# TESTING THE Z-28 CAMARO & SHELBY'S '67 MUSTANGS


# SPORTS CAR GRAPHIC

Sweden KR 3.90 Inkl. oms.

MARCH 1967 50¢


CLINICAL PSYCHOLOGISTS EXAMINE THE RACE DRIVER

SHELBY GT500 & GT350

## EXCLUSIVE: BUILDING THE GURNEY-WESLAKE V-12

## WINGS & SPOILERS...ANSWER OR COMPROMISE?


Z-28 CAMARO

# People write to PENNZOIL

100% Pure Pennsylvania — Safe Lubrication

**Have a question about motor oil? Lubricants? Engines? Ask the Pennzoil experts...**

**Be Seated.** My 1965 Porsche is designed to use a quart of oil in 400 to 700 miles. But the rate is about 300 miles. It appears the oil rings have never seated properly. What do you suggest?

H.J.M., Pasadena, Calif.

*The best way to correct bad ring seating is to change engine speeds on the highway. Raise the speed to the lawful limit, then decelerate as long as possible. Keep doing this. Extra gasoline will pass down through the ring area and help seat the rings.*

**Saab Story.** I have always used Pennzoil with Z-7 in my four cycle engine cars. Now I have a Saab with a two cycle engine. Do you make a two cycle oil? Also, does anyone make a tachometer for a three cylinder car?

S.A.F., Bronx, N.Y.

*Pennzoil does market a two-cycle oil, referred to as Pennzoil Outboard Motor Oil. While it was developed specifically for use in two cycle engines when the fuel and oil are mixed, it will work fine in your Saab's engine. Pennzoil SAE 30 is also recommended. As for the tachometer, it only measures engine speed so it can be adapted to a three, six or eight cylinder engine.*

**Cold.** Where I live, the temperature in the winter will dip to –50° every night for weeks on end. My car will sit for one to two weeks in weather like this and then I'll drive it for a thousand miles or so at high speeds. What weight oil should I use?

J.C., McKenzie Island, Ontario, Canada

*SAE 5W motor oil is ideally suited for cold weather. It has a very low pour point and low temperature cranking characteristics. And don't forget your ear muffs.*

**Canadian Pennzoil?** I would like to know where I can buy Pennzoil in my area.

J.T., Vancouver, B.C., Canada

*Pennzoil is distributed in Canada by British American Oil Company and should be available at any of their service stations.*

**Plugged Up.** I just put a pair of short lakes pipes on my car. They come out just in back of the front wheels. I do most of my driving in the city where they have to be capped. Will capping these pipes hurt my engine?

F.L.M., Ansonia, Conn.

*Capped lakes pipes merely force exhaust gases to travel the route that all stock cars use: through the mufflers and out the tailpipe. So, when capped, exhaust back pressure approximates stock and when open, lakes pipes lower back pressure.*

**Tired Oil?** I have often heard the expression, "my oil is wearing out." What is meant by that?

B.L.H., State College, Pa.

*The term "oil wearing out" has been thought by some people to mean the oil is losing its lubricating value due to extended usage. Actually, the lubricating value is never lost, no matter how long the oil is used. But the oil does become contaminated by fuel dilution, unburned fuel resins, fuel soot, dirt and moisture, all of which can be harmful to an engine.*

**Shocked.** I am restoring two 1933 Hupmobiles. The arm-type shocks call for a cushion oil of 500 viscosity. I tried brake fluid but the shocks became real soft. What should I use?

J.A., Sacramento, Calif.

*An oil with a viscosity of 500 is equivalent to our Pennzoil SAE 30 motor oil. And that's what we recommend to keep your shocks in shape.*

**Cat Food.** I have a 1962 Jaguar XKE for street driving. Pennzoil has been keeping the engine very clean, but I was wondering if there was any advantage to using a racing oil? Does Pennzoil make a racing oil?

C.D.F., Saratoga, Calif.

*Yes, we do make a racing oil. But we recommend it only for racing cars where the oil is drained at short intervals. It is mildly detergent with special additives to counteract the problems of fuel flooding, especially in nitro-fueled cars. Not for Stop-and-Go street driving.*

**Slow Action.** Invariably, after changing oil, the dipstick will show I'm a quart low after 200 or 300 miles. I'm told that in some cars it takes a while for the oil to run back to the oil pan after stopping the engine. Can this be the problem?

M.V.R., North Charleston, S.C.

*In many cases it does take longer for the oil to flow from the upper valve area back into the crankcase. For this reason the engine should be shut off for a few minutes before the crankcase oil level is checked.*

**WE'RE OPEN TO QUESTIONS** about motor oils, lubricants, engines. But, you can tell *us* a few things, too. Maybe you have discovered something interesting about motor oils or lubricants. Or you have a special reason for being a Pennzoil fan. We would like to hear from you. Write to: Pennzoil Company, Research Department, P.O. Box 808, Oil City, Pennsylvania 16301. Note: sorry no pictures or material can be returned. Letters chosen for publication are subject to revision necessary for publication requirements.

**The Pure Pennsylvania Motor Oil with Z-7**


**ask for it!**

# SPORTS CAR GRAPHIC

March 1967 Volume 7 Number 3






**COVER:** Both photos are by PPC, with Photo Director Bob D'Olivo shooting the Shelby GT500 and GT350 in the top frame, and Fred Enke the Camaro Z-28 below.

**COST OF FOREIGN SUBSCRIPTIONS**

| Country | One Year | Country | One Year |
|---|---|---|---|
| Great Britain - £ | 2.2.9 | Norway - Kroners | 42.74 |
| Australia - $ | 5.342 | Sweden - Kroners | 30.93 |
| N. Zealand - £ | 2.2.11 | W. Germany - DM | 24.02 |
| Austria - Schillings | 153.84 | Spain - Pesetas | 358.21 |
| Belgium - Francs | 29.76 | Brazil - Cruz. | 12.765.96 |
| Denmark - Kroners | 41.27 | Mexico - Pesos | 74.72 |
| France - Francs | 29.34 | India - Rupees | 28.46 |
| Holland - Guilders | 21.68 | Japan - Yen | 2,166.06 |
| Italy - Lires | 3,733.70 | Philippines - Ps. | 23.30 |

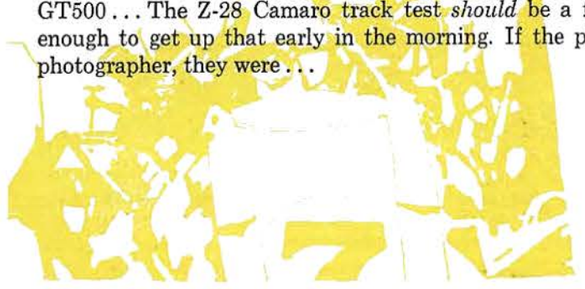
FOR YEARS WE CRIED ABOUT PHONY RACING MOVIES and along comes John Frankenheimer and makes one that's almost *too* realistic. Seeing two vicious wrecks, one driver and two kids killed – in Cinemascope – whilst we relaxed in an armchair, took all the enjoyment out of his "Grand Prix" for us. Except for a couple of fake exhaust pipes and an oil pressure gauge that read Zero while a 'Formula 1' engine turned 9000 rpm, the film was almost faultlessly accurate. As one driver put it, it's as close to actually being in a race car as a spectator will ever get. Only by compressing an entire season into 3½ hours running time has the realism been damaged. Everything portrayed has happened in F1 racing at one time or another. Even the domestic problems of the plot are based on actualities, but you get the impression that the circuit should hire a full-time marriage counselor when the numerous problems are in a single movie. The plot is thin and the character studies a bit unsatisfying, especially when one of the heroes is trying to answer the "Why do we race?" question. But the acting is good and the racing nothing short of fantastic. Clips of the faked races are injected into the filming of the real thing, and the camera work on both is, in a word, exciting. Don't miss it!

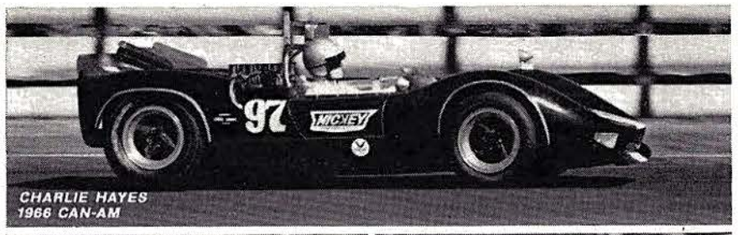
## Who Needs Another Fangio?

There has been a satisfying response to our blast at traffic cops and insurance companies. A New England traffic cop blasted back that we were fostering disrespect for the law by doing so, and our answer was that *over*-enforcement fosters a heck of a lot more than we even could with an editorial. It did result in a long (and friendly) discussion with a judge from nearby Orange County. He didn't pick any argument with what we'd stated editorially, but asked if we might have an answer to all the would-be Fangios leaving an event at Riverside. THAT stumped us. It *is* a problem across the country. Spectators – a small percentage of them – get charged up watching a race and then try to duplicate what they've seen in crowded traffic on the way home. From Sebring to Seattle, from Lime Rock to Laguna, you can usually see an inverted enthusiast or two as you leave the area of a major event... inverted or worse. At best, they give other motorists and law-enforcement officials fits. It's the kind of thing that a certain member of a certain prominent Irish family could one day point his vote-getting finger at and say, "SEE! See what effect those madmen have on the motoring public?" If you can exercise any control over anyone from this ding-a-ling fringe, fer crissake tell 'em to cool it!

## Now, About This Issue...

Accident or not, we have some pretty good things in this issue. Leon Mandel nailed a preliminary report for us from two clinical psychologists gathering personality data about race drivers. We took the test (it's a tedious four hours of paper-marking), and their feedback was, unless they were just being kind, that we were about average for the pro group, but got the sneaking suspicion that maybe we were all a strange breed of cat. You can't really tell from all the forty-dollar words they used... F. Aubry Woods, Weslake's chief designer, finally got the Gurney F1 engine enough under control to sit down and write an exclusive report for SCG. He agreed to it months ago, but we didn't figure his busy schedule would ever permit the time... Another Englishman, L.J.K. Setright, presents his views on automotive streamlining. If you can get past the poetry quotes he traditionally starts with, it's very interesting... A test of Shelby's latest is a bit overdue, but we wanted to wait until a finalized production version was available. They still may make a few minor changes in the GT500... The Z-28 Camaro track test *should* be a first. We doubt anyone else was silly enough to get up that early in the morning. If the photos appear taken by a bleary-eyed photographer, they were...

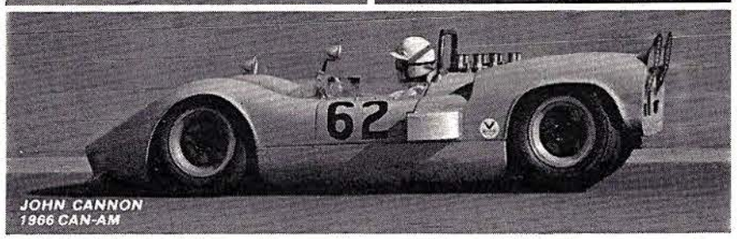




CHARLIE HAYES
1966 CAN-AM

LOTHAR MOTSCHENBACHER
1966 CAN-AM

GEORGE FOLLMER
1966 CAN-AM



JOHN CANNON
1966 CAN-AM





# INTERNATIONAL CALENDAR

*1967* **MAJOR SCCA, USAC, NASCAR, NHRA, and/or FIA EVENTS, MAJOR RALLIES and AUTO SHOWS**

**Key to Abbreviations Used:**

**Cars — FIA Appendix J Class**

T — Touring Cars (Sedans): Gr.1 & 2
GT — Grand Touring Cars: Group 3
S — Sports Cars: Group 4
Stock Cars — U.S. Stock Cars: Group 5b
SP — Sports Prototype Cars: Group 6
SR — Sports Racing Cars: Group 7
F1 — Formula 1 (3-liter): Group 8
FL — Formula Libre
DR — Drag Racing Cars
T/A — Trans-American Sedan races

All dates subject to change without notice!

## MARCH

5 Asheville-Weaverville, N.C. – "Fireball 300," Stock Cars – NASCAR, FIA Nat'l Open.
9-12 Germany – "German Rally" – ADAC, FIA.
12 Hillsborough, N.C. – "Carolina 150," Stock Cars – NASCAR, FIA Nat'l Open.
19 Bristol, Tenn. – "Southeastern 500," Stock Cars – NASCAR, FIA Nat'l Open.
23-27 Kenya, Africa – "East Africa Safari Rally" – A.A.E.A., FIA.
24-26 Washington, D.C. – Auto Show, Nat'l Guard Armory.
31 Sebring, Fla. – "Sebring 4-Hour" T/A Sedans – SCCA, FIA Int'l.

## APRIL

1 Sebring, Fla. – "Sebring 12-Hour," SP, S, GT – SCCA, FIA Int'l Mfr. Championship.
1-9 New York, N.Y. – Auto Show, New York Coliseum.
2 Atlanta, Ga. – "Atlanta 500," Stocks – NASCAR, FIA Int'l.
4-9 L.A. to Detroit – "Mobil Economy Run" – USAC.
7-9 E. Germany – "East Germany Rally" – FIA.
7-9 Atlanta, Ga. – "Sports Motorama," Marriott Hotel.
14-16 California – "Desperation 500 Rally" – FCCA.
16 Green Valley, Tex. – T/A Sedans – SCCA, FIA Int'l.
16 N. Wilkesboro, N.C. – "Gwyn Staley Memorial," Stock Cars – NASCAR, FIA Nat'l Open.
23 Martinsville, Va. – "Virginia 500," Stock Cars – NASCAR, FIA Nat'l Open.
23 Trenton, N.J. – "Trenton 100," FL – USAC, FIA Nat'l.
23 Las Vegas, Nev. – "Stardust USRRC," SR–SCCA, FIA Nat'l Open.
24-29 Holland – "Tulip Rally" – KNAC, FIA.
25 Monza, Italy – 1000 Km. race, S, SP, GT – FIA Int'l Mfr. Championship.
30 Riverside, Calif. – USRRC, SR – SCCA, FIA Nat'l Open.

*(Continued on Page 12)*


## The Fair Tire Guides

*By Robert Herzberg*
*SCG Washington Editor*

EFFECTIVE FEBRUARY 19, 1967, MUCH OF THE GUESSWORK WAS TAKEN OUT OF BUYING TIRES. Thanks to the Federal Trade Commission's new "Tire Advertising and Labeling Guides," customers will be given some basic information with which to compare different grades of the same brand and tires of like grades with different brands.

The Guides, which have the force of federal law, climax over 30 years of Commission concern with the practices employed in the marketing of automobile tires, and has nothing to do with the recently-passed auto-safety legislation. Indirectly, of course, public airing of the auto laws enacted last year did force the Commission into action under existing authority.

In January 1965, three days of public hearings, on various practices used by manufacturers and marketers of tires were held by the FTC. Included in the proceedings were the areas of tire safety, the adequacy of existing minimum safety standards, the need for federal minimum safety standards, and a grading system, price misrepresentations, and guarantees. During the course of those proceedings, testimony was received from representatives of virtually every level of the industry, and included participation by manufacturers and marketers, retailers, retreaders, and various trade association groups. There was the general feeling that the Federal Guide lines were necessary in order to be fair to all members of the trade and to customers.

In all, 19 "guides" resulted. They apply to the car's original tires as well as replacements. Of particular interest to sports car owners is "Guide 13 – Racing Claims." This guide directs that advertising in connection with racing, speed records, or similar events should "clearly and conspicuously" disclose that the tires on the vehicle are not generally available, all-purpose tires, unless such is the fact. The requirement of this guide is applicable also to special-purpose racing tires, which, although available for such special purposes, are not the advertiser's general-purpose product. Similarly, designations should *not* be utilized in conjunction with any industry product which falsely suggests, directly or indirectly, that such product is the identical one used in racing events or in a particular event.

A brief description of other guides follows:

Guide 1 – Tire Description: To be disclosed before the sale of the tire are such important factors as the tire's load-carrying capacity, generic name of cord material used, actual number of plies (2 ply, 4 ply, etc.), and *not* ply equivalent test. Also under this guide, permanently disclosed on the tire is to be the size, whether the tire is tubeless or tube type, and actual number of plies. The generic name of cord material used in ply is to be affixed in such a fashion that it cannot easily be removed prior to sale. For proper care and use of the tire, information about pressure and load-carrying capacity will be provided.

Guide 2 – Designations of Grade, Line, Level, or Quality: To be disclosed are expressions such as "line", "level", and "premium", which relate only to the private standard of the marketer of the tire. Additionally, products will not be described as being "first line", etc., unless the products so described are actually the case.

