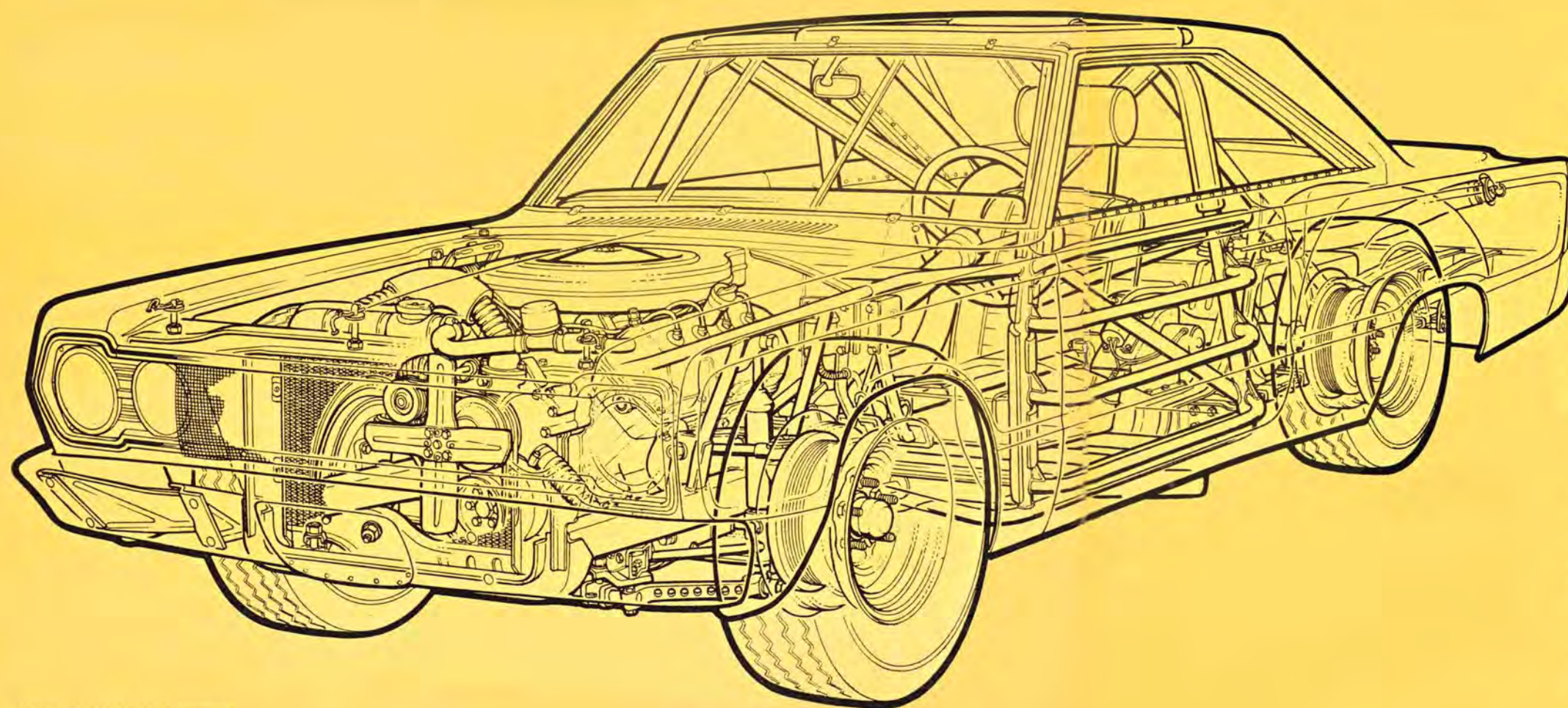
The Petty Plymouth is prepared by Petty Engineering Inc. This corporate title applies to Lee Petty, his sons, Richard and Maurice, and a crew of 10 men who are employed as full-time race car builders and crew members. As Lee (called “Bossman” by the crew) points out, “NASCAR racing is a 13-month business, each and every year.” Lee is a former NASCAR Grand National Champion, one of the finest stock car drivers ever to run the ovals of the Southeastern U.S. In fact, the career victory record that Richard Petty broke in 1967 was his father’s. Lee had been NASCAR’s winningest driver

of all time until Richard began running.

