

# SPORTS CAR GRAPHIC

FEBRUARY 1966  
50c

Exclusive Technical Report  
Jack Nethercutt's

## MIRAGE

Competition:

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### 1st STARDUST GP

Road Test:

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# MIRAGE

**W**HEN JACK NETHERCUTT SOLD HIS LOTUS 19 SOME MONTHS AGO, it was one of the fastest big Modified sports cars on the West Coast. Dan Gurney is reportedly quoted as saying it was "the best prepared 19 in the world." Fast and successful as it was, it was sold with no other contender on the competitive horizon, save the then highly-touted Lotus 30 which was making its debut at the London Racing Car Show.

It is a paradox of racing that when a car is finally developed to its ultimate form that it already is obsolete. So it was with the Nineteen. On paper and on test circuits were several new cars which would soon destroy the Nineteen's supremacy — the Lola T-70, the Chaparral, the Brabham, the McLaren, and some of the hairy hybrids like the "King Cobra" on a Cooper chassis that continually pop up in the Southern California area, with big breathing V-8's intricately nestled in the rear bays.

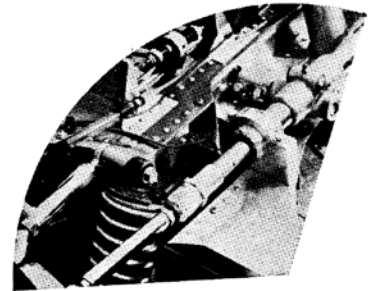
Sports/racing car design was going through a rather drastic evolutionary period. The big American V-8 was beginning to emerge from scorched asphalt strips, where the eight second-200 mph battles were being fought, into the rarified air of the international road racing scene as a very strong and reliable piece of engineering. Maybe the F.I.A. didn't know it then, but a new type of racing automobile was being born, a wild Anglo-American combination that is now officially recognized as the F.I.A. Group 9 sports/racing car.

With most of the important component manufacturers in Europe, Colotti, Hewland, Z.F., Girling, etc., the design and construction of this unique type of automobile has been pretty much dominated by a tight group of individuals who all seem to speak with pronounced English accents. Be that as it may, the talent for building such an automobile has long existed in the United States, but only Jim Hall has been resourceful and bold enough to come up with a competitive example of pure American engineering talent, and design. Although Mr. Hall is an extremely talented racing car designer, there can be no doubt now that he has had some very good advice and technological assistance from a certain manufacturer of automobiles somewhere in the Midwest, who prefers to remain anonymous! But he has led the Americans into what should rightfully become "their" field within a year or so. Others began planning similar projects about the same time as Hall, with no less ambition to build the best, yet some, like Jack Nethercutt, prefer the challenge of doing everything on their own, with no outside assistance. Both methods can be extremely successful when done correctly; it's just that one takes a little longer than the other.

Jack has long harbored the idea of building his own car, but it wasn't until the Nineteen was sold that the opportunity really presented itself. The conception of such a machine has evolved over a long period of time. With racing experience that goes back several years, and not a few very good racing cars, Jack knew precisely what he wanted.

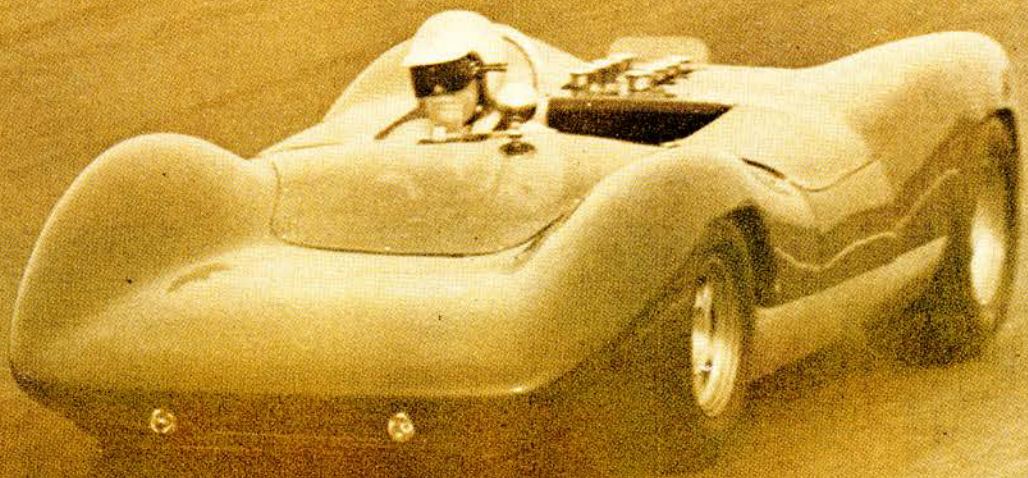
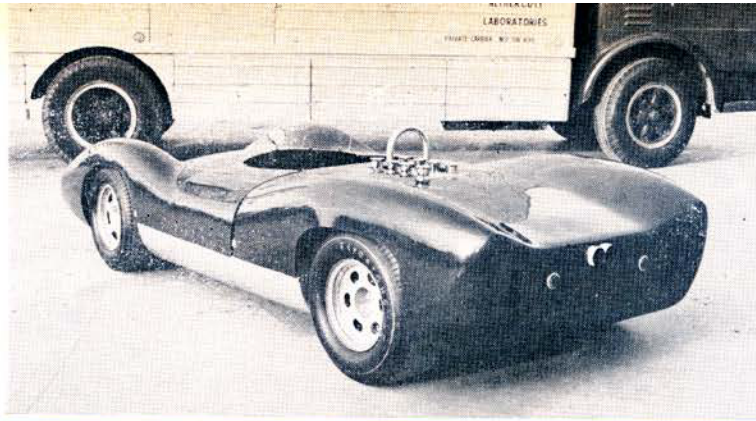
Helping stir all the ideas around in such a manner that they could actually be put down on paper was Ted Depew, a 38 year old aerospace engineer who has been involved in sports car racing since 1954, and closely associated with Nethercutt's racing during the past four years. Ted's previous experience designing racing cars had been more of a consultant nature to other Southern California constructors, and his thinking is quite evident in a very successful Formula car being constructed in the area. Although the Mirage is Ted's first solely designed racing car, his job in the aerospace field was an ideal source of information and technical background for such an ambitious project. This, coupled with some very practical experience in re-engineering Jack's previous mounts, resulted in some very advanced and sound

