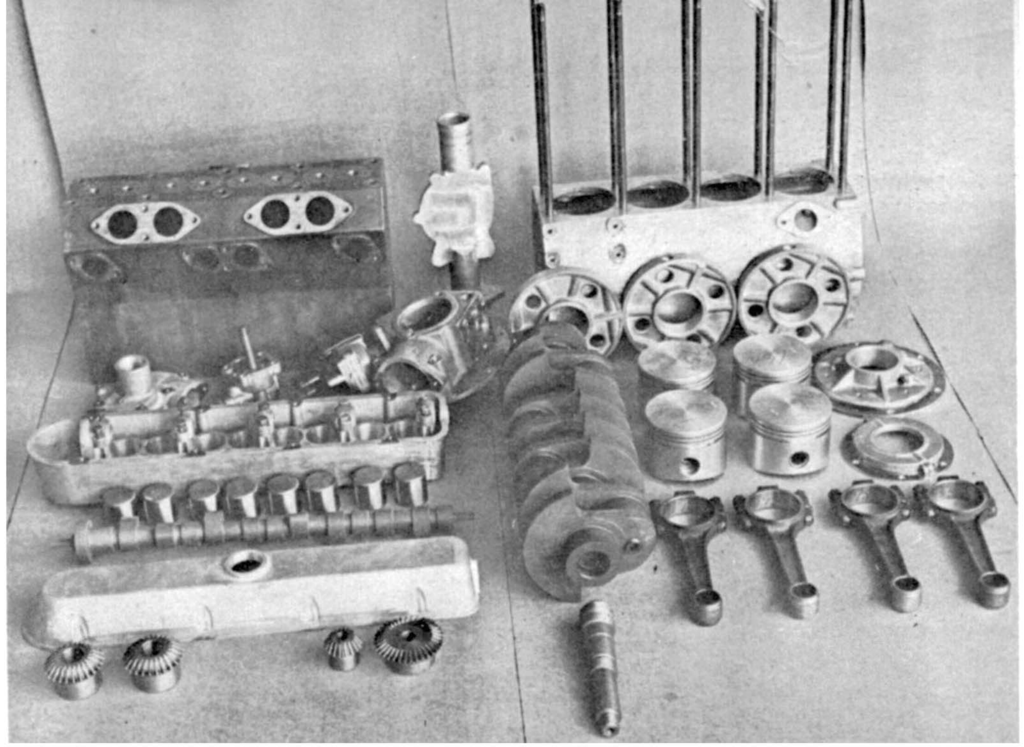
# ONE HORSE PER POUND

## PART II Concluded

by OCee Ritch

ALTHOUGH the fabricated steel block of the original Crosley engine was put down as a complete failure by most of the automotive industry, its designer, Lloyd Taylor, was convinced that the *process* on which it was based was sound. Other engine concerns continued to use a hand-welded method of fabrication successfully and, as SCI technical writer Karl Ludvigsen notes in his article on the Mercedes M196 ("Mercedes Hottest Engine" SCI May, 1957): "They (Mercedes) can draw on experience with everything from powerplants to fighter planes and have plenty of time to test out new ideas thoroughly in the racing shop. For this reason their well-tried welded cylinder block construction was resurrected again for the new racing engine. Totally unsuited to mass production, it nevertheless is reasonably light and gives perfect control of wall thickness."

Two points are well brought out here. Hand welded fabrication is time-consuming and therefore costly. But the use of steel plates of accurately-controlled thickness produces walls of even heat-transfer ability, eliminating hot spots and the other headaches of core castings. If, possibly, one could take advantage of the latter without the disadvantage of the former, a new advance would be made in automotive engine design.