Today, Lee is only semi-active in the Petty Engineering operation. Richard is the driver, with additional drivers occasionally hired to pilot one of the other Petty Plymouths in major races. Maurice is the chief engine builder, and is largely responsible for the immaculate preparation and dependability of No. 43. Among the rest of the crew are suspension, engine, and overall car experts. Many of the crew are long-time Petty employees. These men have experience gained from years of building winning cars for Lee and Richard, and are all fine craftsmen and knowledgeable racers. Their product speaks for their abilities.

A casual observer, one not keyed into the finer points of racing cars, could pass over the Petty Plymouth without noticing anything except, perhaps, the lowest Plymouth Belvedere outside a custom car show. Just open the hood, though, and much of the





DRAWING BY CLARENCE LA TOURETTE

RICHARD PETTY'S PLYMOUTH BELVEDERE

DIMENSIONS, GENERAL

Wheelbase, in.	116.0
Track, f/r	62.0/61.5
Overall length, in.	200.5
width	82.0
height	51.2
Ground clearance, in.	6.0
Curb weight (with fuel), lb.	3960
Distribution, f/r	53.5/46.5

CHASSIS/SUSPENSION

Frame type: Unitized, with tubing reinforcement.
 Front suspension: Independent by s.l.a., torsion bar springs, telescopic shock absorbers, antiroll bar.
 Steering system: Standard Belvedere steering gear, parallelogram linkage behind front wheels.
 Steering ratio, overall: 23.5:1

BRAKES

Type: Cast iron duo-servo drums, front and rear, two-line hydraulic system with optional power booster, ceramic linings.
 Front drum, dia. x width: 11.0 x 3.0
 Rear drum, dia. x width: 11.0 x 3.0
 Total swept area, in.²: 414.5

WHEELS/TIRES

Wheel rim size, f/r: 15 x 8.5/15 x 8.5
 Tires: Firestone Speedway Stock or Goodyear Blue Streak Stock.
 size: 8.20-15

ENGINE

Type: Plymouth 90° V-8, ohv, hemispherical comb. chambers.
 Bore x stroke, in.: 4.25 x 3.75
 Displacement, cu. in.: 425.589
 Compression ratio: 12.5:1
 Fuel required: Premium gasoline.
 Estimated bhp @ rpm: 600 @ 6500
 Carburetion: 1x4, Holley.
 throttle bore, pri./sec.: 1.688/1.688
 Valve train: Racer Brown camshaft, stock lifters, pushrods and overhead rocker arms.
 Camshaft: Racer Brown STX-21 (normally).
 timing, deg. int./exh.: 50-76/80-46
 duration, int./exh.: 306/306
 lift, int./exh., in.: 0.560/0.560
 Exhaust system: Tubing headers, into single collector for each bank, 4-in. dia. collector pipes.

DRIVE TRAIN

Clutch: Standard MoPar competition unit, single dry disc.
 Transmission: Standard 4-speed Plymouth Hemi gearbox (H.D.).
 Gear ratios: (normal) 1st: 2.65:1
 2nd: 1.90:1
 3rd: 1.39:1
 4th: 1.00:1
 Final drive ratio: Variable, depending upon race course.
 Differential: MoPar/Dana limited-slip type.

CALCULATED DATA

Lb./bhp (est.): 6.6
 Lb./in.² brake swept area: 9.56

PETTY'S PLYMOUTH

continued

mystery unfolds to knowledgeable eyes.

Plymouths have unitized construction, right? Well, all but this one. The Petty Plymouth includes the longitudinal "frame" members of the original unitized chassis/body structure, but the real structural integrity and torsional rigidity comes from the extensive "roll cage," or tubular reinforcement network that fills the car's interior and engine compartment.