**The experience of being the owner and driver of a big, sleek racing machine can only be surpassed by also being its designer and builder!**



BY: J. R. D. SHUNTMASER





Jack Nethercutt, below, can be justifiably proud of the startling beauty and design concept exhibited in his new machine. While still unsorted, its potential is obvious. Future plans may include limited production. If so, you can bet Jack will have a line waiting outside his door for Mirages. We hope future tests won't show a need for spoilers and scoops that detract from the car's exceptionally clean appearance.





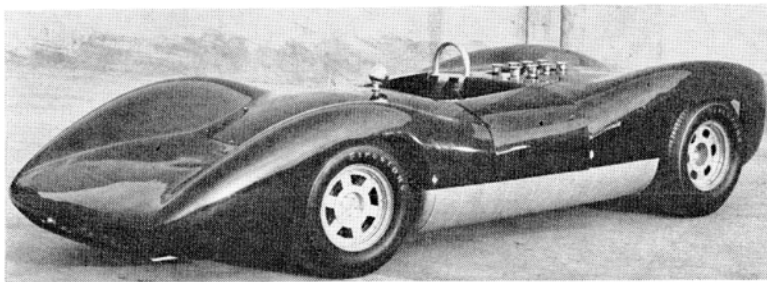
thinking when the blank sheet of velum was rolled out. Several premises were agreed upon at the outset, and rigidly adhered to until the time the Mirage was rolled out for its first tests at Riverside. Primarily, the car was to have the best power-to-weight ratio possible within the strength limitations Ted and Jack felt were necessary to keep the suspension geometry true under all conditions of stress. As they knew only so much horsepower could be extracted from a given number of cubic inches, and that that limit would soon be reached

even with the big American V-8's, they felt the limitation of frontal area and the aerodynamics should be of extreme importance. Thirdly, the car was to be simple—not the simplicity of crudeness, but of sophisticated design that could be modified easily, should it be necessary.

As the power-to-weight ratio was of prime importance, much of the initial thinking revolved around construction of the chassis, as this would naturally represent a good percentage of the final weight. Even with Ted's experience in aircraft design

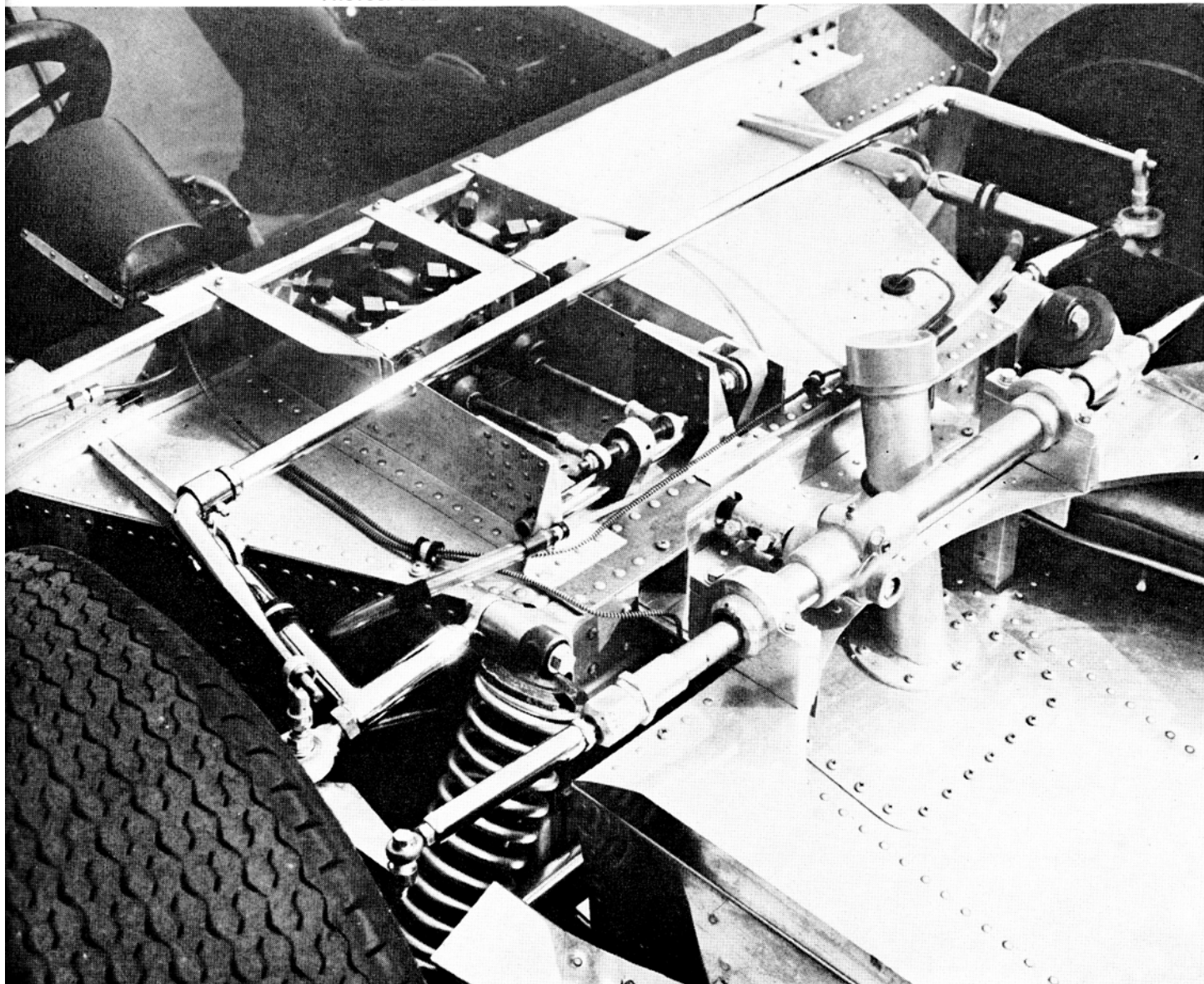
it is amazing that the Mirage was built in the monocoque principle, because it is so completely different from conventional chassis structures that most private constructors hesitate to even think about it. On top of this, special fabrication skills are required and most racing mechanics know very little about monocoque construction unless they've worked in the aircraft industry. Nevertheless, the challenge and the tremendous advantages of strength and ultra-light construction convinced the two that this was the answer. First Ted de-