Guide 3 – Deceptive Designations: In the advertising or labeling of products, industry is not to use designations for grades or products that deceive purchasers into believing that such products are equal or superior to a better grade; in other words, the best grade of tire cannot be called "Standard" and one of lesser quality called "Super Deluxe High Standard" or "Premium."

Guide 4 – Original Equipment: Original equipment tires are to be not only the same brand but also the same quality tire used as original equipment. A tire which was formerly but is not currently used as "original equipment" shall not be described as such without clearly indicating the actual year such tires were used as "original equipment."

Guide 5 – Comparative Quality and Performance Claims: Claims of superior quality or performance to other products will not be made unless it is proven in an actual test using adequate and technically sound procedures and the results recorded and available for inspection. Claims of "comparative or identical" quality, etc., may not be made unless this is essentially the case.

Guide 6 – Ply count, Plies, Ply Rating: "A ply is a layer of rubberish

*(Continued on Page 20)*

## CALENDAR

*Continued from Page 8*

30 Indianapolis, Ind. – IRP "Yankee 300," Stock Cars – USAC FIA Int'l.
30 Richmond, Va. – "Richmond 250," Stock Cars – NASCAR, FIA Nat'l Open.

### MAY

1 Spa, Belgium–Spa Grand Prix, S, SP – FIA Int'l Mfr. Cham-Championship.
3-10 Canada – "Shell 4000 Rally" – CASC, FIA.
3 Danville, Va.–VIR T/A Sedans – SCCA, FIA Int'l (tentative).
7 Monte Carlo, Monaco – Monaco Grand Prix, F1 – FIA Championship.
7 Laguna Seca, Calif. – USRRC,
10-14 Austria – "Austrian Alpine Rally" – OAMTC, FIA.
SR – SCCA, FIA Nat'l Open.
13 Darlington, S.C. – "Rebel 400," Stock Cars – NASCAR, FIA Int'l.
13-14 Atlanta, Ga. – "Mountain Goat Rally" – GSSC.
14 Sicily – "Targa Florio," S, SP – FIA Int'l Mfr. Championship.
20-21 Riverside, Calif. – "Road Rally U.S.A." – NRRA.
21 Bridgehampton, N.Y. – USRRC, SR – SCCA, FIA Nat'l Open.
25-28 Greece – "Acropolis Rally" – ATCG, FIA.
28 Charlotte, N.C. – "World 600" (now there's humility for you), Stock Cars – NASCAR, FIA Nat'l Open.
28 Nurburgring, Germany – "1000 Km," S, GT, SP – ADAC, FIA Int'l Mfr. Championship.
30 Lime Rock, Conn.–T/A Sedans – SCCA, FIA Int'l.
30 Indianapolis, Ind. – "Indianapolis 500," FL – USAC, FIA Int'l.

### JUNE

3-4 Zandvoort – Grand Prix of Holland, FI – FIA Championship.
10-11 Le Mans, France – "Le Mans 24-Hour," S, SP – FIA Int'l Mfr. Championship.
10-11 Bristol, Tenn. – "Springnationals," DR – NHRA, FIA Nat'l Open.
11 Lexington, Ohio–Mid-Ohio T/A Sedans – SCCA, FIA Int'l.
15-18 Switzerland – "Geneva Rally" – ACd'S, FIA.
18 Spa, Belgium – Belgian Grand Prix, F1 – FIA Championship.
18 Rockingham, N.C. – "Rockingham 500," Stock Cars – NASCAR, FIA Nat'l Open.
24-25 Spokane, Wash. – "Ponderosa Sweepstakes Rally" – SCCS.
25 Watkins Glen, N.Y. – USRRC, SR – SCCA Nat'l Open.

### JULY

2 Le Mans, France–French Grand Prix, F1 – FIA Championship.

*(Continued on Page 16)*


*By John Blunsden*
*SCG European Editor*

## Fiat 124—Car of the Year

There seem to be so many 'Car of the Year' contests that someone recently suggested there should be a competition to decide the 'Car of the Cars of the Year.' But the contest which seems to mean most – in Europe at any rate – is one sponsored by the Dutch motor journal, 'Auto-Visie', which invites a forty-five man panel, representing twelve countries, to name the top five cars in order. Points are awarded 5, 4, 3, 2, and 1 to the cars chosen by each member of the panel – so there is a theoretical maximum of 225 points to be scored, provided the same car is named top-of-the-list by all forty-five members.

This year, the winning car received 144 points, making it a rather decisive winner. It was Italy's Fiat 124.

Next in order came to BMW 1600 (69 points), the Jensen 'FF' (61 points), the Volvo 144 (46 points), and the DAF 44 (41 points).

Last year's winner was the Renault 16, with the Triumph 1300 and Oldsmobile Toronado both well placed.

## Group 1 and 2 Porsches!

Oh dear! The Porsche 911 has just been homologated with the F.I.A. as a Group 2 car, and the 912 is now a Group 1, no less. Exactly what effect this is likely to have on sedan racing and international rallying is not too difficult to imagine – I can't see the 'big guns' sanctioning expensive, competition budgets when they know their products lack any real chance of success.

Ford of Britain's immediate reaction to the news was to say, "Why bother?" This should not be taken to mean it is definitely backing out; but it does give an indication of the way people are thinking. There is, of course, a touch of irony in this, in that it was Ford's homologation of the Cortina Lotus as a Group 2 car which sent all the previous stalwarts of 'tin-top dicing' to disappear one by one from the circuits.

Neither Ford in the past nor Porsche now can be blamed for taking advantage of eligibility regulations – it is the detail of the regulations themselves which should be questioned.

It probably came as a surprise to some people to know that the Porsches qualified dimensionally – but the regulations are not overly strict on this score. Even so, if any change in the rules is justified (and this is rather a case of shutting the stable door after the horse has bolted), it is surely in the minimum production figures. The Porsche 911 and 912 have been homologated because the factory has satisfied the CSI's homologation committee that the cars are produced at the rate of one thousand and five thousand annually. I would have thought figures of five thousand and twenty thousand would have been more in keeping with the spirit of Groups 2 and 1. But then, I suppose, someone would find a way of making a quick five thousand 'ultra-hot' ones and we would be back where we started.

Perhaps the answer lies in a price limit in the country of origin. Meanwhile, 1967 looks like being one hell of a good year for Porsche, in most categories.

## BMW-Glas Prospects

The fairly recent absorption of Glas by BMW has resulted in a potentially strong, Bavarian-based combine, the activities of which have been giving that other West German consortium of Daimler-Benz, Auto-Union, and Volkswagen considerable concern.

The German auto industry has been in something of the doldrums during the winter, with short hours, layoffs, and redundancies all too evident. But it is significant that BMW has been least affected by the economic storm. What a change from a few years ago, when the company was fighting a desperate battle for survival!

One car changed all that – the four-door sedan, which first appeared as a 1500, became a 1600, then an 1800 and 2000. The four-door sedan has given the 200 Mercedes-Benz a real battle. Now, with the two-door 1600, BMW is nibbling away at the Audi, and is even a potential threat to the cream of the VW 1600 market.

What next? Well, there is some model overlap in the BMW and Glas ranges, so it would only seem sensible for Glas to drop its 1700 sedan (which looks too much like a BMW anyway), concentrate on its GT coupe, and produce and market a new BMW-Glas sedan to serve the lucrative 1300-cc market. This way, the new combine, which financially seems to be very well backed, could take on the really big boys – VW, Opel, and Ford – and provide blanket coverage of the entire car market up to two liters. Beyond that? Well, a six-cylinder BMW has been rumored for a long time, but don't forget Glas already has a useful 2600 V-8 in that range, which is used to power the Frua-styled coupe. Interchange of mechanical components must be one of the first steps in the rationalization process, and here geography helps – Glas headquarters at Dingolfing are only about sixty miles from BMW in Munich.

*(Continued on Page 28)*

## CALENDAR

*Continued from Page 12*

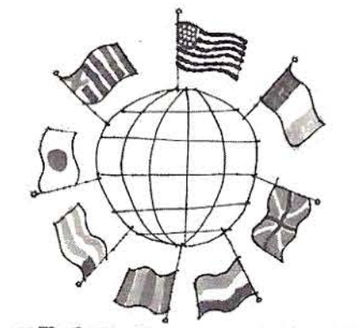
4 Daytona, Fla. – "Firecracker 400," Stock Cars – NASCAR, FIA Int'l.
4 Colorado Springs, Colo.–"Pike's Peak Hill Climb," FL, T – USAC, FIA Nat'l Open.
6-9 Czechoslovakia – "Czechoslovakian Rally" – UA, CSSR, FIA.
9 Thompson, Conn. – T/A Sedans – SCCA, FIA Int'l (tentative).
9 Bridgehampton, N.Y. – "Bridgehampton 150," Stock Cars – NASCAR, FIA Nat'l Open.
15 Silverstone, England – British Grand Prix, F1 – FIA Championship.
16 Kent, Wash.–"Pacific Raceways USRRC," SR–SCCA, FIA Nat'l Open.
19-20 Roumania – "Danube Rally" – AARSR, FIA.
22-23 Mexico City, Mex.–24-hr. Rally – FIA, CAF.
23 Bristol, Tenn. – "Volunteer 500" Stock Cars – NASCAR, FIA Nat'l Open.
23 Indianapolis, Ind. – IRP "Hoosier Grand Prix," FL – USAC, FIA Int'l.
30 Danville, Va.–VIR T/A Sedans – SCCA, FIA Nat'l Open.
30 Langhorne, Pa. – "Langhorne 150," FL – USAC, FIA Int'l.

### AUGUST

2-5 Poland – "Polish Rally" – PZM, FIA.
6 Loudon, N.H. – Bryar T/A Sedans – SCCA, FIA Int'l.
6 Nurburgring, Germany–German Grand Prix, F1 – FIA Champ.
6 Atlanta, Ga.–"Dixie 400," Stock Cars – NASCAR, FIA Nat'l Open.
13 Marlboro, Md.–12-Hr. T/A Sedans–SCCA, FIA Nat'l Open.
18-20 Finland – "Rally of 1,000 Lakes" – SAFA, FIA.
20 Asheville-Weaverville, N.C. – "Nat'l Sweepstakes 250," Stock Cars – NASCAR, FIA Nat'l Open.
25 Indianapolis, Ind. – IRP "Century 100," Stock Cars – USAC, FIA Int'l.
26 Canada–"Canadan Grand Prix," FI – FIA Championship (course undecided).
27 Lexington, Ohio – "Mid-Ohio USRRC," SR–SCCA, FIA Nat'l Open.

### SEPTEMBER

3-4 Elkhart Lake, Wis. – "Road America 500," SR, SP, S, GT – SCCA, FIA Int'l.
3-4 Indianapolis, Ind. – IRP "The Nationals," DR – NHRA, FIA Int'l.
4 Darlington, S.C. – "Southern 500," Stock Cars – NASCAR, FIA Nat'l Open.
4-9 France – "Alpine Rallye" – ACd'FC, FIA.




## It's on the Calendar!

The 1967 Calendar, starting on page 8, is as up-to-date as we are able to get it, with the international dates just received from the FIA in Paris. Two points of interest are that the Indianapolis 500 (rather than the U.S. Grand Prix at Watkins Glen) is still considered the United States' "Grand Epreuve," or major Formula car race, and that the French Prix isn't at Reims or Rouen this year, but at Le Mans, on the new, short 'Bugatti Circuit.'

Also notice that there are thirteen Trans-American Sedan Championship races listed, with only three tentative at press time. The venues include Daytona (see next month's SCG), Sebring, Mid-Ohio, Marlboro, VIR, Green Valley, Bryar Park, Thompson, Lime Rock, Kent, Riverside, Las Vegas, and Vaca Valley.

## SCCA National Rally Champions

Point standings for the Sports Car Club of America's 1966 National Rally Series were spotty and incomplete all last year, due to myriad problems, including an over-abundance of protests and appeals. However, the official word has arrived from headquarters in Westport, and Dennis and Sally Koelmel from Huntingdon Valley, Pennsylvania, are again National Champions with 44 points each (see SCG Jan. 1967). In second place are Jim and Barbara Bickham of Upper Sandusky, Ohio, with 30.7 points, followed by Russell Brown and Nathan Jones from Houston, Texas, with 26.6 points. These results show a wide geographical spread on the top national competitors.

Chrysler-Plymouth has again won the Manufacturer's Championship, garnering a resounding 64 points, with Chevrolet in second place with 48 points, closely pursued by Ford at 47 points. Trailing the big three domestics, the imports scored with Triumph in fourth spot, followed by Porsche and Rover.

The new season will be extremely difficult to score during the year since both SCCA Divisional and National Rallies will count for points, but it should make for a wild scramble near the end of the rally year, with the possibility of a four- or five-way tie extremely probable.

## Dunlop Sports Radial

Dunlop recently introduced a new radial ply tire especially for American and imported sports cars. The tire differs from Dunlop's SP41 in tread design, the new tire having a heavy lug type tread, but incorporating the wrap around saftey shoulder of the SP41. The tire should be excellent for rallying or slaloms, and other competition events.

## Elfins in America

Don Mansell has contracted for the U.S. importation of the complete range of competition cars of Elfin Sports Cars of Australia. The range includes Formula B and C racing cars, a small engine capacity sports car, as well as a Group 7 sports car. On the drawing board is a Formula A racing car which will be supplied with the latest Repco-Brabham three-liter engine and DG-300 Hewland gearbox. The Formula A car will be of monocoque construction, as are the Formula B and C cars.

The first car to reach America was an 1150-cc sports car. This will be followed by several Formula cars. Mansell's address is 2040 Hagen Lane, Flossmoor, Illinois 60422.

## Hands Across the Channel

Designed particularly for the European market, the new Lotus "Europa" uses a special version of the Renault R16 engine-gearbox. The engine is

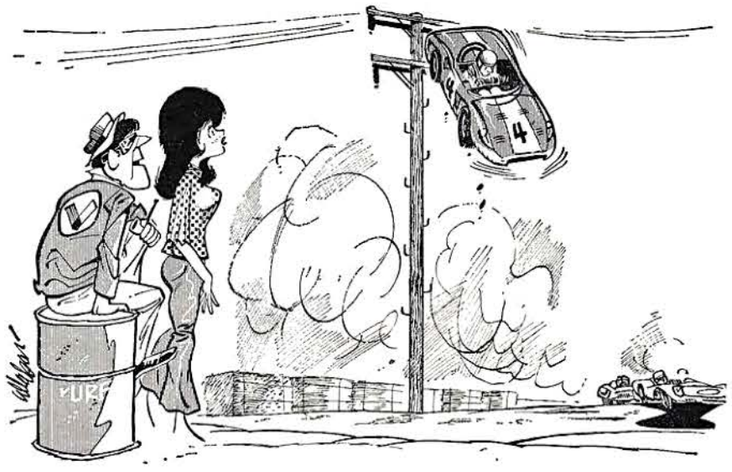
1470-cc displacement, giving 82 bhp at 6000 rpm, using push rods, a twin-choke carburetor, and a four-speed, all-synchro box. A proposed racing version of the Europa will be called the "Lotus Type 47."

## Studs

Despite their obvious contribution to driving safety, studded tires for Winter driving have met some scattered resistance in this country. This resistance is usually centered around old laws which forbid steel-lugged tractors, half-tracks, tanks, and spike-shod distance runners to tear up the streets.

It was proved by the National (disappointed-if-you-don't-die-on-the-highway) Safety Council that studded tires increase traction on ice and hard-

*(Continued on Page 20)*




"Now THAT'S what I call a spectacular spin-out!"

## ATW 30D

*Continued from page 10*

packed snow by 136 percent over normal tires.

Some States have undertaken tests and found that minor pavement damage does occur at controlled intersections, but the damage generally is not


significant, especially compared with that caused by tire chains. A spokesman for Goodyear Tire & Rubber Company says that this happens mainly during "panic stops" or "jackrabbit starts" on dry pavement. However, damage from studded tires generally is no more than an abrasion on the surface, which often will not affect the life of the pavement.

For most of the nation, the gains in safety seem to outweigh any element of pavement damage. To date thirty-four States and the District of Columbia either expressly permit the use of studded tires or do not oppose them. With the exception of a four-state, Midwestern pocket – Iowa, Illinois, Indiana, and Michigan – most of the remaining States not permitting use of studded tires are not considered to be in the ice and snow belt.

Miami, where the snowfall is you know what, allows studded tires, while Chicago, where the annual snowfall average is thirty-seven inches, does not. Perhaps both anticipate they'll be in different positions when the world turns.