*In addition to fabricated steel block with integral head, Taylor's Super Sports consists of a variety of special castings, standard American internals, British externals. Latter were chosen to simplify sports car conversions.*

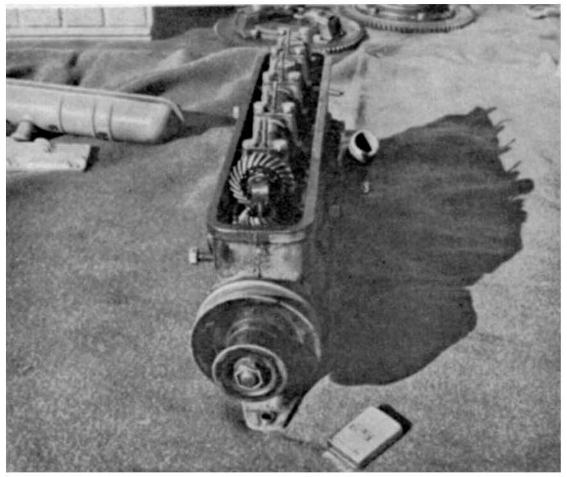
In 1946, Lloyd Taylor set up a small shop in the industrial section of Los Angeles to begin work on a new model. It was to be built to rigid specifications, yet involve no hand work in fabrication. Being only partly idealistic and knowing that self-satisfaction won't pay any bills, Lloyd also looked around for an outlet for whatever might emerge from the works. Having had recent bitter experience with big industry, he reasoned that aiming another shot in that direction would be futile. Aircraft builders were pretty well hooked on air-cooling, so he settled on the racing brotherhood as possible customers. Here is a group constantly on the *qui vive* for new developments, and one which demands perfection and doesn't mind paying for it.

At this period, Los Angeles was being swept by a boom in midget racing. A half-dozen quarter-mile ovals in the area were causing angry protests from sleepless neighbors, and you could attend a midget "go" every night in the week by traveling only across town. This was the era of the Gilmore Gold Cup, the board tracks in the Coliseum and Rose Bowl and the "Big Money". So many races were carded that the URA, the sanctioning organization, divided its cars into "Red" and "Blue" circuits, separating the Offies from the V8-60s and other non-ohc mills.

Competition among drivers was keen but there was little competition for the Offy. This looked like a worthy challenge to Brother Taylor, so he set out to build a 96 cubic-inch two-stick overhead lighter and even more rugged than the redoubtable Meyer-Drake.

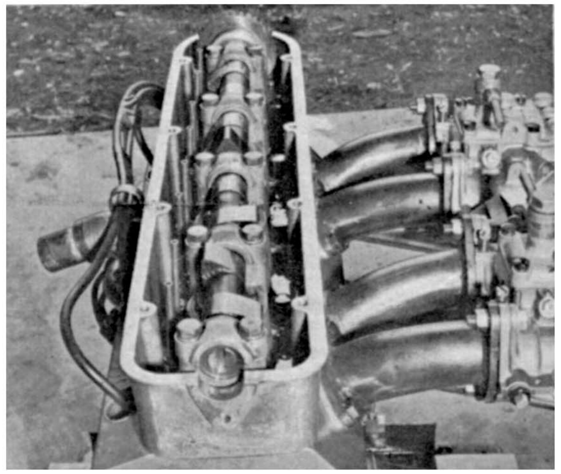
The results of his labors weren't as productive as he had hoped. The midget madness swept through the land like the Asiatic Flu, passed on about as quickly, and left a lot of sick people. By the time Taylor had completed his shop and, working unaided, assembled equipment, had tooling made and produced an engine, the midget market had pretty well disintegrated. Used midgets were for sale at half the filling stations in town. But with the philosophic approach which has carried him through the past 30 years, Lloyd went ahead with experimentation.

About the same time, the Richfield Oil Company was delving into new high-octane fuels and had set up one of the most complete engine analysis labs to be found on the Coast. Upon completion of his double-knocker, these facilities were offered to Lloyd. On the dynamometer at Richfield, the results of many new and interesting ideas were studied, accepted or discarded, and the groundwork was laid for the present Super Sports engine.