The chassis/body structure of a stocker must be rigid enough to prevent structural flex as it absorbs cornering loads. No longer can racers install a roll cage that looks sturdy enough, and base cage design upon apparent driver protection. Today, roll cages in winning stock cars generally are computer-designed as a part of the

vehicle's basic chassis. Without the roll cage, the cars would handle like flexible, 4000-lb. go-carts.

An idea of the suspension loadings encountered in a top stocker is seen in the ride rates (force required for vertical wheel deflection at road contact point). At the front wheel/road contact point, a stocker such as Petty's Plymouth has a ride rate of some 800 lb./in. This compares to a standard Plymouth front ride rate of about 130 lb./in. Roll rate, or force required for given amount of lateral body roll, runs up to 1700 lb./in. for Daytona. This roll rate is roughly five times that of a stock Belvedere. Suspension rates of this magnitude require that the chassis be extremely rigid or torsional chassis flex will have more effect upon car

handling than the suspension system. Actually, before the Detroit engineers entered the racing picture, cars often raced with suspension systems so stiff, and chassis so flexible, that roll resistance was independent of suspension system spring rates or antiroll bar diameters.

These stiff ride and roll rates are necessary at Daytona due to the normal, or vertical, loading on the high-banked turns. Petty's Plymouth, while turning 180-mph laps, absorbs normal loadings of over 2 G. That is, a car that normally weighs 4000 lb., doubles its weight in the turns—forces acting on the car now are over 8000 lb., straight down into the tires. With normal passenger car ride rates, the car would be forced down onto the jounce bumpers under such loadings. Then, there would be no suspension travel, and ride rates would rise from the normal 130 lb./in. to near infinite rate as the jounce bumpers compressed.

Petty's car is set up for various tracks by choosing spring rates (direct-

ly proportional to ride rate) for maximum jounce travel of 2.5 to 3.0 in., measured at the wheel. For slow tracks, with low cornering speeds, suspension loadings will be much less than at Daytona, and softer springs are fitted to permit the desired travel. At Milwaukee, for example, ride rates as low as 350 lb./in. may be used.

Total permissible wheel travel in the Petty Plymouth is 8 in., evenly divided between jounce and rebound. The remaining inch of travel accommodates unexpected bumps, running off the smooth track surface, etc. Also, suspension geometry is such that any more than three inches of jounce travel moves the wheel beyond the point of desirable road/wheel relationship. Petty's crew alters suspension geometry to provide more initial negative camber, and less camber change through jounce and rebound, than standard Belvedere front suspension.

Rear suspension is by multileaf springs, with leaf thickness and number varied between tracks. Surprisingly,

the heavier rear spring (and front torsion bar) is installed on the inside (left side of the car) for oval track racing. Weight transfer effects cause this apparent incongruity.

To illustrate, assume that the right rear spring has a rate of 1000 lb./in., and the left rear spring is 100 lb./in. As 100 lb. of weight transfer from left to right, the left rear corner will lift one inch, while the right side will depress only 0.1 in. This means that the center of gravity of the car rises nearly an inch, which in turn causes further weight transfer. Thus, cornering forces tend to magnify weight transfer effects, increasing unequal tire load, and therefore cutting cornering power.

Now, assume that the right rear spring has a rate of just 100 lb./in., and the left rear is 1000 lb./in. As 100 lb. of weight is transferred by cornering loads, the right side will drop one inch, and the left side will rise only 0.1 in. Thus, the car actually lowers and weight transfer is reduced. This sort of spring rate biasing makes