# MIRAGE

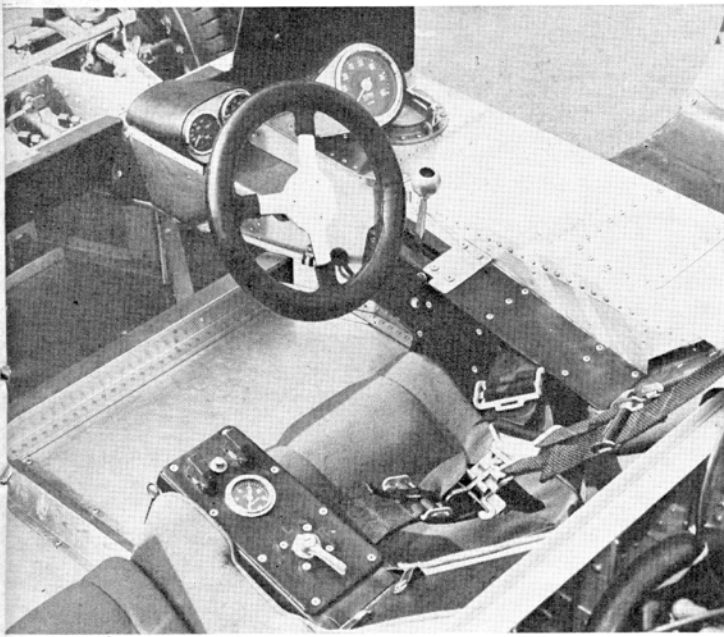


PHOTOS: PETE BROCK — BOB D'OLIVO — DARRYL NORENBURG

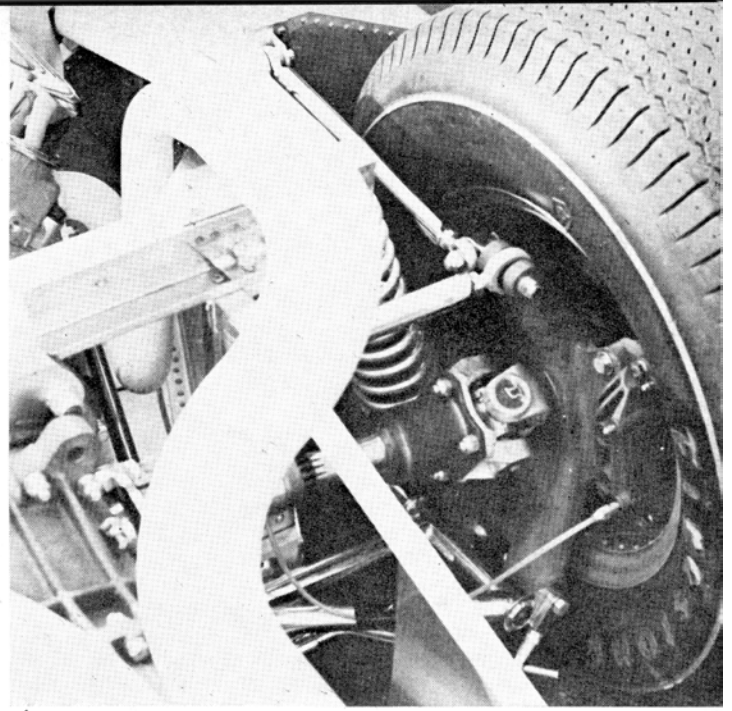
- 1—Glass body covers all-aluminum structure underneath. Fuel tanks are built into rocker panels.
- 2—Upper suspension arms, both front and rear, are exceptionally short. Light-weight rack-&pinion connects in same plane with suspension.
- 3—The cockpit is both tidy and roomy, with the tach located to the right of the small wheel.
- 4—Cast rear hub-carriers are braced well into the wheels. Airheart caliper is visible here.
- 5—Monocoque wheels shock onlookers, but actually are as strong as cast wheels, lighter to boot.