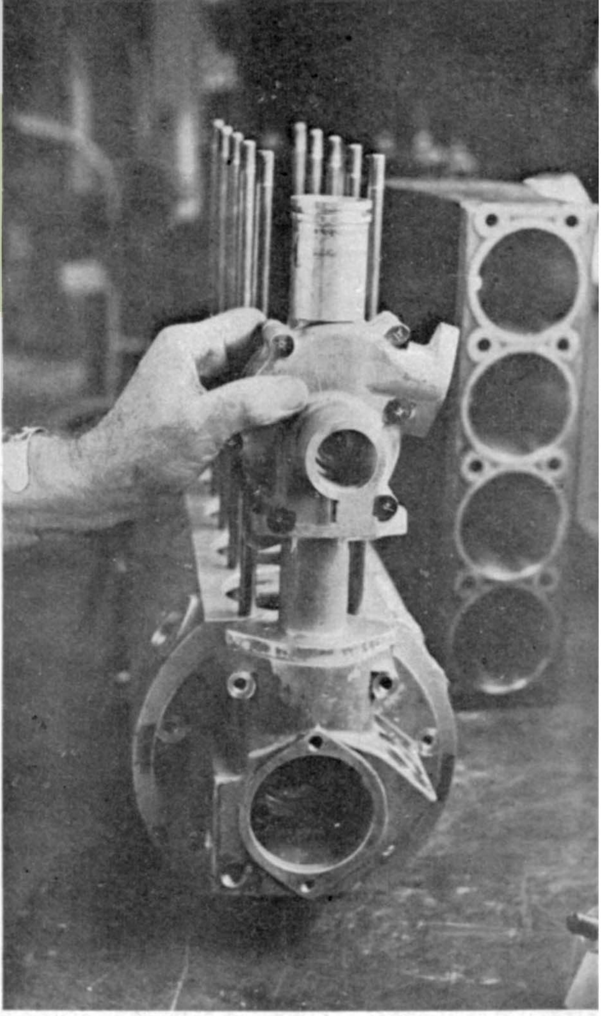


*LEFT, The Crosley, though similar in layout, differed in bevel drive details and required accurate adjustment.*

*RIGHT, Taylor's SS features separate ports and easily adjusted bevel drive gear.*



*Tower shaft to single overhead camshaft (sohc) drives water pump. Preloaded thrust bearing eliminates gear noise when block expands or contracts with temperature changes. A 2nd bevel gear on crankshaft nose drives oil pump, distributor.*



The fabricated two-cam 96 had 12/1 compression, developed 90 hp on pump gas and weighed 190 lbs. It was run-in in one to eight-hour periods for 200 hours at full throttle, full load and never faltered. (The same sparkplugs were used during the entire period and were later installed, for luck, in the SS when it was fired up for the first time.) This is about like running your car at top speed for some 20,000 miles, a couple of hundred miles at a time, letting it cool down periodically only to induce maximum wear.

Following this display, Lloyd installed the 96 in his MG TD and drove it daily for another year. Upon disassembly, the engine showed only tolerable wear in cylinders or bearings.