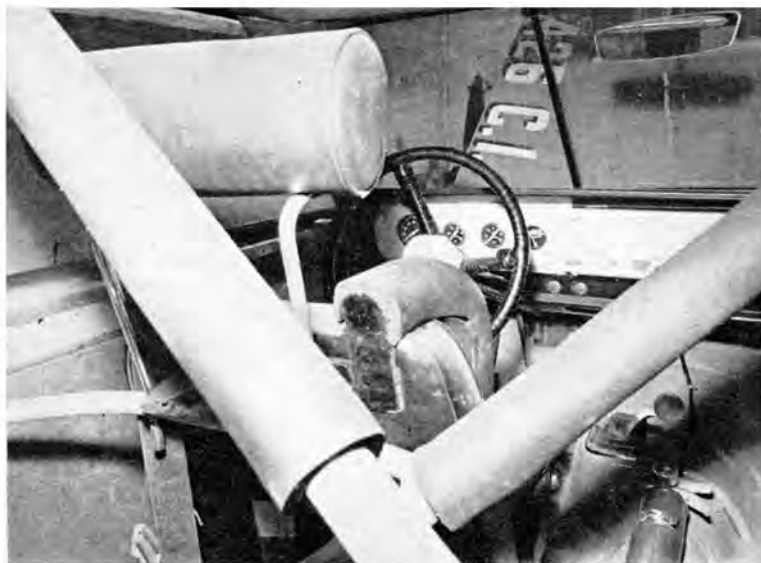
weight transfer self-limiting. Obviously, a spring as soft as 100 lb./in. would not be used at the outboard side of a 4000-lb. stocker. However, this principle is used for spring selection on every really competitive stock car, including Richard Petty's Plymouth.

Aside from the massive strength of the springs themselves, suspension system components, such as control arms, spring mounting hangers, shock absorber mounts, and all steering parts





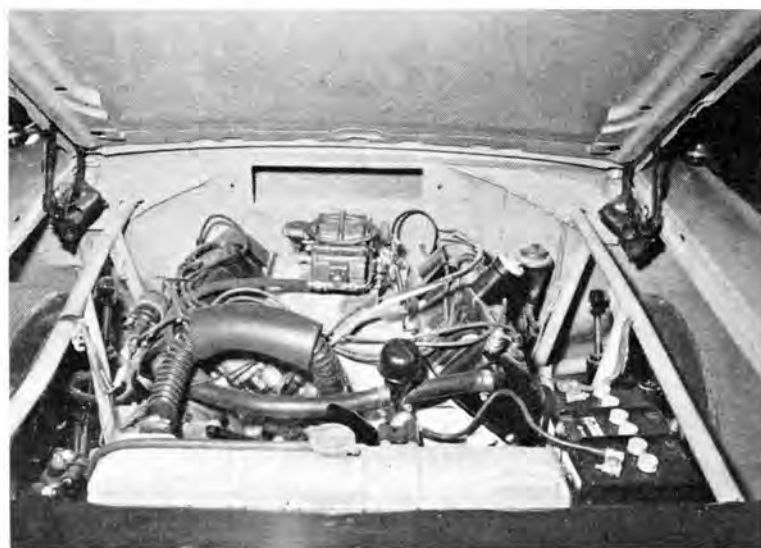
RICHARD'S ROOST features seat bolster to combat centrifugal force in left turns, padded steering wheel and headrest.



HEAVILY PADDED roll cage of steel tubing retains driver cavity shape despite rollovers or severe side impacts.



FOUR SHOCK absorbers attach to rear roll cage crossmember. Blower/cooler on floor keeps rear axle lubricant cool.



TUBULAR FRAME reinforcements help absorb front suspension loading. Hole in cowl plenum feeds engine air cleaner.

PETTY'S PLYMOUTH

continued

are much stronger than the original Belvedere parts. This does not mean that the standard parts were inadequate even for severe driving in the hands of a customer, but emphasizes the stresses that a NASCAR stock car must withstand. Paved tracks, with their bumps and dips, can cause tremendous strain on suspension and steering components when the 4000-lb. vehicle corners at lateral forces of over 0.7 G. Dirt tracks, with their pot-holes and ridges, batter suspension components with incredible shocks.