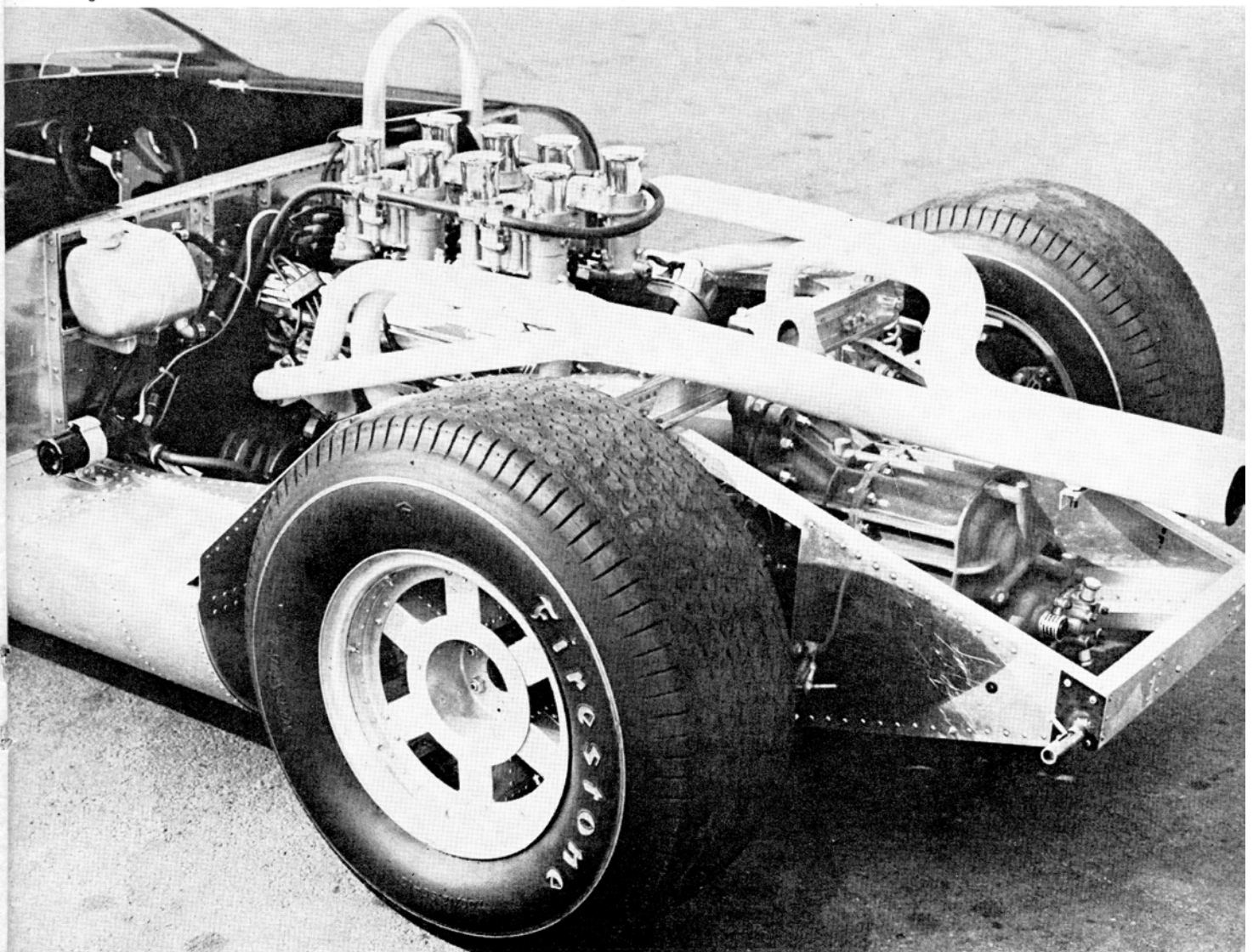




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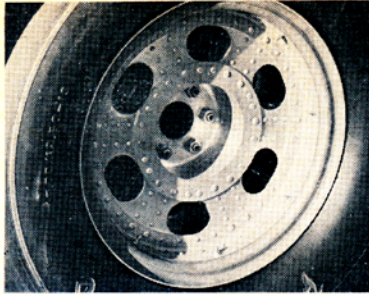