### Two Auto Shows

The 11th annual 'International Auto Show' will be at the New York Coliseum April 1-9, and 'Sports Motorama' will be at the Atlanta Marriott Hotel, in Atlanta, Georgia, from April 7-9.

## WASHINGTON

*Continued from Page 18*

fabric contained in the body of the tire and extending from one bead of the tire to the other bead of the tire." Phrases such as "Super 6", etc., may not be used when less than a six-ply tire is used. And, since the quality of the "ply" differs from company to company, "ply rating" may not be used to mislead customers.

Guide 7 – Cord Materials: The material used as the cord material may not be misrepresented as to mislead the public. An extreme example of this would be advertising "Nylon Tires" when only a "Nylon Cord Tire" is offered.

Guide 8 – "Change Overs", "New Car Take Offs", etc: Products should not be represented as "Change Overs" or "New Car Take Offs", etc., unless the products have been used for more than just moving new vehicles prior to delivery. "New Car Take Offs", etc., may not be sold as new products.

Guide 9 – Retreaded and Used Tires: "Snow Tread", etc., may not be used to describe "retreads" or "retreaded" tires.

Guide 10 – Disclosure that Products are Obsolete or Discontinued Models: Advertisements will clearly and conspicuously disclose that the products offered are discontinued models or designs or are obsolete when such is the fact.

Guide 11 – Blemished, Imperfect, Defective, etc., Products: Such products should be conspicuously disclosed. Such markings as only "XX", etc., may not be used to describe such products.

Guide 12 – Pictorial Misrepresentations: Pictures must be related to the actual tires offered. For example, white walls may not be pictured when black walls are offered at the advertised price.

Guide 13 – Pricing Claims: (See previous coverage.)

Guide 14 – Bait Advertising: A reduced price may not be offered unless such is the actual fact, and tires must be available.

Guide 15 – Deceptive Pricing: "Fifty percent off", etc., cannot be claimed unless this is the actual fact. Such terms as "Substantially" or "Reduction" or "Savings" may not be misused. Similarly, other claims such as "No Trade-in Price", "Second Tire Free", etc., may not misrepresent the actual fact.

Guide 16 – Guarantees: It was found by the Commission that "Guarantees" were being misused by dealers and manufacturers to pull back customers. All gimmicks such as charging full list price on a guarantee exchange when outright purchases are reduced will be illegal. And such terms as "guaranteed for life" should be fully explained as "Guaranteed for the life of the tread."

Guide 17 – Safety or Performance Features: Such terms as "blowout proof", etc., should not be unqualifiedly used unless such is the case under any and all driving conditions.

Guide 18 – Other Claims and Representations: This is a generally-worded guide or catch-all which directs the industry not to otherwise mislead the general public, even though it is not specifically mentioned in the other guides.

Guide 19 – Snow Tire Advertising: Metal spiked tires may not be advertised, demonstrated, or sold in areas where the law prohibits their use on the highways without a warning to the public of the law.

# LETTERS

## The Last King Cometh

Here is a clipping from a November issue of "Chemical Week":

*"A ban on gasoline-powered cars in California by '80 was suggested by Frank M. Stead, chief of the state's Division of Environmental Sanitation for the California State Dept. of Public Health. As Stead sees it, the state's fixed capacity to receive wastes will be hopelessly overtaxed and the only satisfactory solution he envisions is electric cars and trucks. He feels the state should underwrite an educational campaign to convince the public of the need. The proposal can be expected to get something less than a warm reception from auto makers and refiners, of course. Chrysler President Lynn Townsend, for instance, told the American Petroleum Institute the week before that petroleum would remain the main power source for motor vehicles for years to come. And even the most ardent boosters of electrical cars do not foresee them as a complete substitute for vehicles now powered by the internal combustion engine."*

Judging from this, the article 'The Last King,' appearing in the January issue of Sports Car Graphic is not as far out as one might expect. The clipping mentions California's suggested ban on gasoline-powered cars. Should this take place, I wonder, can we keep it from snow-balling and making 'The Last King' a reality?

Stewart Jackson
Hermitage, Tennessee

## SCG'S Slalom Code

I have just finished reading your 1967 National Slalom Code. Such a national code would be a great help to the sport. In reading your code, I noticed there is considerable similarity between your code and the Metropolitan Washington Council of Sports Car Clubs Championship Autocross Rules, the major difference being the classes. The term "autocross" is used in the Washington, D.C., area as the general term for slaloming. Most autocrosses in the area conform to your definition of autocrossing.

First, I would like to mention certain specific changes and additions that would make your code better. Section 4.6 should be changed to accept tubeless tires. I can see no reason for barring them as there has never been a problem with them in this area. Section 5 should be changed to allow the contestants to walk through the course to aid in their familiarization of the course, and instead of running the cars by classes, it would seem better to run by heats so that late comers will be able to run. Your system of running by classes and not allowing further entries, after the first run of the class has been completed, seems unnecessarily restrictive on the entrants.

As I mentioned earlier the major difference between your code and the MWCSCC Autocross Rules is the classes. In both cases the classes are based on relative potential performance, but in the Washington area the courses are relatively tight, putting a premium on small size. Large cars are not competitive in the classes you place them. Even in MWCSCC Sedan A the Corvairs and Mustangs are not very competitive, the top cars being Saab, Cortina Lotus, Mini 850, and Heishman GT (a 1300 VW modified by a local VW dealer along the same lines as Yenko modifies the Corvair). The sports racing and Formula cars are lumped into the top class in the Washington area because there are very few of them. In fact, only one Formula Vee and one sports racing car are regularly entered. The fastest car in Washington autocrosses is usually a race-prepared Sprite 1100.

As you can see, your classes are not really applicable to Washington autocrosses. Considerable revision would seem to be needed to make your code truly national, perhaps separate classes for race-prepared cars, or a provision for moving them up one or two classes from the basically stock cars, and also separate classes for U.S. sedans – the faster compacts in one class and the other sedans in one or more other classes.

In closing I would like to say that I am glad to see a magazine with national circulation finally beginning to give rallying and autocrossing the coverage they deserve.

Robert L. Walker
McLean, Virginia

* * *

...It may be of interest to your autocross genius to know that my husband, Colorado's [Region of SCCA] Activities Chairman, is going to propose that Midiv adopt SCG's autocross guide for their newly begun runoff. This was the first year for the runoff, so they are not as yet tied to a format...

Sylvia Rydjard
Englewood, Colorado

* * *

I am unhappy over the fact that you didn't include my 1960 Singer Station Wagon in your list of production autocross cars. All we owners of 1960 Singers are going to boycott your damn magazine if you don't include us, as it's not fair to make us run in the Modified classes with the Lolas. I think we should be down in Class H with our little sisters, the single-carb Hillmans, even though we have twin carbs like our big brothers, the Sunbeam Rapiers. Please reply as soon as possible for we plan to tow back for the Grand Prix Slalom of West Pumphandle, Nebraska, which will be held in conjunction with their Fourth Annual Marijuana Picking Festival.

Thanking you in advance for your prompt attention to this important problem, I remain,

Bob Hagin
LaFayette, California


**"It's easy, lady . . . Just follow the oil leaks!"**



I have just read your "National Slalom Code" in the January, 1967 issue of SCG. This is something we have been in need of for a long time.

I am Vice-President of the Thames Valley Motor Sports Club of New London, Connecticut, and on behalf of the club, I would like to ask for permission to reproduce this code, either in its entirety or with some slight modification, for the use of our club. I would also like to ask if reprints of this article are available from you.

Gilbert H. Steinfort
Groton, Connecticut

* * *

...On re-reading certain articles, the humor of this issue of SCG really comes through, but those slalom classes are the funniest thing since Batman. All kidding aside, except for the groupings of some of the classes, Graphic has done a fine job of setting out the rules for clubs who wish to put on a slalom event but lacked proper knowledge.

Dick Thomas
Victoria, B.C.

* * *

...I have been a member of the Corvettes Limited of Connecticut, and I am now in the process of forming a club here within our county which will be known as the Litchfield County Corvette Association. Several of the members have participated in slaloms in the state, but the code which they used is not standardized. My purpose in writing to you is to inquire whether there is a way to obtain a copy of this code.

Phil Sok
Harwinton, Connecticut

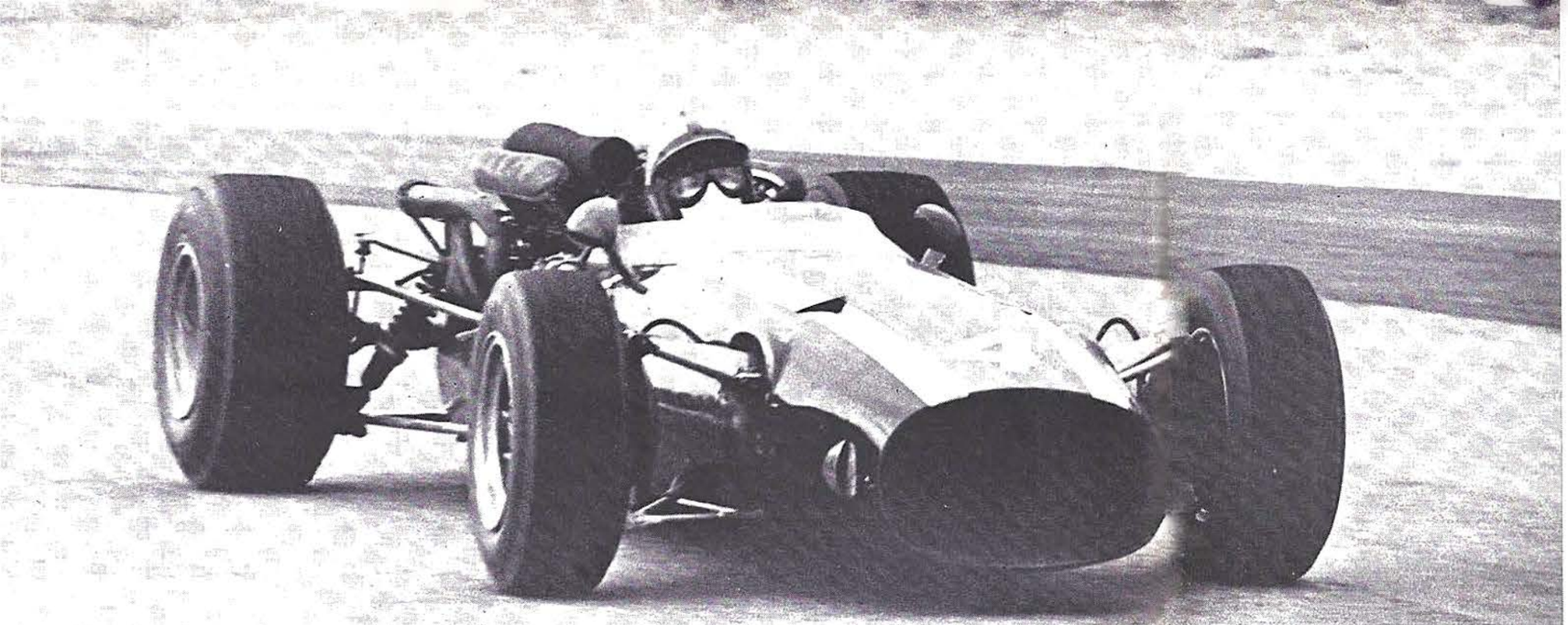
* * *

Before the hordes of technical types descend upon you in wrath, let me express my enthusiasm for 'The Last King.' Others may feel that a fiction (I hope) piece has no place in SCG, but I differ strongly. I have raced and slalomed for three years, but I still get a cold chill at the sound of an uncorked V-12 screaming past, and I always will. For me, racing is justified simply by the sight and sound of the machines, and it cheers me to find a glimmering of this philosophy still remaining in a sport that seems to be more concerned with valve clearances every day.

Also, in reading your proposed National Slalom Code, I noted that you include Devin Porsches in Class A along with such things as Cobras, Corvettes, and Lotus Elans. Since I am the only person to my knowledge who has actively slalomed a Devin Porsche in southern California, or anywhere, I get the feeling that somebody up there doesn't like me. Please, fellas, the car is fast, but not *that* fast. It would fit into Class B very nicely, thank you, but a Cobra-eater it isn't.

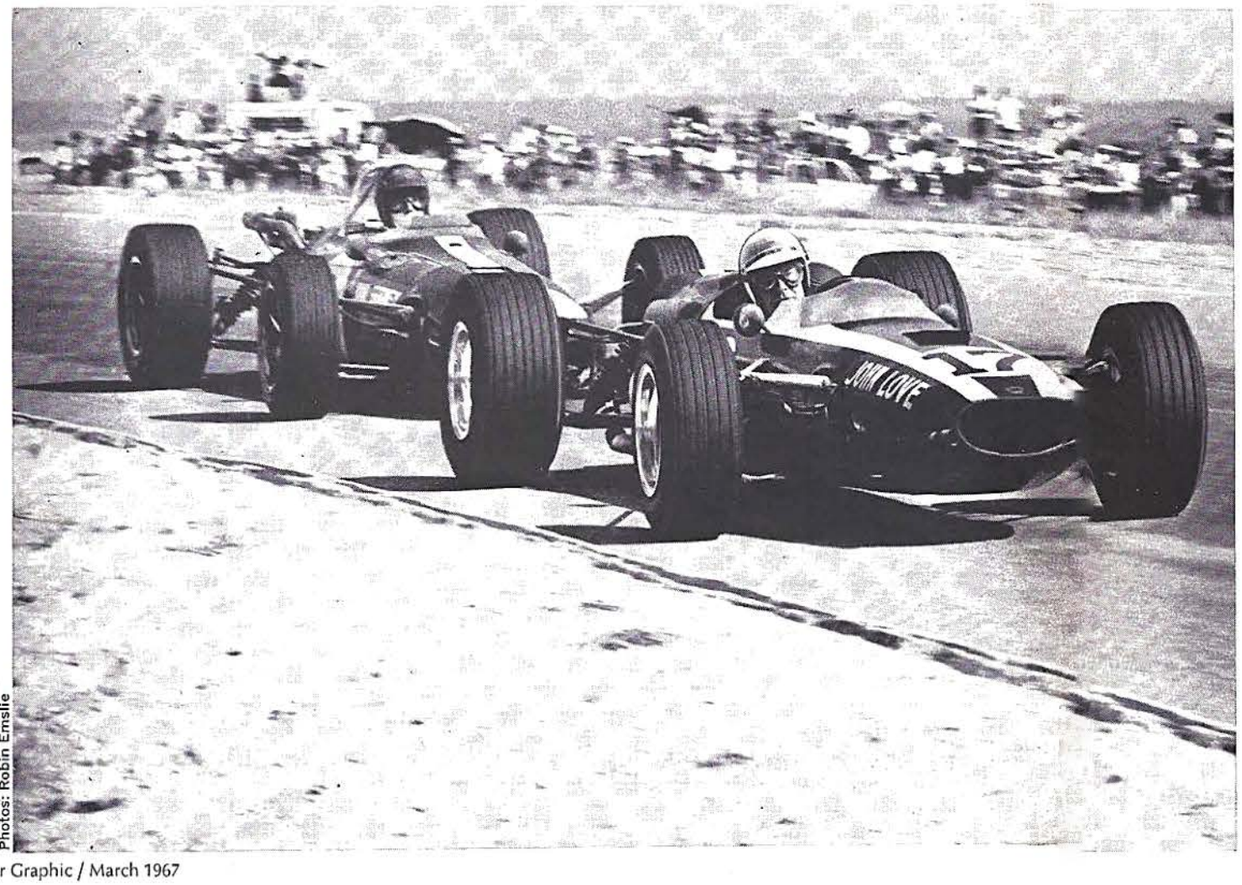
Anyway, the So Cal boys can relax; I sold it.

Peter Roehling
Redlands, California



# SUID-AFRIKAANSE GRAND PRIX

Above, a last-minute substitute, Pedro Rodriguez wins for Cooper. Below, second-place John Love battles with determined Dan Gurney.




Photos: Robin Emslie

## OF SOUTH AFRICA

### First World Championship points of 1967 go to Pedro Rodriguez and Cooper-Maserati

By David Eastaugh

BLOW UPS, BREAKDOWNS, INCIDENTS, AND DRAMA were the order of the day at Kyalami on January 2 when Pedro Rodriguez drove his Team Cooper-Maserati to victory in the 13th South African Grand Prix. He won his first World Championship Grand Prix after Rhodesian John Love had lost his lead after a fuel stop only seven laps from the end of the 80-lap race.