Enabling Petty's racer to generate such high cornering forces are really

exceptional tires. A 4000-lb. vehicle, with slight frontal weight bias, cornering at speeds which were beyond the capabilities of unlimited sports cars just a few years ago, requires great adhesion and casing strength. A fact that few enthusiasts consider, in comparing stock car performance to more exotic Group 7 sports/racers or Formula I Grand Prix cars, is that NASCAR regulations specify stocker tire sizes which are smaller than those used on the rear of 1500-lb. sports cars. Also, the NASCAR racer is limited to using equal tire size front and rear, a limitation not shared by sports cars.

NASCAR permits tires that are designated 8.00/8.20-15. This is a great hoax, of course, since the tire measure nearer 12 in. than 8.2 in. in width. Road contact width is approximately 10 in. Rim width is 8.5 in., also limited by association rules. For contrast, consider the Posey/Caldwell Can-Am sports/racer (CAR LIFE, Nov. '67). It uses rear wheels with rim widths of 15 in., and tire contact width is almost the same at 14.5 in. And, this car weighs less than 1500 lb., without fuel or driver. Petty's Plymouth, with a 426-cid engine, must weigh 3990 lb. with fuel, oil and water. Petty also uses a destroyed engine with 404 cid, permitting a car weight of 3780 lb. The lighter car is an advantage on smaller tracks, where tire wear and handling characteristics are more important than the slight power gain of the larger engine.

High tire loading causes stock cars

to be driven quite differently from other racing vehicles. While sports and Grand Prix cars do little sliding in corners, stockers always slide around turns with reverse steering lock applied. Why? The highly loaded rear tires cannot accept cornering forces along with the brutal torque of a good NASCAR engine. As the driver starts to "power out" of a turn, the rear end of the car slides toward the guard rail in an exaggerated power-oversteer attitude. It may not be tidy technique, but stock car racing fans love it. One thing is sure. It's a thrilling sight to see Richard Petty roar through a high speed turn, tail hanging out almost to the rail, engine roaring at full loud.

A full-floating rear axle is required on NASCAR stockers. This means that the rear wheel cannot pull away from the car if an axle shaft fails. To prevent wheel loss, the axle shafts are carried in a pair of extra large tapered roller bearings, and attached by hubs which fit over flanges in the axle housing. If an axle shaft breaks, the outer portion of the shaft holding the wheel and brake drum will be held by the flanged housing. However, no power

can be transmitted through the broken shaft.

Front wheel bearings are huge. They look more like parts from a 50,000-lb. truck than those of an intermediate-size automobile. They revolve on large-diameter spindles, designed to accept full crash impact without snapping. And, they usually can do it.

Lower control arms are Chrysler Corp. C-body units, as normally fitted to Plymouth Furys, Dodge Polaras and all Chrysler models. These are shortened to match B-body (Belvedere, Coronet) length. Then they're rewelded. Petty's Plymouth is different from most Chrysler product race cars in the rear suspension area. Rear springs are inboard of the longitudinal frame members, to increase tire clearance. Petty's crew therefore must use heavier rear springs for a given roll rate, due to the increased leverage of the tires on the narrow-center springs. Also, this narrow spring spacing requires higher ride rates for a given roll rate, not always desirable for wheel adhesion on rough surfaces. However, the handicap must be more apparent than actual, since Richard is very fast on

the small, rough-surfaced ovals, too.

Powering this assembly of ultra-heavy chassis components is the famed Plymouth Hemi. The engine can be run in either 426- or 404-cid trim. The higher powered 426-cid engine is the one used for super/speedway (Daytona, Charlotte, Atlanta) races. The only significant difference between the two engines is the crankshaft stroke.