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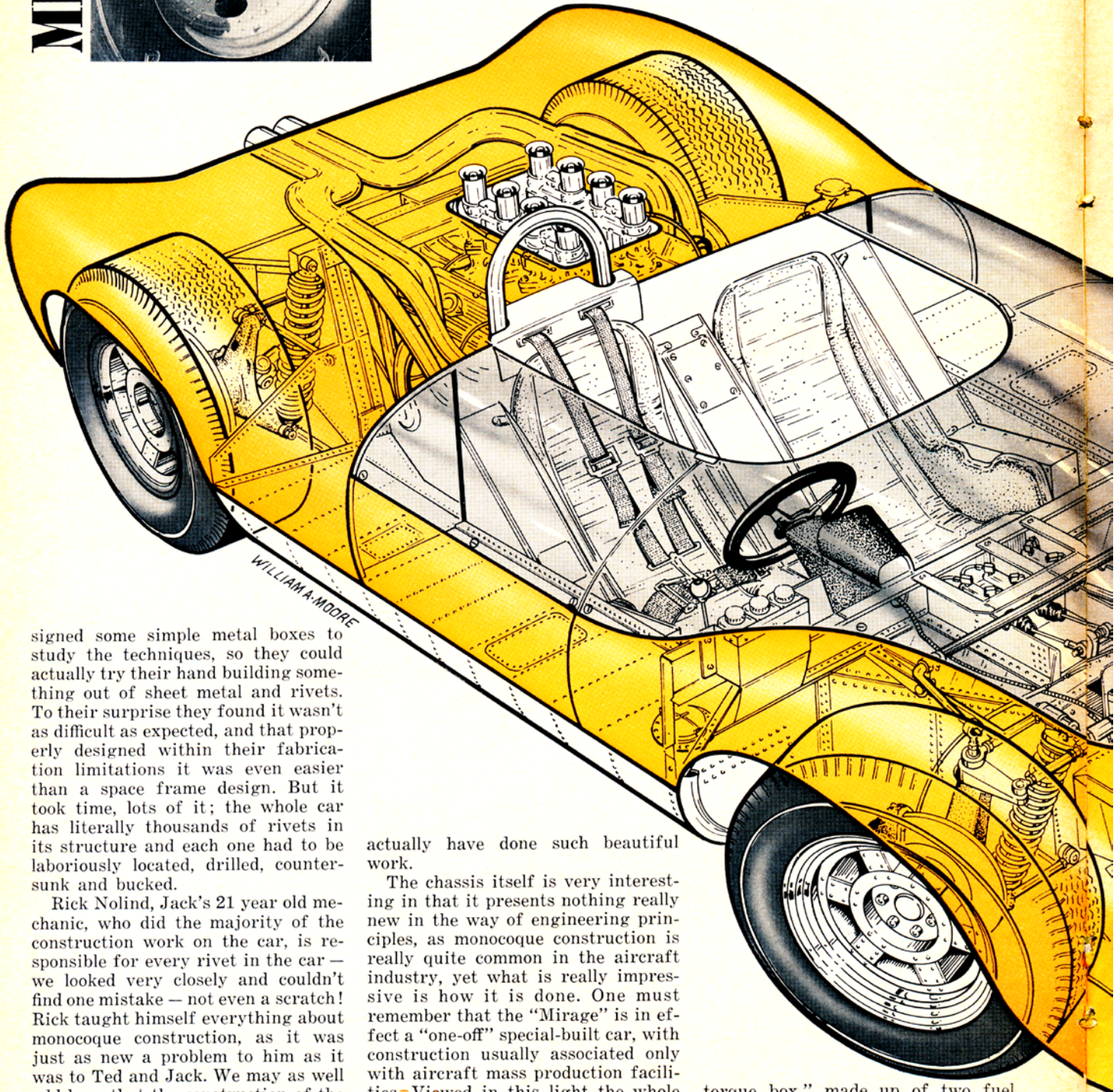




# MIRAGE



Made of alloy sheet, the 13-inch wheels both bolt and rivet to the rims and machined hubs. Bill Moore's cutaway shows the chassis details.



signed some simple metal boxes to study the techniques, so they could actually try their hand building something out of sheet metal and rivets. To their surprise they found it wasn't as difficult as expected, and that properly designed within their fabrication limitations it was even easier than a space frame design. But it took time, lots of it; the whole car has literally thousands of rivets in its structure and each one had to be laboriously located, drilled, countersunk and bucked.

Rick Nolind, Jack's 21 year old mechanic, who did the majority of the construction work on the car, is responsible for every rivet in the car — we looked very closely and couldn't find one mistake — not even a scratch! Rick taught himself everything about monocoque construction, as it was just as new a problem to him as it was to Ted and Jack. We may as well add here that the construction of the whole car was Rick's responsibility, and the quality of work is far beyond his years — most observers look back and forth between Rick and the car several times to try to assure themselves that such a young man could

actually have done such beautiful work.

The chassis itself is very interesting in that it presents nothing really new in the way of engineering principles, as monocoque construction is really quite common in the aircraft industry, yet what is really impressive is how it is done. One must remember that the "Mirage" is in effect a "one-off" special-built car, with construction usually associated only with aircraft mass production facilities. Viewed in this light the whole exercise is fantastic, as Depew has managed to simplify complex airframe techniques into construction methods entirely suitable and practical for race car construction. Ted describes the chassis as a "multi-cell

torque box," made up of two fuel sponsons on either side of the box that are forced to take the torsional loads of the automobile, as well as accepting partial suspension component loads, and of course function as fuel tanks. It is to this basic

**SPORTS CAR GRAPHIC**



structure that all sub-assemblies, including pedals, steering, engine, transmission, and suspension components, are attached. A target weight of "under 1300 pounds" was planned, and the resulting 1280 pounds shows Ted's engineering wasn't far off. With half a load of fuel in its 34-gallon tanks, the car scales about 1400 pounds. Fully gassed, sitting on the line, with Jack in it, the car weighs 1620.

We asked Ted about the torsional rigidity of the chassis and he explained that it was impossible to gauge the strength accurately without actually putting it on a torsional rack and destroying the chassis, but that mathematically he has estimated the resistance to twist at "something like 5000 ft. lbs/degree." This is an extremely rigid figure, and compares favorably with the finest racing chassis in the world. The structural rigid-

ity of a modern racing car chassis is of extreme importance if the laboriously calculated suspension geometries are to be of any value, as the slightest flexing in the chassis will completely destroy the suspension geometry plotted with a rigid chassis in mind.