Of the 18 starters, which included the Brabham, Lotus, BRM, Cooper-Maserati, All American Racers, and Honda factory teams — with the notable exception of Ferrari — only eight cars were still running at the end of the 202-mile Grand Prix and only six of these had covered the required distance to be classified as finishers. The high rate of mechanical failures was largely due to the combination of the 5000-foot altitude of the 2.544-mile Kyalami circuit and the prevailing hot weather, which raised the track temperature to over 130 degrees during practice sessions. This gave the factory teams overheating and fuel vaporization problems, which were even more serious than those experienced during last year's Mexican Grand Prix.

The writing was on the wall on the first day of practice: if the weather didn't cool down, it was almost a certainty it would be an expensive race for constructors and frustrating for drivers, with mechanical reliability playing a more important part than usual in the outcome of the first event of the 1967 World Championship season.

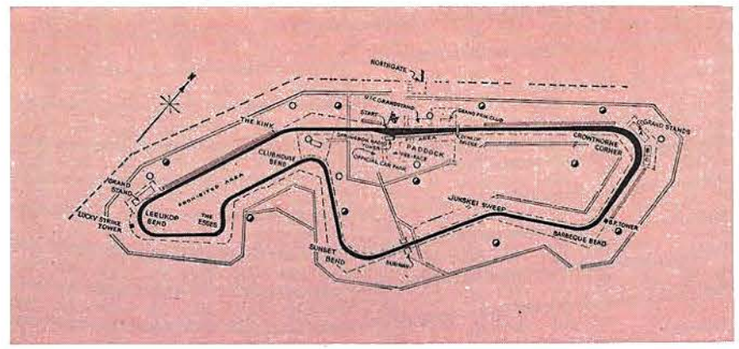
Due to the unfamiliar conditions, it was not surprising that everyone was in trouble on the first day of practice — everyone that was except Jack Brabham and Denny Hulme, who seemed to have their Repco-Brabhams fully sorted right from the word go. They scorched around the track to record the two fastest times of the session, with Brabham turning one minute 28.3 seconds, more than three seconds under the lap record held by John Love. Hulme was a second slower with one minute 29.4 seconds, with Pedro Rodriguez turning an identical time in the Cooper-Maserati during the final minutes of the Thursday practice session, around five o'clock when the track started to cool.

However, the Cooper-Maseratis of Rodriguez and Jochen Rindt were only running for three laps at a time before overheating brought them into the pits. Rindt could manage no better than 1:32.5, which was one-tenth of a second faster than Jim Clark's best time in the brand new Lotus-BRM. Clark's Lotus required extensive sorting out and ran most of the session without its fiberglass nose in an effort to keep the two Lucas fuel 'bombs', mounted in front of the radiator, cool enough to prevent fuel vaporization.

Graham Hill, having his first drive with Lotus in seven years, fared dismally in practice with the ex-Jim Clark Lotus-BRM. He failed to turn a single lap on Thursday, after continued failure of the fuel-injection pump diaphragm. In the three official practice sessions, Hill managed only six laps and recorded a best time of 1:32.6 to start on the next to last row of the grid with Jo Siffert in the Rob Walker Cooper-Maserati.

Brabham did not appear for the Friday practice session, though Hulme was out again and improved on his previous best time with a lap of 1:28.9, which was the fastest time of the day.

The sensation of the Friday session was John Love's fastest lap of 1:29.5, after blowing a gasket on the previous day. Love's ex-McLaren, Tasman Cooper-Climax was immaculately prepared and, with the advantage of valuable experience in tuning the Cooper for the Kyalami circuit and the competition of the overseas drivers, Love got in the groove near the end of Friday's practice. He put in his quick laps slipstreaming Jochen Rindt's Cooper-Maserati before actually passing the V-12 engine car with the old Climax 'banger'



going down the straight! Said Rindt, "When Love pulled out and passed me, I couldn't believe it!" Love, in fact, was two seconds a lap faster than his own lap record, and South African Dave Charlton in his 2.7-liter Brabham-Climax followed suit by recording sixth best practice time on Friday of 1:30.3, which was also quite a bit quicker than Charlton's previous best times at Kyalami.

Throughout the sessions, it was obvious that the most serious team of all on the track was Honda, and it was making an all-out effort to sort out the big V-12 monocoque, and no amount of time nor money would stop the team from doing it. John Surtees arrived with the car and a team of mechanics six days before the race and started to practice in earnest.

Despite the obvious effort from the team, the Honda V-12, although it appeared on Thursday, did not practice while the mechanics struggled to tune the engine for the altitude. The following day Surtees turned a fastest lap of 1:31.1. But, before the final practice on the Saturday was over, the Honda had blown two engine and a new crankshaft was flown out from Japan to enable the team to build a new engine from the remaining bits and pieces.

The 'round-the-clock effort was rewarded with Sturtees' 1:29.6 lap in the last half hour of the final session on Saturday, which put him on the third row of the grid alongside John Love.

During the last hour of the Saturday session, all drivers were making a last minute bid to improve their practice times. Jim Clark took advantage of the cooling effect of some clouds to record 1:29.0, almost two seconds faster than his best on the previous day, putting him in the second row of the grid alongside Pedro Rodriguez. Jackie Stewart in the #1 Team BRM was unable to get under 1:30 and had to settle for the fifth row of the grid with Bob Anderson's 2.7-liter Brabham-Climax, which was going surprisingly well after being seriously damaged and rebuilt before the Rhodesian Grand Prix a few weeks earlier.

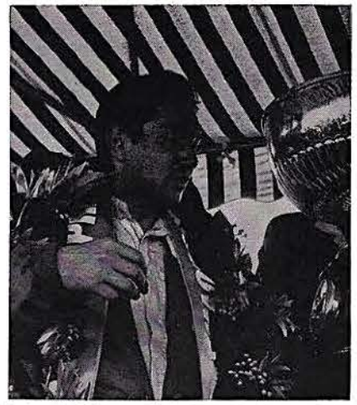
Dan Gurney's Eagle-Climax was on the following row, a tenth of a second slower than Anderson's Brabham. Despite some extensive tuning sessions and help from Love's pit, Gurney's 2.7-liter Climax did not have the power to get with the lighter Brabhams and Love's Coòper. Gurney brought only one car for himself, having decided to leave the Weslake engine behind, after he had unofficially broken the lap record at Goodwood by two seconds with a Weslake-engined 'Eagle.'

Bench tests had shown the engine to be producing a reliable 370 bhp, though the oil temperature during these tests in the English Winter indicated the engine would be unsuitable for South African conditions. Although the Climax engine was very much down in power, the beautifully-built monocoque Eagle seemed fully 'sorted', suspension and chassis-wise. If the V-12 engine had been available, there is no doubt the All American Eagle would have been highly competitive.

The final positions at the end of the Saturday practice were:

| | |
|---|---|
| J. BRABHAM (1:28.3) Repco-Brabham | D. HULME (1:28.9) Repco-Brabham |
| J. CLARK (1:29.0) Lotus-BRM | P. RODRIGUEZ (1:29.1) Cooper-Maserati |
| J. LOVE (1:29.5) Cooper-Climax | J. SURTEES (1:29.6) Honda |
| J. RINDT (1:30.2) Cooper-Maserati | D. CHARLTON (1:30.2) Brabham-Climax |
| J. STEWART (1:30.3) BRM | B. ANDERSON (1:30.6) Brabham-Climax |
| D. GURNEY (1:30.7) Eagle-Climax | J. BONNIER (1:31.8) Cooper-Maserati |
| M. SPENCE (1:32.1) BRM | S. TINGLE (1:32.4) LDS-CLIMAX |
| G. HILL (1:32.6) Lotus-BRM | J. SIFFERT (1:32.8) Cooper-Maserati |
| L. BOTHA (1:33.1) Brabham-Climax | P. COURAGE (1:33.8) Lotus-BRM |

Monday, the day of the race, was fine and hot, much to the chagrin of the overseas team managers. At 2:30 p.m., half an hour before the scheduled start of the Grand Prix, almost 100,000 fans had streamed into the circuit. The skies had become suddenly overcast, providing some last minute drama for the tire boys. Honda, after using Goodyears for four days in practice, had tried some hand-cut Firestones late on Saturday, which had proved half a second a lap quicker than the Goodyears, and the special Firestone tires were to be used for the Grand Prix. However, as the first spot of rain began to fall, the Honda mechanics whipped off the Firestones and replaced them with the all weather Goodyears of a similar tread pattern to the tires used by the Brabham and AAR teams. Jackie Stewart and Mike Spence in the team BRM H-16s were on Dunlops for practice and the race, while Clark and Hill used Firestones, hoping the rather imminent looking Transvaal thunderstorm would fail to materialize — which fortunately turned out to be the case. Both Rodriguez and Rindt practiced and raced on Firestones as did most of the independent teams and drivers, including Jo Siffert and Jo Bonnier.



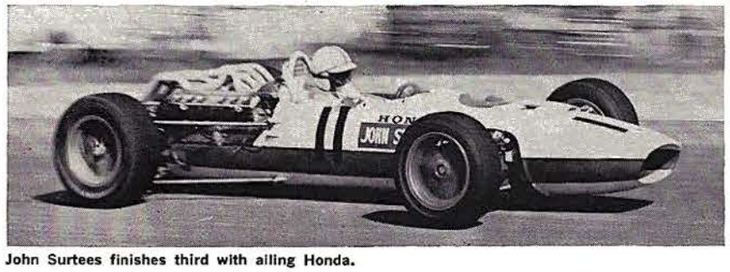
Pedro Rodriguez: First Formula One victory.

As the South African flag dropped at 3:05 p.m., the field got away to a clean start from the slightly uphill and rather narrow, two-two starting grid, with Hulme leading Surtees, Clark, and Brabham into Crowthorne corner — the long downhill right-hander at the end of the straight.

Denny Hulme pulled out a small lead at the end of the first lap, with Brabham and Surtees in close attendance, and then Rodriguez, Clark, and Rindt, bunched together, followed by Anderson, Stewart, Charlton, Love, Siffert, Bonnier, Gurney, Spence, Hill, Courage, and Botha, who had started one lap in arrears.

In the early laps Hulme proceeded to pull away from the rest of the field, with nothing much anyone could do about it, including team leader

*(Continued on Page 70)*



John Surtees finishes third with ailing Honda.

*Continued from Page 14*

## F2 Championship for Comingmen

The framework of the 1967 European Formula 2 Championship has now been settled, and is a less complex affair than was originally intended. The Championship will be restricted to 15 events – three each in Britain and France, two each in Germany and Italy, and one each in Belgium, Finland, Holland, Spain, and Sweden.

Two important rules are that the contest will be restricted to non-graded drivers (i.e., non-points winning Formula 1 drivers), although graded drivers will be permitted to take part in the races to battle for general prize money, but not Championship points, and only one graded driver will be accepted from each team.

The intention is that 50 percent of all entry lists shall comprise non-graded drivers, who will get no starting money, but will have their own separate prize fund on top of the general scale of prize money. This means that the first non-graded driver to finish in a race will get £500 (about $1400) on top of what he might pick up for his overall finishing position in the race.

General reaction from factory entrants to the scheme has been pretty cool, because they are not in favor of the principle of 'payment by results', and cannot get used to the idea of running a car without guaranteed starting money. Therefore, some teams may decide to operate just one car, with a graded driver in it. But presumably the 50 percent rule will be enforced firmly, so there should be a reasonable number of drives available for those still on their way up, which, after all, is one of the objects of Formula 2 racing.

## Made in Croydon

Production of the Group 7 McLaren-Elva has been moved from the old Elva headquarters at Rye, on the coast of Sussex, to Purley Way, Croydon, Surrey, where the main factory and offices of the parent Lambretta-Trojan Group are also situated.

The move not only improves production efficiency, but the extra space available will allow an increase in sports car production volume. The 1967 car is to be based on the prototype raced by Bruce McLaren in the Can-Am series. Last year, 50 McLaren-Elvas were built, the majority of them finding their way into North America.

## Brabham Regroups

A major reorganization and redeployment of Brabham business activities has just been completed. The administration headquarters of the Brabham Group has moved to new premises in Guildford, in Surrey, some 18 miles southwest of the former headquarters at Chessington.

The Formula 1 team, which formerly occupied part of the Motor Racing Developments premises at Byfleet, has also been moved to Guildford, along with the conversions assembly shop. MRD (Brabham's racing car production company) remains at Byfleet under Ron Tauranac's control; the conversion manufacturing plant is still in nearby Woking, and Chessington reverts to being simply Jack Brabham Motors – a car sales, repairs and service depot, gas station, and driving school.

No wonder when you ask Jack "How's business?" he replies "Which business?"

## Safety Code: European Reaction

European car makers are worried about certain implications of the 23-point safety code announced by the United States Traffic Safety Agency last December. They feel that unless the regulations are implemented with discretion and flexibility a major part of the U.S. export market could be lost, at least temporarily.

British technical representatives are seeking clarification of some details of the code and point out that certain dimensional requirements, such as headlamp heights, are a departure from the European standard, and if enforced rigidly would mean major restyling and retooling of 1968 models – an operation which could not be carried out by the September 1967 deadline.

An effort is to be made to persuade the Safety Agency to adopt international standards on one or two points, instead of insisting upon arbitrary standards of their own. The British auto industry is not opposing the principles of the American standards, but, through the Organization for Economic Cooperation and Development, is to press for an internationally agreed code of safety for vehicle design.

## Triumph and Rover Merge

Bare months after the news that BMC and Jaguar had joined forces comes the announcement that the Leyland Group (of which Standard-Triumph is a part) has made a successful bid for Rover. This means that the British auto industry has been reduced to a mere five major manufacturing groups – BMC-Jaguar, Triumph-Rover, Rootes (Sunbeam, Hillman, Singer, Humber), Vauxhall, and Ford.

Only the first two of these are wholly British-owned, and when Chrysler buys a majority share in Rootes (a development which is considered both inevitable and imminent), each of the American 'Big Three' will control a useful chunk of the British auto industry. Vauxhall (GM) and Ford are already wholly owned by their respective companies.

## Frustrationville

Oh, to be in England now that the 70-mph limit's here. British sports car drivers, still smarting from being run around by a female non-driving Minister of Transport, are being subjected to a new indignity. The police are patrolling motorways, or hiding up entrance ramps, with a 'secret weapon' – a radar detector device which can

*(Continued on Page 30)*

"Don't you think we should be getting back to the rally, Herb?"

## EUROPE

*Continued from Page 28*

measure the speed of a car either ahead of or behind it. This wouldn't be so bad if the cars concerned looked like police cars: big, black, a bell on the front, and a flashing blue light on the roof. But not a bit of it – the latest lines in 'rozzer" transport are 'E' Type Jags, Mini-Cooper 'S' types, and Sunbeam Tigers . . . in assorted colors, and looking very 'motor club'! Maybe it's their way of encouraging recruiting!

### BMC Plans

No one has been more seriously affected by the recession which has hit the British motor industry than BMC. Its troubles have stemmed not so much from the general economic climate, which has depressed the new-car market, but from yet another wave of industrial unrest.

BMC's poor labor relations and out-of-date wage-bargaining procedures have wrought havoc with production and delivery schedules for years, but at least the big showdown between management and labor during the past few months may provide the opportunity for both sides to put their affairs in order.

The BMC labor force has to be cut and streamlined, but so has the model range. For years there has been far too much duplication of models under different marque names. You have been able to buy an Austin, a Morris, a Wolseley, a Riley, or an MG, all at different prices, and often from different dealerships, and give or take minor styling changes, interior decor, and a few horsepower up or down, you've ended up with the same car. What's more, some models of one make have been cutting across other BMC products from another range, and consequently the two have had to share a market which one model could have served far more efficiently. We also have the curious situation of patently outdated BMC cars vying with up-to-date designs like the Minis and 1100s, the life span of the 'veterans' being extended every time a sizeable order is received for them. Planned obsolescence, if it was ever considered, appears to have been forgotten and a somewhat Victorian image has been created.

But there is now more than a glimmer of hope. Some very wide-awake people are having an increasing say in BMC affairs. They realize the opportunity with which they have been provided by the recent troubles, and there is reason to hope that a lot of the 'dead wood' will be removed in the not-too-distant future.

A key factor in any major model reorganization must be the long-awaited new 1½-liter engine, presumably to replace the 'B' series, and it now seems that this will be seen some time during 1967. Assuming that a new range of cars is wrapped around it, and that a similar operation is mounted to replace all the existing 'A' series three-liter models, BMC will have progressed a long way towards sorting out its troubles.

### New Ford Performance Center

Effective January 1, John Wyer, former managing director of Ford Advanced Vehicles of Slough, England, formed a new company, J. W. Automotive Engineering Ltd., to take over FAV's two Slough factories and develop them into a Ford Performance Center. Wyer is managing director of the new company, which is a private entity, but will work in close association with Ford on both sides of the Atlantic.