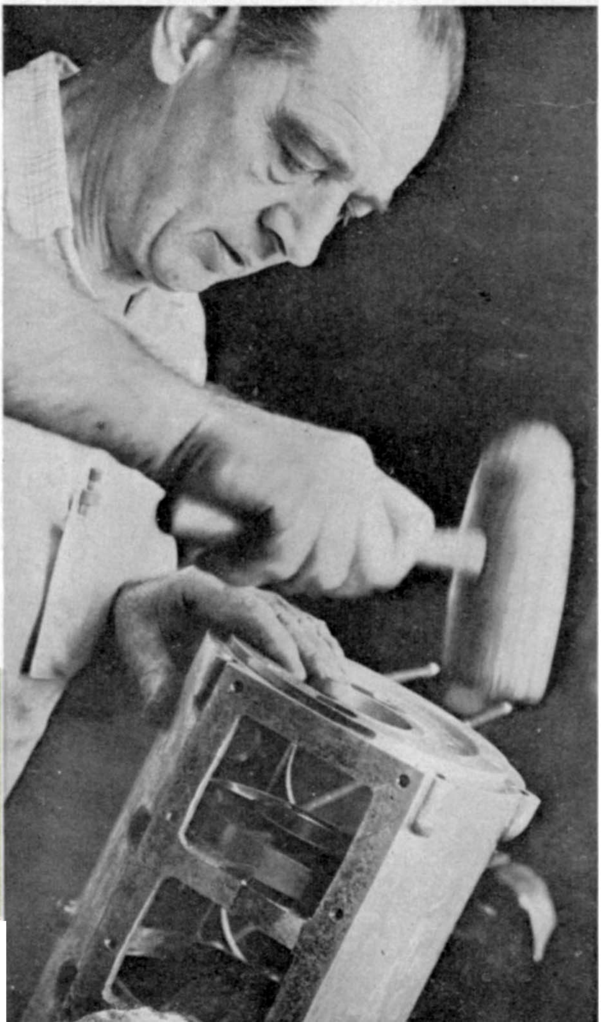
While driving the MG, Lloyd was in the habit of choosing off with others of the breed at the customary stop-light drag strip, and took great delight in storming away to the accompaniment of baffled expressions all around. Taylor avers that he never had an opportunity to unwind the 96, but admits to turning 70 mph in 3rd cog on numerous occasions.

Taylor's more serious experiments might have ended with the midget bust if chance hadn't brought him into contact with his neighbor Orland Wilcox, a young engineer. Fascinated by the story behind the engine in the TD, Wilcox urged Taylor to renew his interest in high-performance mills and to work out new designs for the burgeoning sports car movement.

This combination has proved to be a fruitful one. Certain details of tieing the block to the case had never been solved to Taylor's complete satisfaction, but Wilcox was able to supply a method. Other engineering developments and improvements were forthcoming and patents on a number of unique features have been applied for. A small company was formed and the SS was put into the works. Harry Weber, a pioneer in the hop-up accessory field, is a long-time friend of Lloyd's, and Weber's fully-equipped machine shop, which contains all the necessary mechanical helps vital to building from the bench up, were used for experimental work.

The head-en-bloc design of the SS is not new, but it is one of the soundest approaches to high-output performance. Its disadvantages, when conventionally cast, are largely those of costs. Valve seats and guides are more difficult to insert, an overhead cam arrangement is called for with its attendant drive mechanism, and the need arises for securing the block to the case; all these add up to nearly prohibitive costs.

Its advantages, on the other hand, are important: higher compression is possible without the danger of blown gaskets, and better heat dissipation is obtained through full and continuous water jacket. By using fabricated-steel, the SS at once overcomes the difficulties and takes full advantage of the possibilities.



*Lloyd Taylor demonstrates insertion of rear main bearing web in cast aluminum crankcase. Center three main webs fit into purposely cracked flanges which are afterwards cinched tight with setscrews. This gives a rigid type of barrel case.*

All internal combustion engines are essentially heat engines. The expansion of burning gases in the cylinder drives the piston, which does the useful work. A certain amount of heat is thus transmitted as useable energy, but the remainder is either pushed out during the exhaust stroke or remains in the head and cylinder walls and must be carried away by the coolant, be it air or water. If this remaining heat is not well ducted, the engine overheats, preignition of the gas charge commences and things can come to a smoldering halt. In terms of thermal conductivity coefficient, the heat transfer ability of cast iron is 27, that of steel is 26. When we consider the fact that steel need be but ⅓ the thickness to render the same design strength, its superiority becomes apparent.

The average wall thickness in a cast block is a quarter inch. It is often thought wise to allow an additional sixteenth for core shift. A fabricated steel unit of comparable strength would be .083 inches thick with safety.