Ted's philosophy in designing the suspension was first to determine a target weight, locate the center of gravity (in this case about 12-14 inches off the road surface) and then compute the roll centers. "The front is slightly lower than the rear, to induce understeer, and the geometry is figured on the car being pretty much 'gone' by seven or eight degrees of yaw—within these parameters I've tried to keep everything as constant as possible—no quick changes in geometry mean that things stay pretty predictable, even if you get on the hairy edge. Camber doesn't change more than one degree per inch of travel, and we've got more wheel travel than most, with a total of 5½ inches. This permits a relatively "soft" suspension, which will absorb all but the most gigantic imperfec-

tions in road surface."

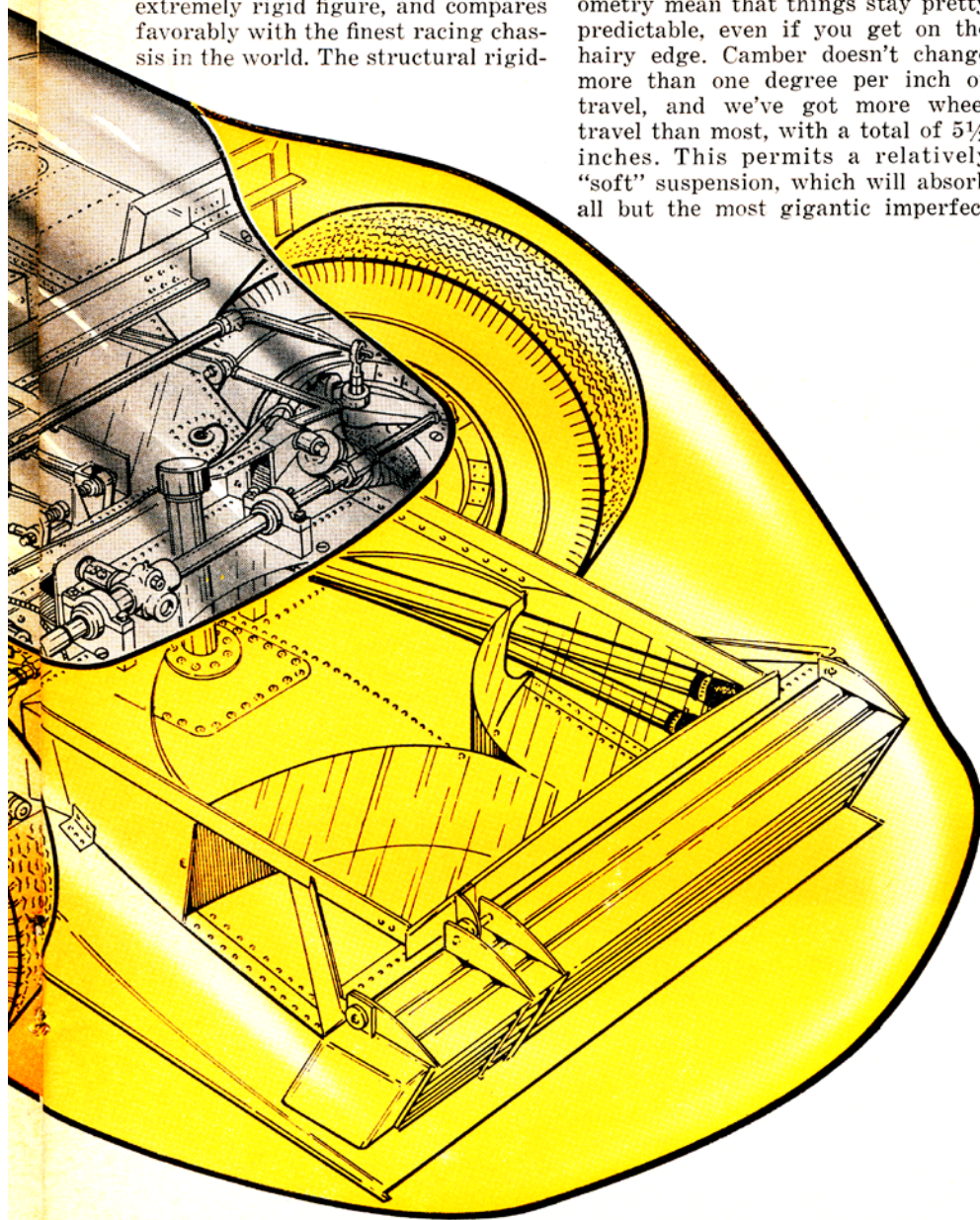
Coil/shock suspension, with special Armstrong shocks and Nethercutt springs, is used on all four corners, and several combinations of anti-sway bars are available at either end to tune the chassis to whatever circuit or conditions prevail.

The handling ability of any automobile is due in part to its ratio of sprung to unsprung weight. With the ideal geometry and suspension points located on paper, the search for lightness in the unsprung area began. The ball joints and fabricated tubing suspension arms are not unique in practice, but Nethercutt's are of surprising lightness because the geometry is designed in such a way as to keep the links as short as feasibly practical.

It is the Mirage's wheels that stop even the most blasé racing enthusiast—they're sheet metal, that's right, a "monocoque wheel" assembled with rivets! When the first rumors of the "monocoque wheel" started filtering out several months ago, no one could quite believe in the concept, much less the actual existence of such a wheel. When finally seen in the broad light of day, the wheels look so simple and so strong it's a wonder that no one has used the idea before. There are good sound reasons for a monocoque wheel, though at first one is inclined to believe it was done just to be different. Hardly. The wheel is a brilliant solution to a problem not even Colin Chapman has been able to solve, a 13-inch wheel on a sports car—Grand Prix cars, yes, but no one has yet designed a successful big-engined sports car with 13-inch wheels because of the brake cooling problem with an envelope body. If you will remember back a bit you will recall that the Lotus 30 was introduced at the London Racing Car Show on 13-inch wheels, but even today the 30 or even the 40 is raced on 15-inch wheels. The crux of the matter is brakes—purely and simply a conventional 13-inch wheel does not permit enough swept area within a sports car body to cool effectively. As brake cooling is directly proportional to the size of the braking disc and caliper, and this in turn is governed by the inside diameter of the wheel, a 15-inch wheel "barrier" seemed to have been reached which, until now, no one could overcome.