Maurice Petty, Richard's brother, is responsible for the screaming Hemi in No. 43. He is acknowledged to be one of the top engine men in NASCAR. But readers expecting to learn a raft of speed secrets now are going to be disappointed. Maurice is a superb engine builder, a craftsman of the highest order. But, the engines he produces for the Petty Plymouth are largely stock. Yes, *stock*. This is not to imply that the Petty engines are simply pulled from a box and raced, but rather that the actual components, the power-producing ingredients of the engines are standard MoPar pieces. Maurice's skill is evident from the competitive record of the car, but this skill is applied in assembly and tuning, rather than in

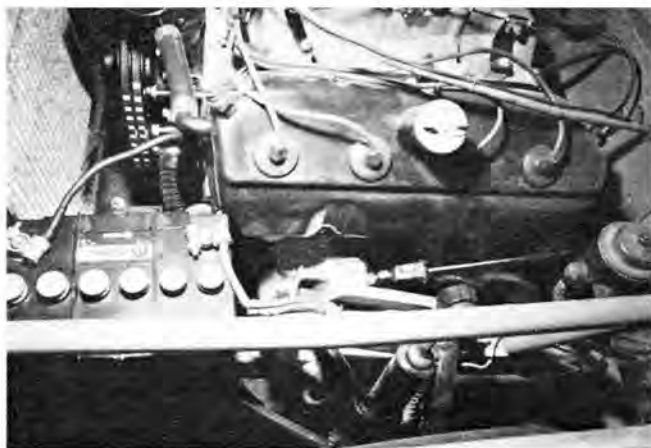
IMMACULATE FAIRING seals area behind rear axle. Springs are mounted inboard of frame rails for increased tire clearance.



STEEL WHEELS have double-thickness center sections to prevent lug nuts from pulling through wheel during hard cornering.



PRESSURE FITTING at front edge of valve cover permits addition of five quarts of oil in seconds during brief pit stops.

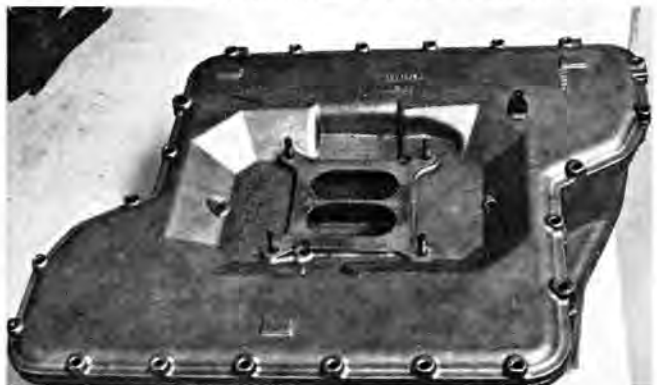


LARGE-DIAMETER, extra-long wheel studs, huge wheel bearing cups reflect magnitude of stresses absorbed in racing.

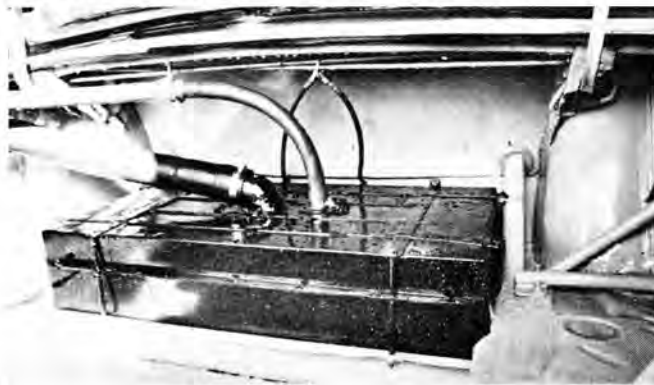




RAM-TUNED intake manifold offers 20-bhp gain over conventional manifold shown in engine photographs, but throttle response is poor, causing driving problems on short oval or road courses.



FUEL TANK is safely encased by rear sheet metal, carries 4-in. diameter, straight-flow filler tube and 1-in. vent tube which exits just above left rear taillight through fender cap assembly.