Road and race versions of the Ford GT40 will continue to be built at Slough, and the company will also provide a car-preparation and maintenance service for owners. Outstanding orders for the GT40 at the time of the changeover were worth in excess of £250,000, or about $700,000.

J. W. Automotive Engineering also became the main United Kingdom distributors for Shelby American products, including the GT350 and GT500, and will maintain a close link with racing as entrants of U.S. Ford-powered cars in various International events.

Advanced engineering activities formerly carried out by FAV, on behalf of Ford of Britain, have now been moved to Ford's new Research and Engineering Center at Dunton, Essex. The center for Ford of Britain's performance car preparation and servicing remains at Boreham, Essex.

### Mann Marks Time

Alan Mann, whose activities as race and rally entrant of Ford products were recalled in the October 1966 issue of SCG, will be running a more modest competition program in this year, pending the construction of new cars 'and a great deal of racing' in 1968. He's using the 'lull' to regroup his resources.

### Ferrari and Dragoni Split

Eugenio Dragoni, the thorn in John Surtees' side throughout his stay with Ferrari, and the man who had been tipped as a possible successor to the Old Man Himself, has severed his association with Enzo.

The parting of the ways took place just before Christmas, and without the recriminations which accompanied the earlier dissolution, but the announcement had a familiar ring about it. In essence, it said, "Signor Ferrari and Signor Dragoni have parted by mutual consent and as friends." John Surtees' first reaction on being told the news was a hearty chuckle!

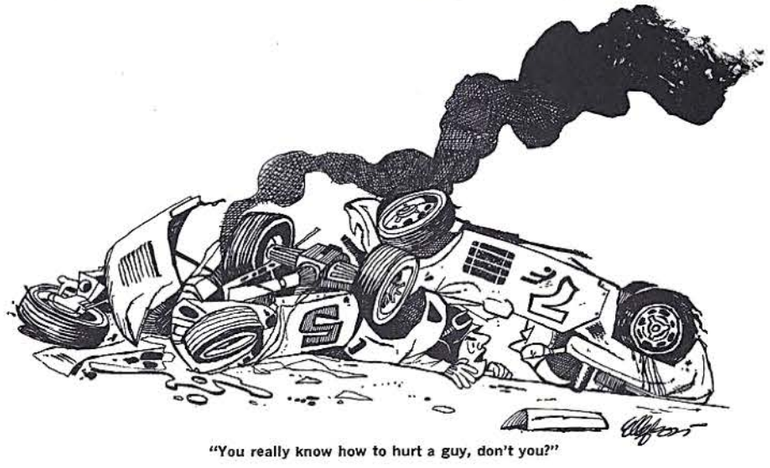
Dragoni, 58, a wealthy perfumier (giving ride to the many stories concerning his facility for raising a big stink!), managed Ferrari's racing affairs on a free-lance basis. His duties with the team are to be taken over by Franco Lini, the well-known and very affable Italian motoring journalist. Sounds like he's gotten his most difficult assignment yet.

### No-change Le Mans

All plans for a 'new-look Le Mans' for 1967 have been shelved, and the regulations reveal only very minor changes of detail compared with those for last year's race.

Once again the event is open to Group 6 Sports Prototypes, Group 4 Sportscars (50 built), and Group 3 Grand Touring cars (500 built), in various capacity classes, starting at 1000 cc. There is a slight modification in the formula for calculating the minimum-distance requirement to qualify for the Index of Performance, and a slight increase in the minimum lap speeds per class which have to be recorded during practice. The organizers are also seeking to overcome any desire to 'jack up' cars just to get them through scrutineering, then re-trim the suspension – ground clearance will be re-checked on every car just before the race!

The race takes place on June 10-11, and the official Test Days are April 8-9 – a weekend on which there appears to be no important international event in Europe for Groups 3, 4, and 6 cars.

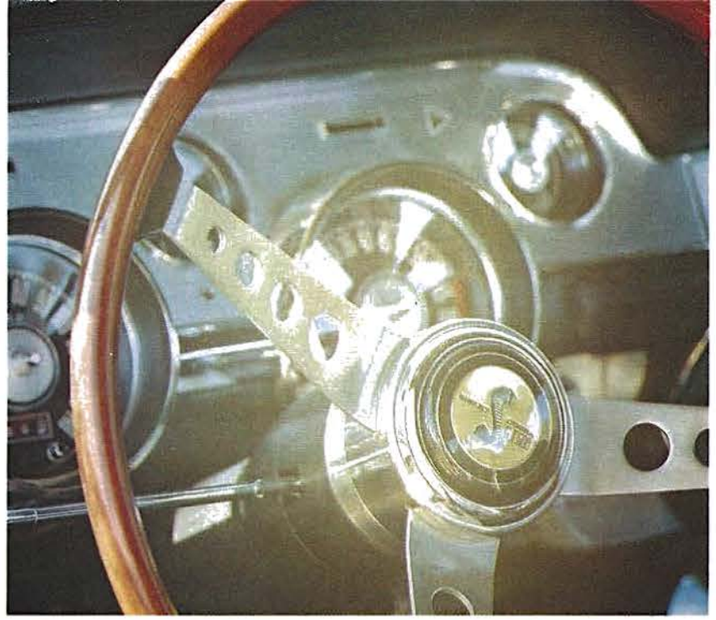


"You really know how to hurt a guy, don't you?"

# SHELBY MUSTANG GT350 & GT500

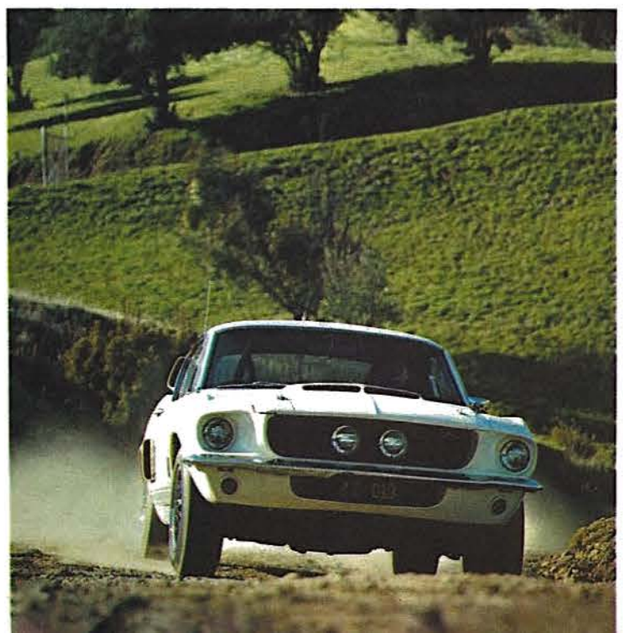
By Jerry Titus

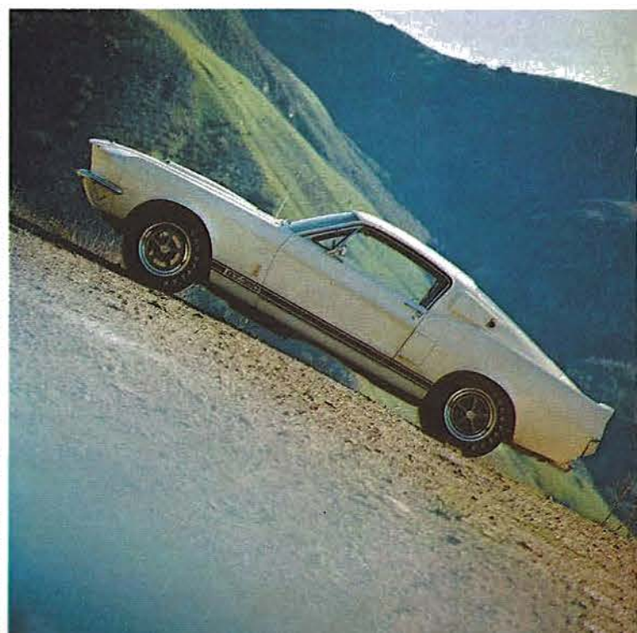
THE PRE-1967 GT350, A SHELBY-AMERICAN REWORKED MUSTANG, WAS A PERFORMING CAR but, in many respects, it was more of a hot rod than a Grand Touring car, With a stripped-out interior, the optional suspension, a rock-crusher limited slip, the mechanical-lifter 289 high-performance V-8, and quick steering, it made a Mexican Road Race Ferrari look like an LTD when compared for noise, comfort, and driving ease. But there were plenty of buyers excited by this kind of "furry-ness," and the prime requisites of roadability and performance were certainly satisfied, so the cars sold. However, the people within Shelby-American were well aware of the shortcomings and the market limitations that they imposed. The '67 production Ford Mustang is a more sophisticated machine, and the GT350 takes maximum advantage of its attributes to improve not only the ride, comfort, driving ease, and noise level, but the handling as well! It is a substantially better and more practical machine, without sacrifice in the performance area.



**The powerful GT500 (instrumentation and engine compartment shown at right) uses two four-barrel carburetors atop the 428-inch engine. Our test unit was equipped with air conditioning and automatic transmission. The sparkling GT350 shown in photos below makes good use of the wider track for improved ride and superior handling in tighter corners.**

Photos: Bob D'Olivo



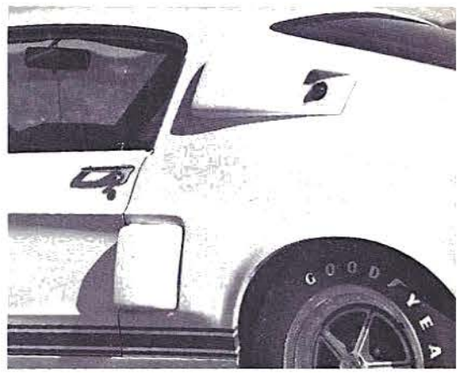


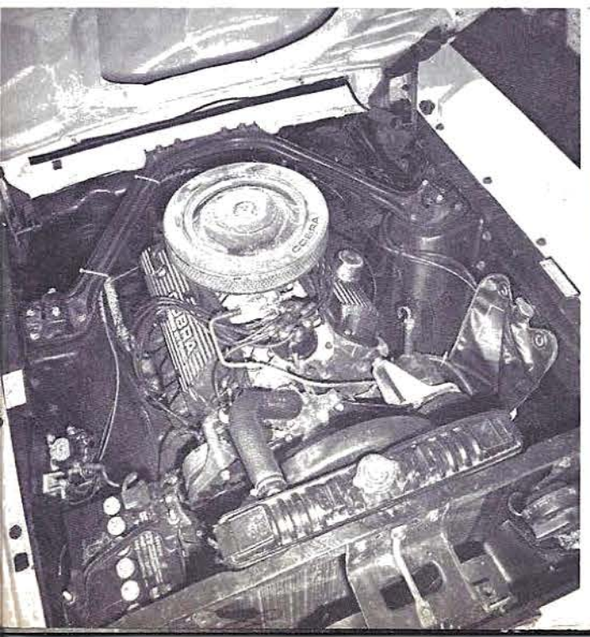
An added model for '67 is the GT500. It features a 428-inch engine. We frankly laughed out loud some 18 months ago when we heard such a prototype was planned. A huge hunk of cast iron sitting that high and that far forward? Lots of luck! Paying us no mind, they did it anyhow, and wound up with a very practical automobile. Combined with a three-speed automatic, the 427 is far more docile and more quiet than the 289, and outperforms it in every respect except gas mileage. You can feel some of the compensations made for the extra weight of the engine, but the end result is surprisingly good.

There were three major goals that Shelby's design/engineering team set out to accomplish with the '67 model: improve its quality, make it more distinctive, and *reduce* its cost. The latter requirement certainly isn't compatible with the first two. The goals were achieved only through months of intensive effort and several weeks' delay in getting the production line rolling. The result has been more than worth the effort and the wait, however.

In striving to make the GT look distinctive, redesign of the front and rear ends has been accomplished with the use of fiberglass components. Last year there were some problems with warpage of the fiberglass hoods, and it was expected that this year's model would have to absorb the extra weight of a steel hood in order to be assured of a decent fit. The problems were cured, however, and the '67s sport 'glass hoods with a split scoop in the center. The complete front grille surrounding is also fiberglass and combines with the extended hood to make a very tasteful and effective change from the standard Mustang grille. The rear deck has a small spoiler lip molded in, and the rear fender caps or extensions (normally die-cast bolt-ons) are also of glass and flare up to match the deck contour, giving the entire rear a 'spoiler' configuration. Wide, special tail lights and a Cobra gas cap complete the distinctive appearance of the rear, but extractor type scoops cover the quarter sections of the roof and a small red 'safety' light is included in the aft opening of each, readily visible from behind and wired to actuate with the brake and turn-indicator lights. Lower in the rear quarter section is a functional air scoop for the rear drum-type brakes. This year you can buy the Shelby products in a wide range of colors and the bold, cop-attracting stripes have been left off. Shelby employees have found their 'ticket ratio' substantially reduced in the unstriped version.

Chassis changes are many. Power steering and power brakes are standard for both GT350 and GT500. The track, as on the production Mustang, is two inches wider. There is still good roll-stiffness, but the ride is quite a bit softer. Brake-pedal pressure is light, as is steering pressure, the latter a result of both the power assist AND a reduction of caster angle. This makes it a little bit too sensitive when you enter a fast corner, but this is a matter of driver adaptation. Also standard in both models is a roll-over bar. Optional — fortunately — is shoulder harness of the reel type,





To enhance distinctive styling, high beams are moved to the grille center, rear fenders and deck are restyled to include a spoiler, and scoops are installed in quarter-panels for functional ventilation and brake-cooling. The 289 engine, lower left, is noisy, but light and very responsive. GT500 interior is shown below with auto-trans quadrant on the floor. Insert shows reel-type shoulder harness mounted to roll bar.

## SHELBY MUSTANG GT 350 & 500

### BASE PRICE

$4195 (GT 350)
$4395 (GT 500)

### ENGINE

Type....V-8, iron, water-cooled
Head.....Cast iron, removable
Valves....Ohv, pushrod/rocker actuated

GT 350
Max bhp.....306 @ 6000 rpm
Max. Torque.....329 lbs. ft. @ 4200 rpm
Bore....4.005 in. (101.73 mm)
Stroke....2.87 in. (72.9 mm)
Displacement.....289 cu. in. 4737 cc
Compression Ratio....10.5 to 1
Induction System..Single Holly 4 bbl.—750 cfm
Exhaust System.Standard, dual
Electrical System.....12 V distributor ignition

GT 500
Max. bhp.....355 @ 5400 rpm
Max. Torque.....420 lbs. ft. @ 3200 rpm
Bore.....4.13 in. (104.9 mm)
Stroke....3.984 in. (91.19 mm)
Displacement.....428 cu. in. 7015 cc.
Compression Ratio....10.5 to 1
Induction System....Dual Holly 4 bbl. — 600 cfm
Exhaust System Standard, dual
Electrical System.....12 V distributor ignition

### CHASSIS

Frame .....Unit, welded
Body.....Steel and fiberglass
Front Suspension .....Unequal arms, coil springs, adjustable tube shocks, anti-sway bar.
Rear Suspension.....Live axle, multi-leaf springs, tube shocks
Tire Size & Type.....Goodyear E70-15

### WEIGHTS AND MEASURES

Wheelbase .....108 in.
Front Track .....58 in.
Rear Track .....58 in.
Overall Weight .....51.6 in.
Overall Width .....70.9 in.
Overall Length .....51.6 in.
Ground Clearance .....6.5 in.
Crankcase .....6 qts.
Cooling System.....20 qts.
Gas Tank.....18 gals.

GT 350
Curb Weight .....2723 lbs.
Test Weight .....3048 lbs.

GT 500
Curb Weight .....3286 lbs.
Test Weight .....3576 lbs.

### CLUTCH

Type.....Single disc, dry
Diameter .....10.5 in.
Actuation .....Mechanical

### TRANSMISSION

Type...Four-speed, full synchro
Ratios: 1st .....2.32 to 1
2nd .....1.69 to 1
3rd .....1.29 to 1
4th .....1.00 to 1

### BRAKES

Disc Diameter front ....11.3 in.
rear .....10. in.
Swept Area .....n.a.