Let's go back a bit to one of the team's basic premises—that of frontal area. As the height of the wheels has a great deal to do with the resulting frontal area, the Mirage team were strongly convinced that their car, no matter what all the experts said, would have to have 13-inch

(continued on page 78)





## MIRAGE

continued from page 72

no spoiler has been designed into the rear end, despite current practice towards larger and larger spoilers.

Brock comments, "We don't anticipate much lift with this shape, and when the car was driven at Kent we ran 174 miles per hour and didn't experience any. However, on some of the fastest circuits with sweeping bends, it might be necessary to move the center of pressure rearward to create a little more stability in the sweepers. If this proves necessary we have a solution ready, but we'll wait until we need it."

On learning that the car had run over 170 miles per hour in tests, we were more than a little interested in what made it go so fast. The engine is a lightweight aluminum Oldsmobile V-8 prepared by Traco Engineering of Culver City. Evidently much special experimental work went into the engine, as it remained at Traco for several months undergoing dynamometer tests and developmental work while the chassis was being constructed. Displacement is 280 cubic inches, which puts out "something over 375 bhp at 6800 rpm. Induction is by four 48-IDA Weber carburetors on a Traco intake manifold. A roller type cam, built by Traco specifications, handles the valve work, while a special distributor fabricated from a Corvette housing, with integral tach drive, takes care of the ignition. The only other external modifications visible are a lightweight alternator and a very special looking fabricated oil pan which, in combination with the rest of the oil system, holds 12 quarts. Although there was some hesitancy to discuss the actual specifications of the engine, there's a lot more than meets the eye to this "little" V-8. Acceleration tests coming out of Turn 6 at Riverside show the "Mirage" to be considerably faster than any of the competition timed there at last year's Times Grand Prix. When asked about the choice of an Oldsmobile for the powerplant, Jack told us that he knew Traco could get the horsepower, as they've got a good background on the B.O.P. aluminum V-8's. They've been working on a developmental program for Brabham and McLaren.

The transmission is the ubiquitous Colotti T-37, chosen more for practicality's sake than any other reason, as it was used on the Nethercutt Lotus 19. This may not be the final gearbox in the Mirage, as we asked Jack his opinion of the automatic type "Chaparral" gearbox and he just smiled. If the engineering in the car in its present form is an indication, it shouldn't be too much problem for Mirage Automobiles to come up with an automatic.

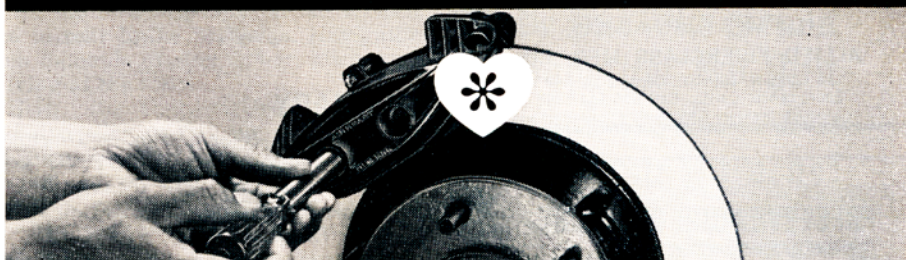
With men like Jim Hall and Jack Nethercutt leading the way, it shouldn't be too long before the other American constructors get going on their own cars, so the Americans will at last be able to compete in their own machinery on equal terms with the best of the European teams.



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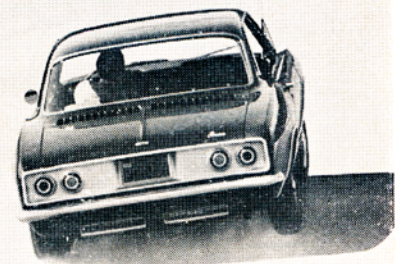
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# STARDUST GRAND PRIX LAS VEGAS

Jim Hall was leading...with one lap to go...when the Chaparral ran out of gas!

BY W.R.C. SHEDENHELM

**L**AS VEGAS IS MANY THINGS TO MANY PEOPLE: It can be garish, noisy, overly-crowded — it can be subdued and desert empty — it can be night clubs and casinos with 'hosts' out of the Elliot Ness era—it can be a completely new, high-speed road racing circuit—and for the Chaparrals it could be, and was, both defeat and victory.

Jim Hall had qualified his older-bodied (no air brake-spoiler) Chaparral-Chevy at a crackling 108.4 miles an hour on the 3.0-mile course, with a time of one minute and 39.6 seconds. The top five qualifiers were within one and one-tenth of a second of Hall's time, with Parnelli Jones (Lola T70) half a second slower, Jerry Grant (Lotus-Chevy), Charlie Hayes (Nickey-Chevy), and Hap Sharp (Chaparral-Chevy 2C) each an additional two-tenths back. All of these top five were well over a 105 mph lap average, which takes 1:42.8. Three seconds back from Hall's fast time came another group of five, these all within less than two seconds of each other . . . Bob Bondurant (Lola T70-Chevy), Mike Goth (McLaren-Chevy), Charlie Parsons (Genie Mk. 10-Chevy), Ronnie Bucknum (Lola T70-Ford) and Augie Pabst (Scarab). The top thirteen had qualified at an over 100 mph average, with the first under-two-liter car of Peter Revson (Brabham BT8-Climax) just over the 'ton.'