All other things being equal, including power output, the rate of heat dissipation must be the same whether the block is fabricated steel or cast iron. Heat flow is proportional to the thermal conductivity coefficient multiplied by the difference in temperature between the two surfaces and divided by the thickness. In formula form, this appears as $q=\frac{K\cdot\Delta T}{t}$.

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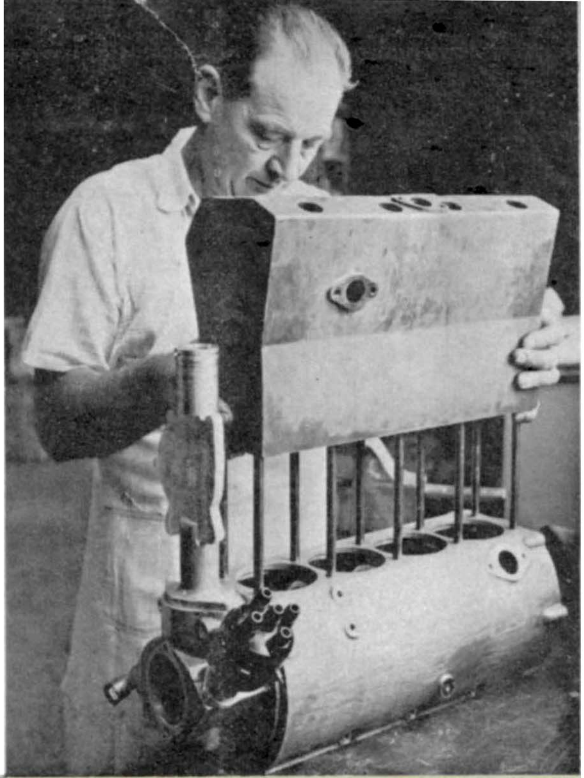
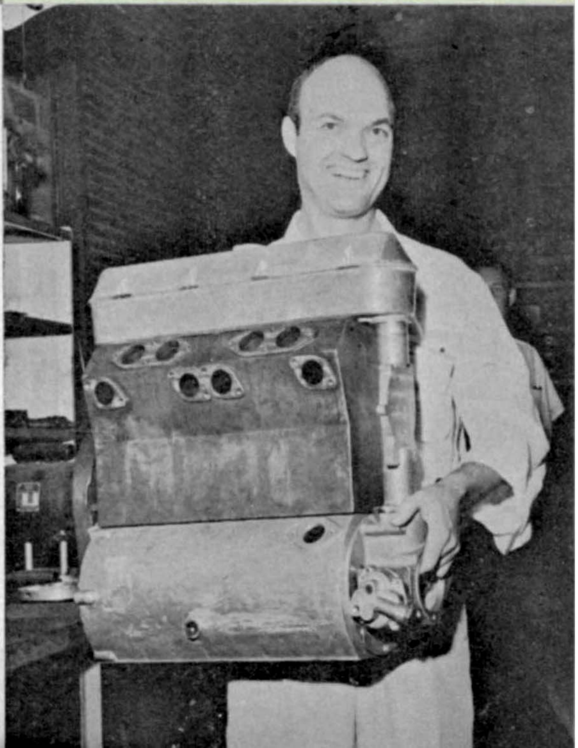


*Taylor proudly slips fabricated head-block unit over the long studs which will hold it to the barrel crankcase. Just visible are the spark plug wells at top of block.*

*Saucer-like cylinder "head" provides wedge type combustion chamber. Fabricated ports can't miss having smooth inner surface. Spark plug insert is still to be added.*



*Co-designer Orland Wilcox smiles as he lifts what appears to be a complete engine. None of the innards are there so it weighs a good deal less than the expected 180 lbs.*

## SUPERSPORTS

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Since the two coefficients are nearly the same, it is evident that the steel engine, with $1/3$ the thickness, need have but $1/3$ the temperature drop across the walls. Advantage may be taken of this from both ends; slightly lower wall temperatures will reduce lubrication problems while higher coolant temperatures (in a well-pressurized system) will permit vast weight saving in a smaller radiator. Even more important is the consistency of wall thickness, especially near the exhaust valves, avoiding undesirable hot-spots which can cause local material failures.