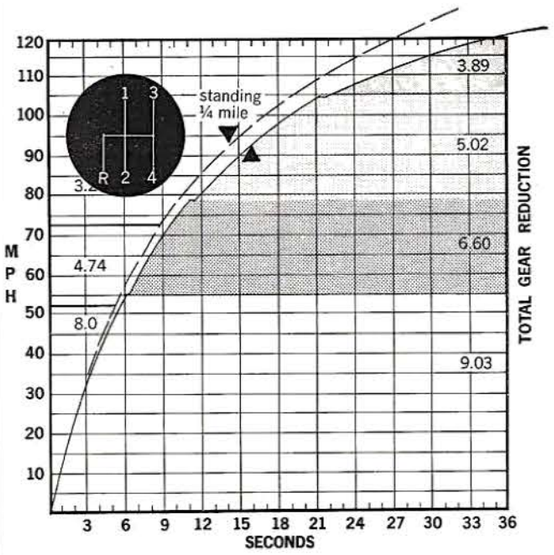
### DIFFERENTIAL

GT 350
Ratio.....3.89 to 1
Drive Axles (type)....Enclosed, semi-floating

GT 500
Ratio.....3.25 to 1
Drive Axles (type)....Enclosed, semi-floating

### STEERING

Type..Recirculating, ball sector
Turns Lock to Lock.....3.5
Turn Circle.....37 ft.




### PERFORMANCE RESULTS

#### ACCELERATION

GT 350

| | | | |
|---|---|---|---|
| 0-30 | 2.8 sec. | 0-70 | 9.0 sec. |
| 0-40 | 4.1 sec. | 0-80 | 11.8 sec. |
| 0-50 | 5.6 sec. | 0-90 | 15.0 sec. |
| 0-60 | 7.1 sec. | 0-100 | 19.3 sec. |

Standing ¼ mile.....15.3 sec. @ 91 mph
Top Speed (avg. two-way run).. 129 mph

GT 500

| | | | |
|---|---|---|---|
| 0-30 | 2.8 sec. | 0-70 | 8.1 sec. |
| 0-40 | 4.0 sec. | 0-80 | 11.8 sec. |
| 0-50 | 4.9 sec. | 0-90 | 15.0 sec. |
| 0-60 | 6.7 sec. | 0-100 | 16.9 sec. |

Standing ¼ mile.....14.3 sec. @ 92 mph
Top Speed (av. two-way run)... 132 mph

#### FUEL CONSUMPTION GT350

Test .....13 mpg
Average .....15 mpg

#### FUEL CONSUMPTION GT500

Test .....9.4 mpg
Average .....11 mpg

#### RECOMMENDED SHIFT POINTS

GT 350
Max. 1st .....55 mph
2nd .....78 mph
3rd .....104 mph
RPM Red-line .....6200 rpm

#### SPEED RANGES IN GEARS:

1st ..... 0 to 55 mph
2nd .....15 to 78 mph
3rd .....25 to 104 mph
4th .....35 to 129 mph

#### BRAKE TEST

74 Average % G, over 10 stops. Fade encountered on 8th stop.

#### REFERENCE FACTORS

GT 350
Bhp. per Cubic Inch.....1.06
Lbs. per bhp. .....8.8
Piston Speed @ Peak rpm..... 2870 ft./min.
Swept Brake area per lb. ..n.a.

GT 500
Bhp. per Cubic Inch.....0.829
Lbs. per bhp. .....10.0
Piston Speed @ Peak rpm..... 3586 ft./min.
Swept Brake area per lb. ..n.a.

#### SPEEDOMETER ERROR GT350

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Indicated | 30 | 40 | 50 | 60 | 70 | 80 | 90 |
| Actual | 30 | 40 | 51 | 61 | 70 | 79 | 88 |

GT500

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Indicated | 30 | 40 | 50 | 60 | 70 | 80 | 90 |
| Actual | 30 | 39 | 49 | 58 | 69 | 80 | 92 |

that mounts to the top of the bar. Its angle is wrong for any real crash protection, but a transverse bar at shoulder height (needed for correct mounting) would also bar access to the 'optional-but-you-can't-get-one-without-it' fold-down rear seat. Yet a lot of care has been exercised to make the bar both effective in an inverted emergency and to blend it into the interior as unobtrusively as possible. Most of the interior is regular-production Mustang. A wood-rimmed steering wheel bears a Cobra insignia, and the right side of the dash has an emblem that designates the model. The large speedo and tach, mounted directly forward of the wheel, are quite legible, but a small, twin nacelle below the dash houses the oil pressure and ammeter

*(Continued on page 74)*

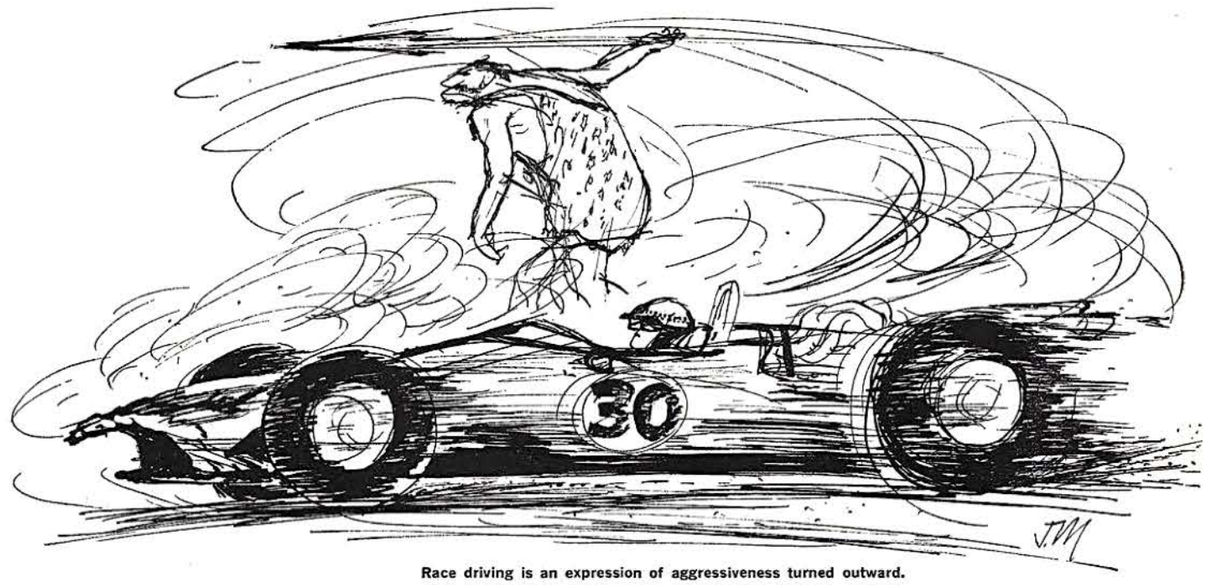

Delving into the mind and soul of the race driver produced some surprising results.

# RACE DRIVERS and the CLINICAL PSYCHOLOGIST

Photo: Robert Franks

## why should anyone want to race automobiles in the first place? and why should a few be so much better than the rest?






Race driving is an expression of aggressiveness turned outward.

By Leon Mandel

IF YOU'RE BRAVE, LOYAL, THRIFTY, REVERENT, and able to leap over a beaver in a single bound, all you can be these days is a Boy Scout. On the other hand, if you're lucky enough to be aggressive with a baseline of hostility, low in self-abasement, deferent, achievement-oriented, and indifferent to succorance, you're prime material to become world champion.

So, at least, says Dr. Keith Johnsgard, a clinical psychologist who has spent the last year delving into the mind and soul of the race driver — with some surprising results.

Johnsgard is well on his way to laying to rest the great 'death wish' theory of race driving. He has discovered that the better the driver the less he cares about the crowd reaction, but the more he is willing to listen to criticism from his equals. Johnsgard can spot a 'balloon-foot' in the pits with one steely-eyed gaze, but says that student drivers and old pros are surprisingly alike with some significant exceptions.

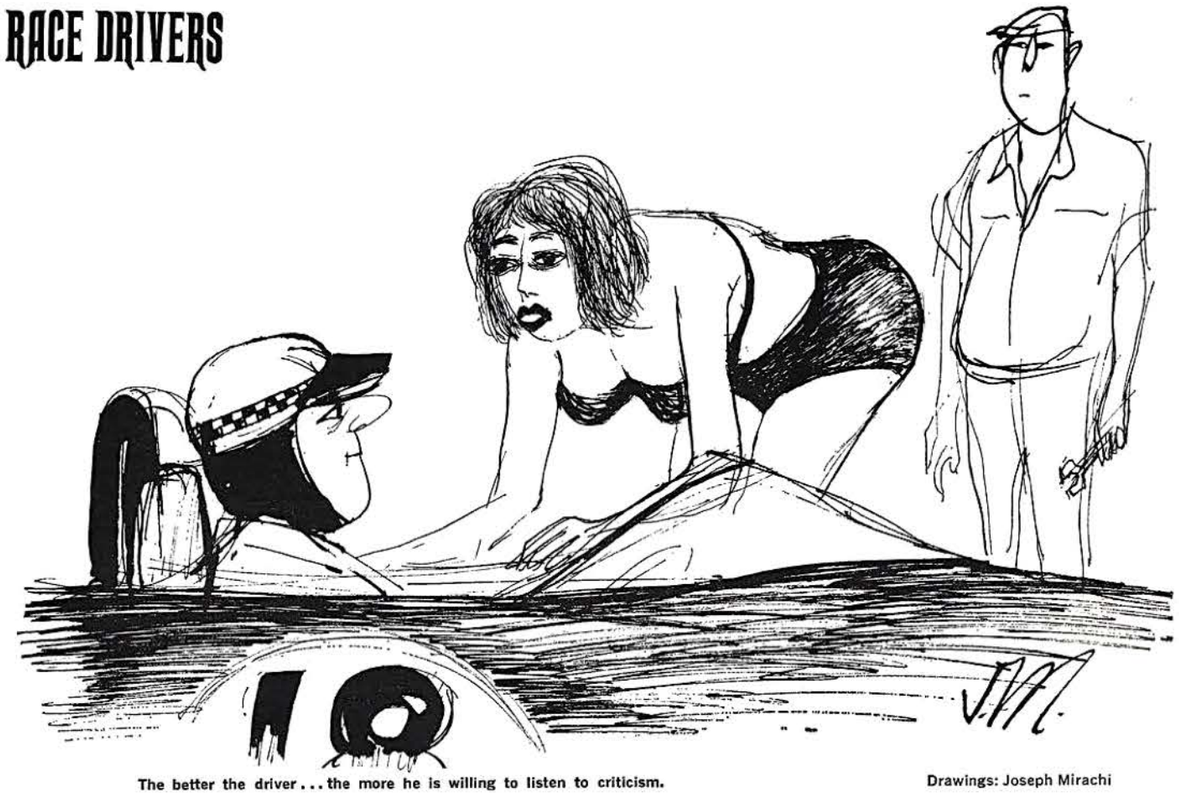
All this is the product of research that began after a casual visit to an SCCA Regional race at Vaca Valley, California. "One of my colleagues, a Jungian analyst who owned a Porsche, took me to a race once . . ." reports the doctor, ever a clinical psychologist. The world of motorsports has not been the same since.

Johnsgard is a youngish man who devotes his time to counseling disturbed students at San Jose State College. ("We compard our results to a group of college men and discovered race drivers were more reserved and self sufficient, more in control of themselves, more relaxed, less neurotic," says Johnsgard.) He also teaches such arcane disciplines as group dynamics, what he calls "basic abnormal scientific methodological stuff," and maintains a small private practice in the evening "so I can afford to be a teacher."

His work has taken him into close contact with another San Jose State psychologist, Dr. Bruce Ogilvie, who for years has been testing athletes. Ogilvie, who has recently published what is surely one of the most specialized books in the world on how to treat problem athletes, had compiled information about more than 3000 men — professional and amateur athletes engaged in every conceivable kind of recognized activity. That information formed a fine basis for comparison with Johnsgard's results, and provided a number of surprises.

Johnsgard, whose work with race drivers began at Vaca Valley that fateful day, found himself there via a circuitous route. He took his master's at North Dakota and his doctorate at Washington State. He prepared for his task with a master's thesis on instrument panel layout in bombers. "My interest in cars (he drove to his first race in an Elan), my work in the area of personal-

# RACE DRIVERS



The better the driver . . . the more he is willing to listen to criticism.

Drawings: Joseph Mirachi

ity, everything seemed to fall into place when I was asked to prepare a questionnaire that would enable the San Francisco Region SCCA to cull out prospective students who would be unsuccessful in their driver's school."

His first sight of cars at speed had no little impact on Johnsgard. "I won't forget it because I couldn't even see the cars until we came up behind that raised area — the outside of the banking on the turn one oval —and suddenly we were right next to the track and those cars were going by at 100 mph or more and they scared the bejesus out of me."

"Stan Petersen and Al Brizard (Lotus 19B, Alfa GTA, Cooper-Alfa, etc.) were there with Dr. Roy Porta, and they asked if I could put something together to give students as a screening device. I told them it wasn't that simple. Prediction is difficult at best."

Johnsgard was copping out, it was right up his alley and he admits it. "I came back down and talked to Ogilvie who said he'd been trying to get his fingers into this pot for quite a while. The more I thought of it the more excited I became."

The result was use of three of Ogilvie's tests plus a fourth that Johnsgard uses to measure "concept dimension."

The tests are standard. Very much like those given to astronauts, executives, convicts, and prospective members of the CIA. They ask about your self esteem, your view of mother, father, clinical psychologist. They ask if you are possessed with the notion that you have a message from God. They ask if you like girls (even if you're a girl, they ask if you like girls). They ask if you vomit a lot.

There are four hours worth of tests, and they have been given to student drivers in northern California and to the Race Drivers Association in southern California. With the help of John Timanus, Johnsgard has been able to convince drivers on the USRRC and Can-Am circuits to submit to tests and, with the exception of Brabham and McLaren, he has tests from every English speaking road racing driver of consequence.

("I haven't given them to USAC or NASCAR drivers yet," he says. "I'd like to very much. I suspect there'd be some significant differences.")

"The results we have now are analyses of tests we took on 38 licensed drivers last Spring. We've split them into groups: a top group of 12 drivers who've obviously achieved sucess, and the others.

"The results are significant enough and consistent enough and exciting enough so that even though they're preliminary data, there's enough here for a dozen publications.

"Hard-core, professional stuff," Johnsgard calls it, sounding very much like a district attorney at a girly magazine rack.

Psychologists, like sociologists, tend to express the commonplace in poly-syllabic pronouncements calculated to overwhelm by sheer weight of pomposity. Johnsgard is little different from his colleagues in this, but more often than expected some "hard-core" sense comes through.

"Licensed drivers as a group have an incredible need for achievement," says Johnsgard, consulting a chart. "Probably more than any group of athletes Ogilvie has tested. The group falls into the 90th percentile, some members are obviously in the 100th percentile."

Johnsgard has had his team translate results onto that device dearest to the heart of a social scientist: the graph. The top achievers are in blue, the less successful group in red. The two lines are remarkably close in their peaks and valleys.

"The second notable characteristic is the good driv-



The tests ask about your view of Mother . . .

. . . even if you are a girl, they ask if you like girls.

The day is far off when a Jimmy Clark is sent back to his herds of sheep because he failed his ink-blot test.

er's need for dominance. These are leaders, much more so than athletes in general. Moreover, they have very high endurance, they keep at something. They're self-assertive people standing up for what they believe. They're independent as hell, and that's an interesting kind of finding when you see that the ones who've made it are also deferential as can be. They're willing to take suggestions. That's one of the big differences between the guys who've been successful and the ones who never have. The good guys are much more inclined to learn than the guys who haven't made it."

Johnsgard notes the biggest difference between students and successful drivers is in exhibitionism.

"The pros, the guys who've really made it, are very low on exhibition," he says. "The guys who haven't made it are really high. And that's not only true for racing drivers, it's true for every sport. What it means is that the guys who haven't made it are out on the track for other people, not themselves. They're very concerned about what other people think.

"The guys who are successful are in it for themselves and, once they've started racing, they don't give a damn whether there are spectators around or not."

The tests use a series of descriptive words which are explained by a string of adjectives on the interpretation sheet. Thus, drivers are "tough-minded", which is described as "self-reliant, realistic, no nonsense." They are "relaxed, tranquil, torpid, unfrustrated." Drivers tend to be the "experimenting type" or "critical, liberal, analytical, free-thinking." If they are successful, they are "assertive" or "independent, aggressive, stubborn," and they are "reserved" or "detached, cool, critical."

If they are leaders, why do they not lead. Answers Johnsgard: "I don't think you'd find these guys in the PTA. Their need to belong to organizations is way below normal. They're not joiners."

It is in the area of "abasement" that Johnsgard finds the most fruitful discoveries. "Abasement" is described as that tendency to be prone to guilt, to blame yourself, to be depressed. Of all athletes tested, race drivers scored lowest on this scale.