The new Stardust International Raceway is difficult to describe by relating it to any other road circuit in the country . . . it is similar to a flattened Willow Springs, which doesn't much help the mental image of anyone who hasn't seen Willow. It is 3.0-miles long, shaped like a lazy capital 'L,' with ten turns, if you count the five-turn esses as three turns. There are no real hairpins, with the slowest turn being taken at 50 mph by the big cars, the fastest at 120. Two of the turns are of decreasing radius and tricky. The esses are currently too tight, and going off the road almost anywhere around the course can lead to a giant, blinding dust cloud, rocks through the crankcase, or a flip. Walt Hansgen, after setting sixth fastest qualifying time, came booming into the fast Turn One, broke traction on some loose gravel on the asphalt, lost control, went off into the sand and flipped the Mecom Lola T70 through the boonies when the front wheels dug in.

Several potentially top cars were out before the starting flag dropped. Dan Gurney's McLaren had broken a suspension member during practice; USRRC Champion George Follmer was disqualified for an illegal start in the Preliminary (first ten made the 'GP' starting grid) Race, and Bondurant blew an engine in Sunday morning's practice that was

removed, rebuilt and replaced . . . three laps after the start. Bondurant's place in the 30-car field had already been filled.

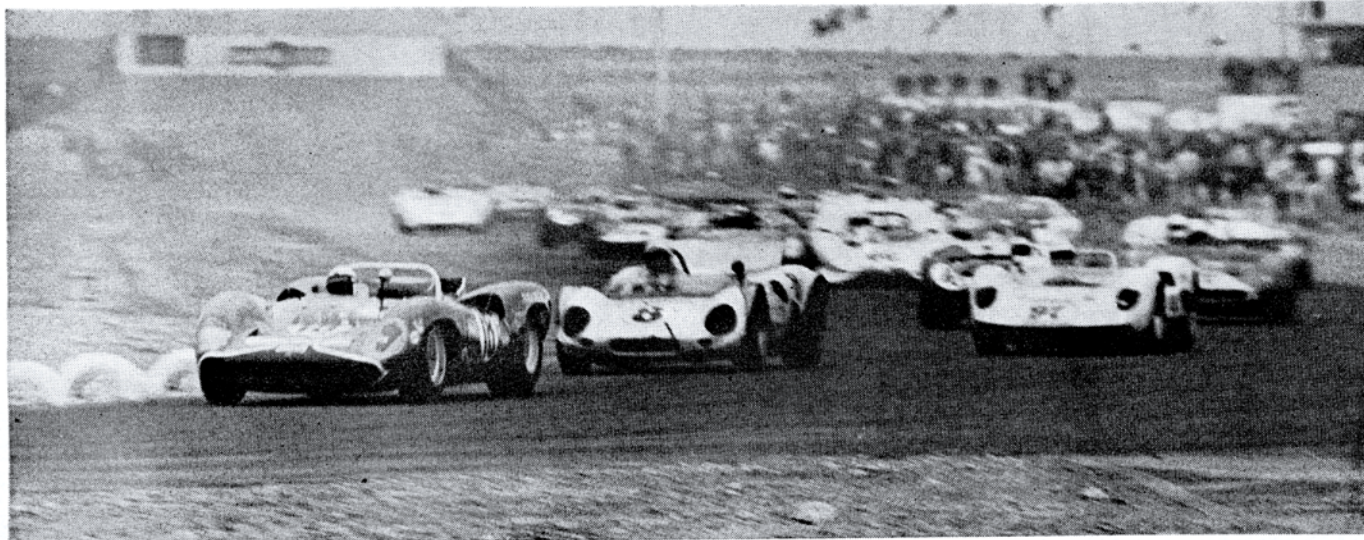
As this Stardust Grand Prix was the first big-time, FIA-observed race at the new track (there had been a hastily flung together SCCA Regional in early October to even qualify the course for that), it did not have FIA International sanction, which meant that none of the non-U.S. Formula 1 Grand Prix points-holding drivers could run, as they had at Riverside . . . Clark, McLaren, Graham Hill and Jackie Stewart.

At the start of the 66-lap 'Grand Prix' Parnelli Jones shot into the lead, his Lola T70 belching exhaust flames everytime he'd back off for a turn, with Jerry Grant's Lotus-Chevy on his tail. Behind this pair came Charlie Hayes in the Nickey Chevy and the slower-off-the-pad Chaparrals. On the fifth lap Jones pulled into the pits with broken

(continued on page 76)

1 — At the start of the Stardust Grand Prix Parnelli Jones (Lola) led Jerry Grant into the fast sweeping Turn One. Charlie Hayes is right behind, with the two Chaparrals a ways behind. 2 — Dave Ridenour (Genie Mk. 8) leads Ralph Salter (McLaren-Olds) out of a right hander. 3 — The Ford Falcons of Don Pike and of Pete Cordts led off the sedan race grid and at end. 4 — SCG's Titus was Second under-two-liter in the Elva-Porsche when his clutch oiled up. 5 — The big moment: Parnelli Jones is out after five laps, Grant (#8) has pitted after leading three more. Hayes now leads, but Hall and Sharp are ready to pass during the next laps.

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