PETTY'S PLYMOUTH

continued

drastic modification. He echoes the opinion of other successful racers, that he does not intend to change a combination which has been developed by a team of Chrysler engineers, using the finest laboratory facilities.

What makes Richard run? Care, mostly. Care in checking individual engine components, care in assembly, and care in tuning and maintenance. The cylinder block, heads and valve train (except for the camshaft) are all standard street Hemi pieces, the same as are fitted to any production Hemi-powered Plymouth Belvedere. Crankshaft, pistons, and connecting rods are super-duty parts sold by Chrysler as special racing units. Maurice inspects each part with fanatical care, using the Zyglon process for detecting cracks, and trusting his experienced eye for picking the best matched and fitted units to run together.

Among the standards the components must meet: Lower-end clearances for the hard-working Hemi are 0.0025 in. for main bearings, 0.003 in. for connecting rod bearings. Chrysler treats the crankshaft with the Tufftride process to improve bearing surface hard-

ness and increase fatigue strength slightly. Maurice polishes this by hand, using fine emery paper on each bearing journal. Feeding these bearings is a standard, dual-pickup Chrysler racing oil pump. This pump draws oil from a swinging, free-pivoting pickup funnel with two outlets. One outlet runs into the pump within the oil pan; the other runs into an external line, which enters the oil pump just above the block/pan joint.

The forged aluminum pistons have 0.008-0.010 in. clearance at the skirts, and carry Dykes-type piston rings (L-section, rather than solid rectangular section). Compression ratio is 12.5:1, a practical limit for sustained hard running on gasoline. Higher compression ratios invariably cause detonation problems, and subsequent engine failure.

The oil pan on Petty's engine is a part built by the Petty crew. The pan is relatively shallow, to stay within NASCAR's 6.5-in. ground clearance rule, but has a very wide lower section. Total oil capacity, including the oil filter and Modine oil cooler, is about 12 qt.

The standard Chrysler ignition sys-

tem is fine for most tracks. On really fast circuits, such as Daytona, Maurice relies on a Chrysler-developed Prestolite Transnitter system. It has transistorized circuitry triggered by a standard race-Hemi short-breaker dual-point distributor. Fuel pump is a standard Airtex mechanical unit. NASCAR rules prohibit electric pumps for safety reasons.

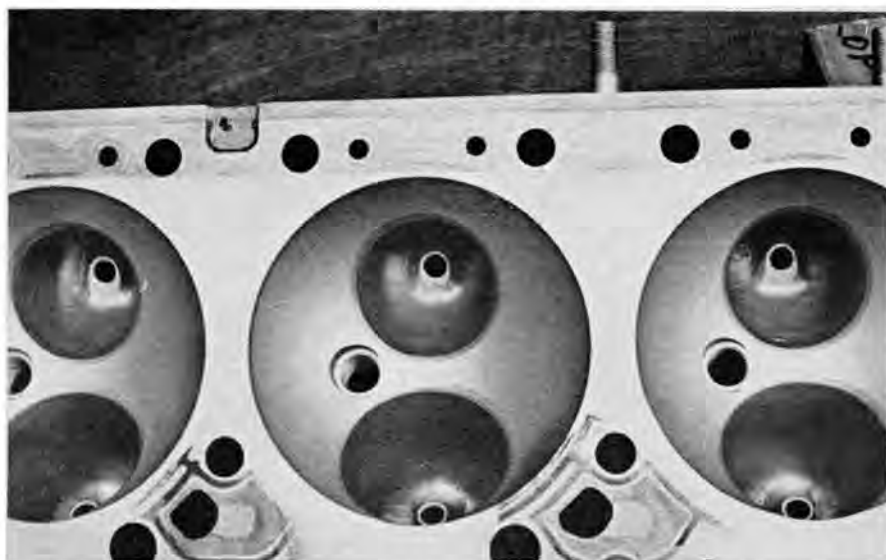
The intake manifold shown in the LaTourette drawing is the "little," or short-track manifold. The photographs show the Chrysler "bathtub" two-piece manifold. The larger bathtub manifold reportedly is worth some 20 bhp, but throttle response with this long-ram unit is not acceptable to many drivers for short-track racing. Currently, Chrysler's stock-car development experts, Larry Rathgeb and Warren Tiaht, are working to improve response without losing this power boost. Whatever manifold is used, the carburetor is a Holley center-pivot 4-barrel unit with 1.688-in. throttle bores. This throttle bore size, limited by NASCAR rulings, caused much grumbling in the Chrysler racing organization. Ford wedge-chamber engines are permitted two similar carburetors, in an attempt to offset the basic superiority of the hemispherical combustion chamber. Petty's Plymouth produces approximately 600 bhp, contrary to the 525-bhp claim of Chrysler Corp.