Because of the expense of making casting molds, fabricated steel gets the nod from a cost viewpoint, at least for limited production. (This is directly comparable to the use of fiberglas for auto bodies.) Freedom of design is a plus for this type of construction, but only when the problems of semi-mass production have been worked out, as they have in the SS two-liter. For instance, the ability to bond different types of steel together in a homogenous unit permits tool steel valve seats to become an integral part of the head, which is a still different alloy from the chrome-moly cylinders.

The combustion chamber of the SS owes no allegiance to the hemispherical shape pounced upon by Detroit some time back. There is a logical reason behind the discard of this shape. As compression ratio rises, the piston must be domed farther and farther into the hemisphere. When carried to its practical limits, we have the spectacle of one teacup inside another, resulting in a thin, curved combustion chamber of dubious efficiency. The SS head, which is bonded into the block, is a flattened saucer with three pipes protruding from its bottom, one each for plug and intake and exhaust ports. The actual shape of the chamber is the familiar "squish" type, strongly reminiscent of the Riley 4-port (for 4 cylinder Ford blocks), a popular racing conversion of the thirties. In the SS layout, the sparkplug is between the valves.

As a sohc engine, both the intake and the exhaust manifolds are on the right side of the block as viewed from the driver's seat, the ignition on the left. Intake port area is one-fifth of the bore area; exhaust ports are slightly smaller. At 6000 rpm, the 3.50 x 3.125 mill records a reasonable gas velocity of 250 ft per sec through the 1-9/16 inch intake port.

Many of the fine points in design of the SS are not apparent on surface examination, and it is necessary to get pretty far into the construction to appreciate them. For example: all external parts, including the cam housing, crankcase, shaft housings, water pump, oil pump, etc. are cast aluminum. The crankcase is a monocoque barrel, somewhat similar to the Offy but without side plates. It is cast in one piece and supports five huge bearing webs which

(*Continued on page 64*)

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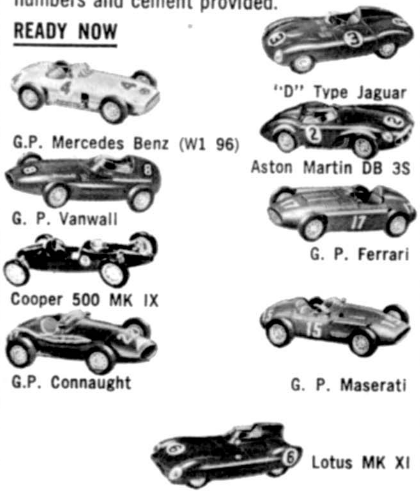

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## SUPERSPORTS

*(Continued from page 48)*

are turned to zero clearance for mating with the line-bored inner supports. The case is split longitudinally at the three center webs, and bolts are threaded in horizontally to spread the gap. The concentric bearing webs (cast in two pieces and machined together) are then assembled around the crankshaft and the entire unit is pushed in from the front. Once in place, the spreader bolts are removed and a cap screw at each main is cinched down.

The crankshaft is unusual, too. Cast of ductile iron, it has a continuous hollow core, much like the Ford *Taunus* 1500. Abrupt changes of thickness where the journals join the webs in solid cranks cause internal stresses as the metal solidifies. In the two-liter's hollow crank, the changes in thickness are much less abrupt. A further benefit is the weight reduction for given size journals. Oil is pressured through the shaft in the conventional manner, but each hollow acts as a small reservoir, giving an extra margin of safety in case of a sudden dumping of lubricant. A standpipe arrangement has been included to trap small particles which might get into the oil stream, centrifugal force keeping them at the bottom of the cavity while oil flows up the small tube to the bearings.