Says Johnsgard, "One of the criticisms leveled at drivers is that they have some kind of death wish. That they're out there trying to kill themselves. This (the score on this segment) argues the other way. It really does.

"Of all the groups we've tested, these guys seem less prone to guilt, less suicidal. That makes sense because the aggression scale is so high."

Johnsgard explains the seeming non sequitur by equating freedom from guilt with the ability to express aggressive tendencies. "Man, of all creatures, is a natural, predatory killer. Cultural, societal, and parental pressures curb this natural aggressiveness. What takes its place is guilt, attempted suicide. Race driving is something that is an expression of that aggressiveness turned outward."

A final surprise comes on the part of the graph that indicates successful drivers don't like parties. "Most of

*(Continued on Page 75)*

*TECHNICAL REPORT:*

# YOUR HOT ENGINE

## PRODIFYING THE PRODUCTION ENGINE FOR PERFORMANCE

***PART THREE: HEADS & VALVES, or keep it legal and keep it smooth.***

Text & Photos: Jim Wright

THERE ARE REALLY ONLY TWO BASIC WAYS OF INCREASING THE POWER OUTPUT OF ANY INTERNAL COMBUSTION ENGINE. The most common way is to increase the volumetric efficiency of the engine. Or, to put it more simply, to increase the degree to which the cylinders are charged, exhausted, and recharged during each engine cycle. This is accomplished by a variety of methods: boring and stroking to increase cubic-inch displacement, larger valves, enlarged intake and exhaust passages, more camshaft timing, multiple carburetion or supercharging, and tuned intake and exhaust systems. All of these modifications enable the engine to take a bigger gulp of fuel and air. Since it is the air-fuel mixture that produces the power, the more of it that can be crammed into the cylinders the better.

The other method of increasing power output is to increase the *efficiency* of the combustion cycle. Once that big charge gets into the cylinders, it has to be ignited at the right time, burned at the right rate, and consumed just as completely as possible. If not, the full potential of any other modifications won't be realized.

To a large extent, both volumetric efficiency and combustion efficiency depend on head and valve design or characteristics. This is especially true in an engine that is being 'prodified'. In this case, SCCA production rules prevent modifications such as stroking the crankshaft or large overbores to gain more cubic inches. The rules also prohibit increasing valve size. So, except for the nominal 0.040-inch overbore that is allowed, the builder has to resort to more subtle ways of increasing VE. The rules *do* allow a fairly free choice of cam-grinds, and also certain changes in the carburetion — both of which will be covered later in this series. The rules also allow — and this is most important — extensive modifications or reworking of the existing head, valves, and valve springs. And while the camshaft timing, carburetion, and exhaust system do supply a certain potential for the engine to charge and recharge itself, the heads and valves are still the limiting factors as to how much, or how efficiently, air will move in and out of the engine.

The first place to start is with the intake and exhaust passages. If you have access to a high-speed hand grinder and a supply of stones, you could do the job yourself — but not very well. There's a lot more to it than just enlarging and polishing. There was a time when this was all it took, but that time is long gone. Head work has developed into a science that is best left to the professional.

There are many reasons why the home builder shouldn't do his own head work. The first and most important is that a professional will have the benefit of past experience and testing with a given head design. He should, and usually does, know where to remove material, where to leave it, where to polish and where not to polish, what works, and what doesn't work.

In the past decade the factories have found out more and more about what consitutes good, efficient port design and have applied it to their engines. But the engines were designed to perform adequately under a given set of conditions, and by prodifying, those original conditions are changed. We're asking them to do more than they were designed to do.

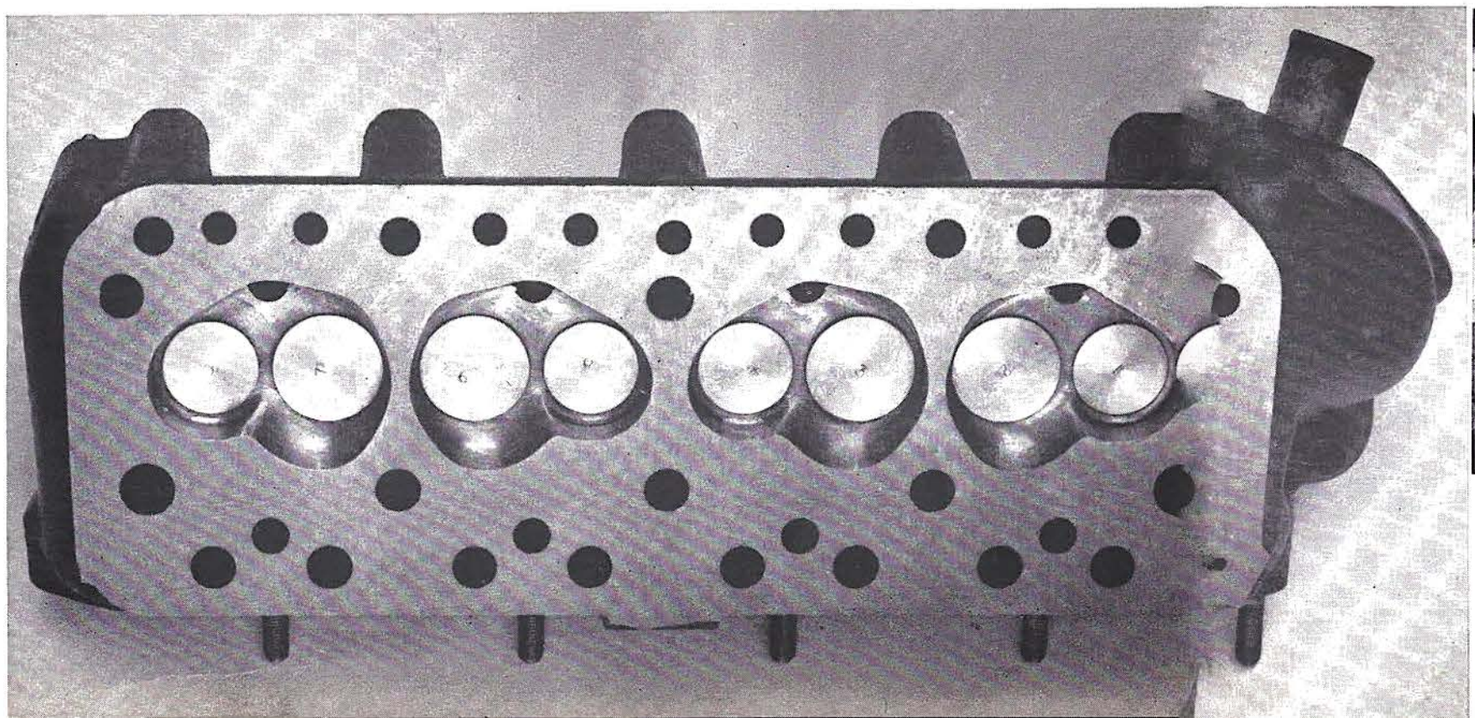
The general practice among head reworkers these days seems to be (in most cases) to retain the basic port shape when it has proven to be good and to improve it by enlarging it slightly where needed, smoothing it where it is rough, and by straightening out sharp bends and radii where physically possible.

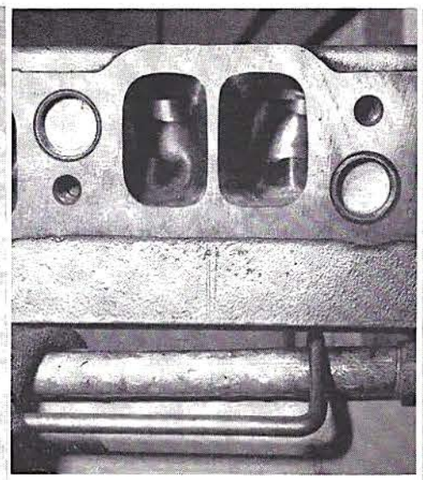
Just how much to enlarge the ports will be limited by the valve size. There's a definite relationship between port area and effective valve opening area that can't exceed. By going too large, gas velocity through the port and valve may drop off in one area, increase in another, with either condition creating excessive turbulence in the gas flow, which will actually act as a restriction.

In some cases the ports will contain a sharp bend or radius which acts as a restriction. By grinding, these bends and radii can be straightened somewhat, reducing the restriction. These areas are critical because the amount of metal that may be removed here is determined strictly by how much metal is available in the port wall. Take too much and you end up in the water jacket. In most cases this can be repaired by welding. The pro knows exactly how much metal he can remove. Generally, you don't.

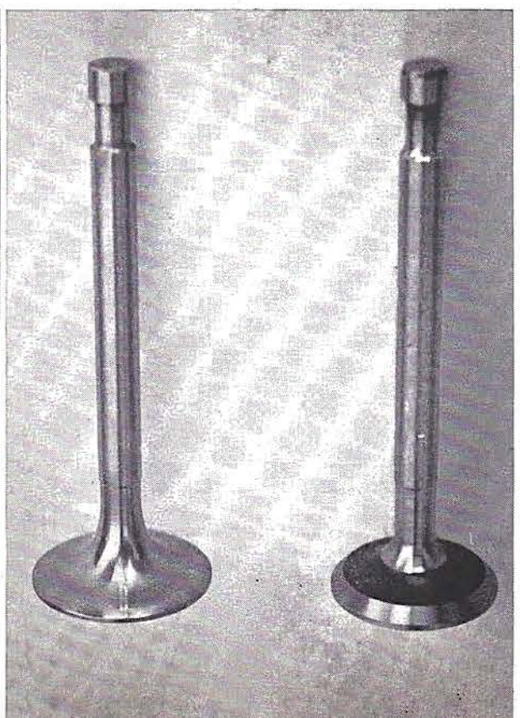
Polishing the ports to a mirror-like finish might look good, but it's usually a waste of time and money. There was a time when this was the thing to do. Some pros still do it, but usually only because they can't convince the customer that he's not being cheated if it isn't done. To understand why, you have to understand a little about the characteristics of the gas flow as it moves through the port. It's a lot like water flowing in a river. The velocity is greatest in the center, slowing by degrees closer to the port walls. Right at the wall a 'boundary layer' exists. In effect this layer is almost static. If the wall is rough the layer will be thick, cutting down on the effective area of the port. Grinding the wall smooth insures that the layer will be kept thin and the effective area of the port kept as large as possible. But, since the layer is static, merely smoothing is just as effective as polishing, and takes a lot less time.

At the outer end of the port, the





At left, a fully prepared head, with polished and lightened valves, relieved combustion chambers, etc., is a thing of beauty. Right, most of the rework is concenerated on the intake valve since the gas flow is from beneath the head and heat is less. A proper porting job, above, provides unrestricted flow, is most critical in the guide area.



## YOUR HOT ENGINE

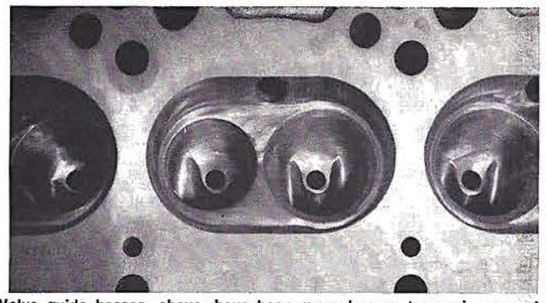
opening will be ground to match the opening of the intake manifold (or exhaust header). The gasket is usually used as a guide. The result is that the transition from manifold to port, or from port to header, will be smooth, containing no restrictions or turbulence-inducing edges that could impair the gas flow.

At the valve end of each port the pro will pay particular attention to size and shape. This is a critical area as far as turbulence is concerned. A certain amount of turbulence is desired because of the effect it has on combustion. In most cases the proper turbulence-inducing shape already exists, because it was designed in by the factory. What isn't needed is too much turbulence, because this can cut down on the effective area. Here the pro will fall back on previous experience that he has gained either through flow bench experiments or through actual practice.

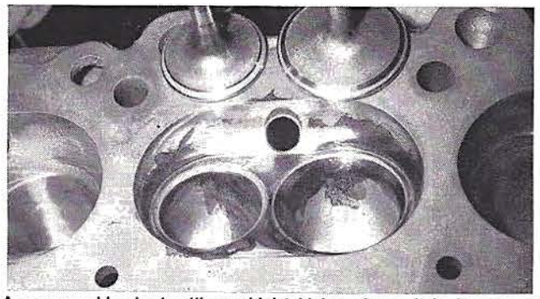
The amount of rework that can be accomplished on the combustion chamber is limited. However, there are several important things that must be done. If it is a cast-in chamber, the surface should be smoothed to insure that no rough or sharp edges exist that might cause localized overheating or hot spots. These can cause a mixture to be touched off prematurely and can lead to burned pistons and overloaded bearings. In some cases the pro might have found that it is advantageous to change slightly the basic shape of the chamber for more efficiency.

The rules prevent the installation of oversize intake and exhaust valves, but do allow stock valves to be replaced with valves of a better material. They can also be reworked slightly. Metal may be removed by machining to both lighten them and improve their shape. The results are

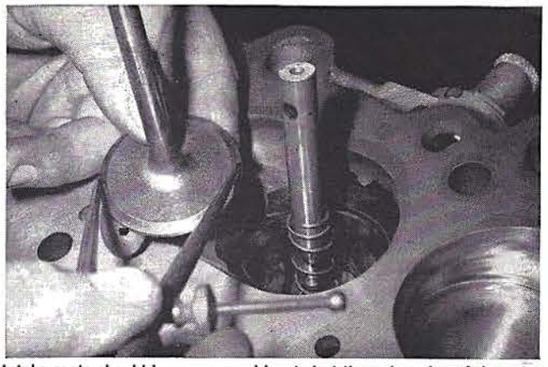
*(Continued on Page 79)*



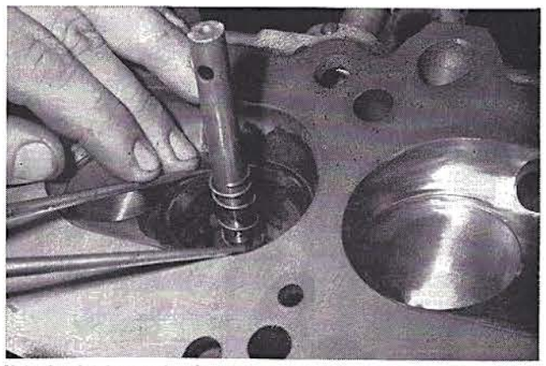
Valve guide bosses, above, have been ground away to maximum, yet still have enough 'meat' left to hold the guide stable under load and heat.



A pre-assembly check with machinist bluing after a light hand-lap of the seats shows the ideal widths to accomplish for intake and exhausts.

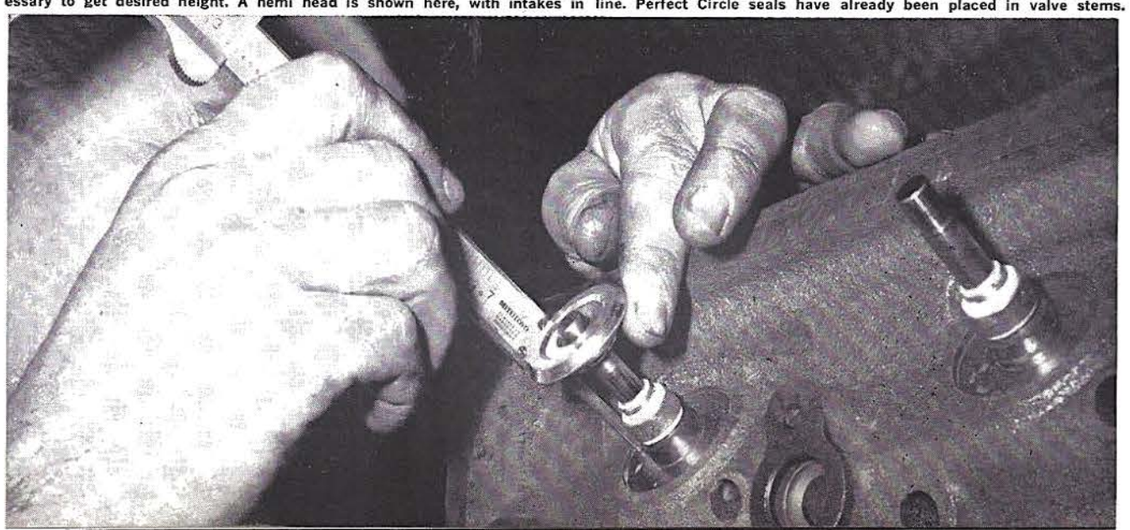


Intake seats should be narrow and located at the outer edge of the valve head to utilize maximum opening. Dividers measure total width here.