Backing up the 600-bhp Hemi is a

standard Chrysler four-speed manual transmission. For oval racing, Petty uses standard ratios. For road racing, he juggles ratios slightly to provide the right gear for each set of curves, although Chrysler racing experts refuse to comment upon their gear ratio selections. The transmission is fitted with an oil cooler, similar to the rear axle oil cooler shown in the cutaway. For oval racing, only the rear axle cooler is used. Both of these coolers have small Modine fin/tube cores and a squirrel-cage blower like that used in passenger car heaters.

The Petty assemblage of go-fast machinery must be stopped, too. And stopping a 4000-lb. stocker that is capable of nearly 200 mph is a real task. Surprisingly, disc brakes won't work on Petty's Plymouth, either for oval or road racing. Reason: There are no disc brakes available having enough heat capacity to do the job. The brakes which will be the huskiest-looking drums used anywhere in the world. Drum diameter is 11 in., and linings are 3 in. wide. But, size is only part of the story. Brake shoes are anchored to cutaway backing plates made from half-inch thick steel plate, and carry five-segment cerametallic linings. These linings are a bit short on effectiveness, so a standard Belvedere power brake booster is used for road racing. Richard prefers not to run power brakes on high-speed ovals. Brake line pressures run as high as 2000 psi, and normal drum temperatures can go as high as 900° F, though lining wear increases drastically as temperature exceeds 750°. These super/drums very effectively retard the progress of Petty's stormer, but better brakes would be a worthwhile improvement, particularly if better, or bigger tires become legal.

The Petty crew's superb finishing



METICULOUS WORKMANSHIP is evident in superb port grinding and polishing job. Chrysler hemispherical-chamber cylinder heads are standard cast iron units.

and detailing are visible in the accompanying photographs. Little things like double-tapered wheel lug nuts (can't be installed backwards), specially threaded lugs which cannot be cross-threaded or stripped, accessible maximum-legal-size (4 in. inside diameter) fuel filler tube, adequate fuel tank venting for fast filling, and a pressure fitting for instant oil addition all insure rapid pit stops, an essential factor in winning long races. Driver comfort is aided by a fully padded, wraparound bucket seat with extra support on the right side for oval racing. The padded steering wheel and spring-surfaced accelerator pedal help driving control on rough surfaces, and extensive roll cage padding reduces the likelihood of injury.

The overall performance of the Petty Blue Plymouth is amazing. Top speed potential is over 200 mph (did someone say this was a stock car?). In view of the size and bulk of the car, handling is really good. Durability is phenomenal, with engine speed running to 7200 rpm down the straights for the 500 miles of Daytona.

This is a racing machine, as sophisticated and well-engineered as any type of competition vehicle in the world. With Richard Petty's aggressive, yet polished driving ability, and a car as well prepared as the famed No. 43 Plymouth, the Petty organization undoubtedly will continue to gather wins in the NASCAR series, America's most colorful and brutally exciting racing show. ■

THE THINGS race cars are made from—these bare unitized bodysells are the beginning of the 1968 Petty Plymouth racing team. From these shells, Petty Engineering Co. will build NASCAR's fastest vehicles.