Power can be taken from the SS at either end. This makes it a natural for marine applications as well as automotive, and the first non-dyno installation was actually made in a hydroplane.

Further twiddling with carburetion and cams on the dyno will be productive in establishing the right combinations for marine, sports car and other possible applications. Accessibility of the overhead cam makes this sort of experimenting easy and rewarding. The cam is driven from the crank through bevel gears and a tower shaft which is splined on one end and tapered on the other. To change valve timing in relationship to the crank, all that is necessary is to loosen a bolt threaded into the shaft through the top bevel gear, tap the shaft lightly, twist the cam to the desired position, reseat the gear on the taper and snug up the bolt. Any Crosley inconveniences have been well solved. Eight cap screws secure the cam cover and ten bolts hold down the cam bearing halves, so changing cams is a snap. Broad cam cups cover dual Chevvy springs which return the valves (likewise Chevvy) at about 180 lbs. pressure. The valves seem long to those who are accustomed to working with small imported iron, but they have withstood the high rpm that hot-rodders use with the Chev V8s and there's no reason to expect any less here.

The lower portion of the front case is occupied by bevel gears driving the vertical shaft, oil pump and the distributor. As a possible replacement for BMC and other import engines in more or less short-block form, it was thought well to use as many existing accessories as practical . . . hence the Lucas distributor, starter and generator. The mounting pads are arranged for MG and Healey installation and the bell

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housing accepts the gear boxes of these cars directly, taking others through adapter rings. The side-draft SU jugs, common to this strain, are also suited to the SS and dropping a two-liter into most of the small sports cars or sedans should pose only minor problems. The lightened weight of the front end may cause some suspension problems, but Lloyd avers that his TD 96 was a handling marvel and had less tendency to push the front end out in the corners than a stocker. As more conversions are made these values will become apparent.

The first SS was set up with Solex 40 PII carburetors bearing 29mm venturis. These were deemed adequate for preliminary tests, but larger ones are necessary before high speed potential can be explored. Any all-out version will probably call for a different spark distribution set up as well. But, even without fancy extras, the SS compares extremely well with existing two-liter jobs . . . most of which are hardly available as a package and some of which are stratospheric in cost.

Best known of the Class E performers is probably the Triumph, a sturdy sort which hasn't gotten around to subscribing to the over-square theory. This 1991 cc pushrod four has an 8.5/1 compression ratio, and develops 100 bhp @ 5000 rpm and 118 lb-ft of torque @ 3000 rpm.

Pertinent details of other 2 liter power plants are shown in tabular form. Accurate weight estimates are not at hand for most of these specimens but the TR is known to tip the beam at about 350 lbs. The Bristol would probably be a bit heavier, the Maser might be a trifle lighter with its extensive use of aluminum. None, of course, can approach the SS' 180 pounds, nor do any of the group boast its 12/1 compression ratio. Horsepower ratings and torque comparisons show the SS in great shape, too, exceeded only by the Maser 'all-undone' model, and when the final returns are in, that figure may well be equalled or surpassed. Priced at $800 (give or take a few bucks) the SS is a champ.

Coincident with the favorable economic picture is the availability of spares. In addition to the previously noted Chevvy items, Ford Six rods and '54 Ford V8 pistons can be used. All bearings, (main, crank and cam) are standard sizes to be found at any parts supply house. Taylor's plans to keep a good supply of alternate cams and other vitals warehoused at all times. Production is being set up to handle a limited number of engines, but it is expected that they will be available in good quantity within the next six months. All tooling necessary to manufacture the various parts is ready to build the first five engines, so that the only lag between prototype and production will be testing time — in car, boat and on the dyno.

One SS is being put into a Devin-TR for street use and another will be installed in a hydroplane, but the most exciting possibility is that one two-liter will go into a featherweight Devin tube-frame chassis. Suitable housed in the fiberglas body, it will be entered in as many races as possible. Watch for it, you may be seeing the forerunner of America's first small-bore sports car.

*OCee Ritch*