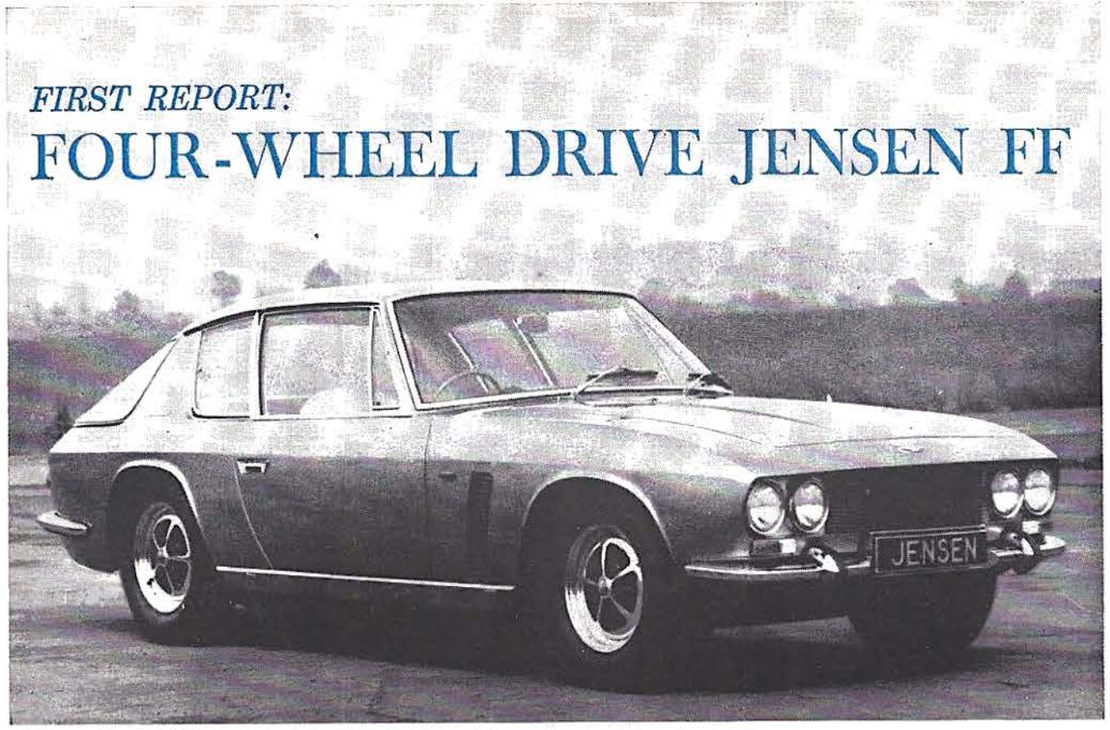
Note that intake port has been enlarged to the i.d. of the seat to provide maximum flow. It's a tricky job that HAS to be very accurate, though.

Total spring height with the valve in closed position is critical for equal pressure. Shims or sometimes grinding of the spring seats is necessary to get desired height. A hemi head is shown here, with intakes in line. Perfect Circle seals have already been placed in valve stems.



*FIRST REPORT:*

# FOUR-WHEEL DRIVE JENSEN FF




**By John Blunsden**

JENSEN MOTORS, whose CV-8 four-seater coupe has for the past few years been one of Britain's most luxuriously-equipped and safe-handling high performance cars — if not one of the most aesthetically pleasing — has announced two new cars offering much greater sales potential for 1967.

They are the Interceptor and the FF, sharing the same power unit and transmission options – the Chrysler 383 cubic inch (6276 cc) V-8 with four-barrel carb, and either three-speed Torqueflite automatic or four-speed manual gearbox. The major difference is that the FF is fitted with (and gets its initials from) the Ferguson Formula automatically-controlled center differential, a mechanical device which divides the driving torque between all four wheels. The four-wheel-drive Jensen also features the Dunlop Maxaret anti-lock brake unit.

Apart from a lowered floor line, the two new cars are technically very similar to the normal and FF versions of the CV-8, which is now discontinued. But the body, apart from its new styling, represents a big departure from previous Jensen practice, which was to use top-quality, fiberglass moldings.

The new Jensens are built in steel (employing a method of construction developed by Vignale). Although the bodies are built by Jensen in Britain, the styling has been influenced by Superleggera of Italy.

These are expensive cars — even in Britain — but Jensen has proved over the years that there is a market for a very-high-performance four-seater, provided that chassis performance matches engine performance, and that the whole thing is wrapped up in a really luxurious package, with no evidence of skimping or penny-saving anywhere along the line. The Interceptor and FF follow this theme.

Standard equipment includes Armstrong Selectaride driver-controlled adjustable shocks, rack-and-pinion steering, self-adjusting Dunlop disc brakes all around with separate front and rear systems and servo-assistance, comprehensive instrumentation, wood-rim steering wheel, thermostatically-controlled heating and ventilation system with three face-level air outlets plus foot-level outlets, twin rear-window defroster fans, fully reclining seats, safety belts, movable rear parcels shelf, Wilton pile carpeting, transistorized radio with twin rear speakers, warning lights in the trailing edge of the doors, twin sealed-beam headlights with flasher control, engine and trunk compartment illumination, two-speed wipers with anti-lift blades, cigar lighter, back-up lights, electric clock ... the list just goes on and on.

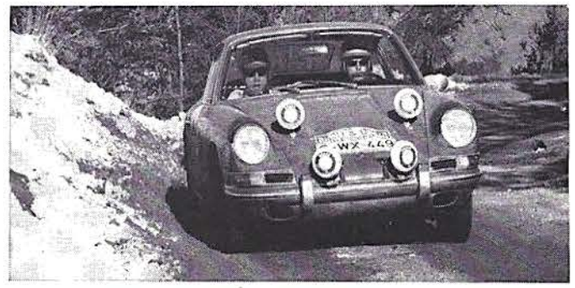
On the FF, the center differential not only splits the drive between all wheels, but also ensures that when a predetermined proportion of speed difference in the output shafts is reached, two elements in the differential train become automatically clutched together, thereby preventing further unnecessary differential action. This means that in no circumstances can one wheel individually, or the front or rear pairs of wheels separately, spin under drive or lock under braking. The function of the Maxaret unit, operating on the brake servo system, is to prevent the locking-up of all four wheels.

The resultant gains are in exceptional acceleration and cornering power without the tire scrub and mechanical wind-up which prevents other systems being employed on the road, and of course a marked reduction in the chances of skidding or wheel-spinning when accelerating or cornering.

The Ferguson-Teramala four-wheel-drive system, that has been tested and developed on prototype cars in Britain for many years, was first seen in racing in the days of the 2½-liter Formula 1 with the Ferguson monoposto racer. It subsequently was used by BRM in an experimental 1½-liter Formula 1 car and recently has been seen in the Felday 4 and Felday 5 sports-racing cars produced by Peter Westbury's Felday Engineering. Westbury currently holds the marketing rights for racing applications.

It has been a long, costly, uphill struggle to get this inevitably expensive system adopted by manufacturers, but now at last there are signs of at least a limited breakthrough.


By John Blunsden



**At left: Timo Makinen displays classic Mini cornering style on the Monte Carlo.**

**At right: Gunther Klass with a Porsche 911 won the GT Championship.**

**Below: Good service crews can win the rally; here Citroen has a bundle of spares ready, while Ford of Britain changes tires before a special stage.**

# EUROPEAN RALLY CHAMPIONSHIP

*Amidst complicated formulae, protests, and disqualifications, The 1966 Championship was in a continual state of utter chaos!*

MAYBE SOME OF THE RALLYING WAS AS GOOD AS IT HAS EVER BEEN, but the 1966 European rally season was ruined for everyone concerned by a distasteful mixture of organizing incompetence, behind-the-scenes intrigues, petty officialdom, and — in the case of the European Rally Championship — a chaotic points-scoring system which would test the ability of professional mathematicians. Little wonder that the FIA itself (which fixed the rules) proved incapable of keeping its own points chart in order, so that the various Champions (there was one in each of three FIA car classification Groups) were not known until weeks after the last of the fourteen points events had been run!

European rallies are open to cars complying to various combinations of Group 1 'series touring' sedans, Group 2 'touring' sedans, or Group 3 'grand touring', of the FIA's Appendix 'J'. The organizers of the fourteen Championship-qualifying events had to name two of these Groups as qualifying for Championship points (cars were to be admitted from the third Group, but would not score points). For example, the Monte Carlo Rallye, which opened the contest, was a Championship-qualifier in Groups 1 and 3, while the RAC Rally of Great Britain, which closed it, was a Groups 2 and 3 Championship event. The final tally resulted in nine Championship rounds for Groups 1 and 3 cars, and ten for Group 2 cars.

A double points system was operated, the recipients in each case being the car's two drivers. First, 9-6-4-3-2-1 points were allotted for the first six places in the general classification for each Group of cars. Second, a further 7-5-3-2-1 points were awarded for the first five positions in each capacity division (these were up to 1000 cc, 1001 to 1600 cc, 1601 to 2500 cc and over 2500 cc for Groups 1 and 2, and up to 1300 cc, 1301 to 2000 cc, and over 2000 cc for Group 3). But the class points could only be awarded when there was a minimum of ten cars competing in that class, otherwise the class had to be amalgamated with the next higher class. When there were insufficient entries in the top-capacity class of each Group, no points could be awarded for those classes.

Furthermore, all these points applied only when two people were in a car. If a third crew member was carried, the points were multiplied by two-thirds, if a fourth they were halved, and if a fifth person went along (most unlikely), the score was multiplied by two-fifths. Finally, only the seven best performances counted from the fourteen events, and no driver could claim a Championship of a Group if his score stood at less than thirty points.

It only needed a series of scrutineering squabbles, resulting in cars being moved from one Group to another, or being disqualified from the results pending appeals — which in some cases were not heard until months after the events in question — to put the whole Championship scene into complete chaos. However, ultimately, the FIA announced the following champions for 1966:

Group 1: Lillebror Nasenius (Opel Rekord 1900) — 34 points

Group 2: Sobieslaw Zasada (Steyr-Puch) — 50 points

Group 3: Gunther Klass (Porsche 911) — 72 points

Of the three champions, only Klass was able to win a qualifying rally outright — his 'home' event, the West German Rally. The lead drivers of the winning cars in each case were:

Monte Carlo Rallye* (January 14-22): Pauli Toivonen (Citroen DS21)

Swedish Rally (February 7-13): Ake Andersson (Saab Sport)

Rally of the Flowers* — Italy (February 24-27): Leo Cella (Lancia)

Tulip Rally — Holland (April 25-29): Rauno Aaltonen (Mini-Cooper S)

Austrian Alpine Rally (May 12-15): Paddy Hopkirk (Mini-Cooper S)

Acropolis Rally* — Greece (May 26-29): Bengt Soderstrom (Ford-Cortina-Lotus)

Geneva Rally (June 10-12): Gilbert Staepelare (Ford-Cortina-Lotus)

Rally Vltava — Czechoslovakia (July 1-3): Rauno Aaltonen (Mini-Cooper S)

West German Rally (July 13-17): Gunther Klass (Porsche 911)

Polish Rally (August 3-6): Tony Fall (Mini-Cooper S)

Rally of the 1000 Lakes — Finland (August 19-21): Timo Makinen (Mini-Cooper S)

Coupes des Alpes — France (September 5-10): Jean-Pierre Rolland (Alfa-Romeo GTA)

Munich-Vienna-Budapest Rally — Hungary (October 7-9): Timo Makinen (Mini-Cooper S)

RAC Rally of Great Britain (November 19-25): Bengt Soderstrom (Ford-Cortina-Lotus)

*These rallies were 'won' by other cars which were subsequently disqualified following post-rally scrutineering.

A glimmer of hope for better things in 1967 is contained in the decision to run only two Championships — one for Groups 1 and 2 combined, the other for Group 3. However, the FIA would do well to scrap the 1966 regulations, and replace them with a much simpler and less contentious system of scoring!

# When the roads are wet and icy
# Then's the time to really start driving!

# SKID SCHOOL

By Joe Scalzo

IN HOLLAND, WHERE THE YEARLY RAINFALL OFTEN EXCEEDS 32 INCHES, and the roads are about as narrow as your driveway, wet-weather driving is an art practiced by many but mastered by few. However, with more than one million cars in the Netherlands, no less than 50,000 drivers have taken courses in a remarkable Dutch school whose sole curriculum is driving in the rain and on ice.

Rob Slotemaker's Anti-Slipscholen (Anti-Slip School) is located within a gear change of the Zandvoort circuit, and in the last couple of years the likes of Dan Gurney and Jim Clark have passed through its portals. Certainly Clark, of all people, didn't need any lessons, but he later remarked, "This has been a very instructive day."

"Clark was a natural," said Slotemaker, 33, the school's founder and owner. "Just a single ride with him in one of our cars, and you could see it." Being a practicing — and highly proficient — racer and rallyist himself (he has driven for Triumph at the last three Le Mans, and in '67 may be piloting Ferrari Dinos for a Dutch group), Slotemaker knows the whys and hows of competition. But his true forte is his school and his nearly unbelievable ability to horse cars around in the wet. At the latter he is like the reincarnation of Carraciola, and has even given demonstrations in the U.S.

In 1957, Slotemaker, a jet pilot, was weather-bound at the ice-glazed airfield of Volker. With no jets being able to land or take off because of conditions, Slotemaker was lying around trying to kill time. He took a borrowed car and began driving around the slick field and very soon and very much to his surprise, the car spun out. "It bothered me and it interested me," Slotemaker remembers. "There didn't seem to be any way of controlling a skid on ice or in the wet. So I kept driving around like that for 10 days and found I was wrong. There are several things that can be done."

With this in mind, he summarily quit the service and set up his school. It was located on a tiny, dead-end street in Zandvoort and was immediately successful and immediately too small. This led him to the Zandvoort track proper where he spent $3500 to build his present facility And in the last two years he has started another school in Deurne, and one each in England and Belgium.

How does the slip-school operate?

Slotemaker's guiding premise is a delightfully basic one. He believes any man, woman, or Indian chief can automatically check a sudden slide on slick pavement. "But a person will usually over-correct. And getting the car straightened out after they over-correct is where the average person gets into trouble." Slotemaker sees no difference in pulling a car out of a slide at 10 mph or 100 ("The technique is always the same.") but he is concerned with what he calls the 'safety angle' of each car. "When the average car is sliding, if it goes beyond a 45-degree angle, it can't be corrected. This is when a driver should stop fighting to correct, let it spin, and then concentrate on getting it headed in the proper direction. It varies with cars, but 45 degrees is the usual safety angle."

For reasons of durability, ease of maintenance, and because they pretty well typify the cars on Dutch highways, Slotemaker's school machines are Simca 1000s. Owing to the rigors they go through, however, even these tough little cars are replaced on a half-year basis.

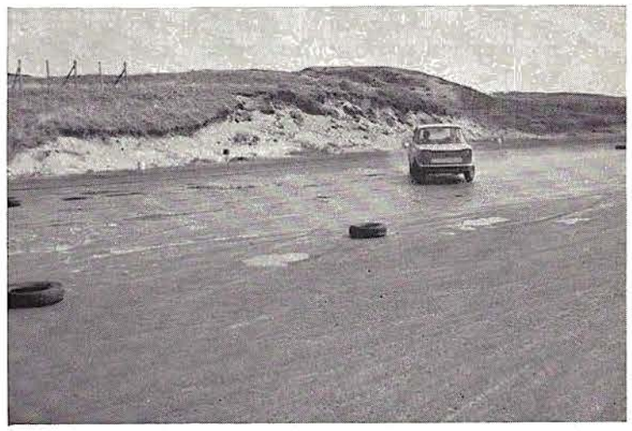
Courses are held daily, rain or shine, and Slotemaker even prefers a rainy day because traction is just that much more limited. Still, on the dryest of dry days, Slotemaker has made sure things will be slippery indeed.

The area where the schooling takes place is an asphalt 'skid pad' 95 yards in length, 18 yards wide, and with a 150-yard runway for cars to get up to speed before attacking the pad itself. The area is continually saturated with water and oil, and the school cars are 'equipped' with well-worn tires to ensure even less-than-normal traction.

School opens at 9:00 o'clock and as many as six students can be handled in a day. There are four instructors besides Slotemaker, and to accommodate the large foreign trade, each one speaks Dutch, French, German, the Belgian languages, and English. As is readily apparent, Slotemaker's task of training his instructors, then being sure they were fluent in at least five languages, was not an easy one.

After an hour of briefing, three students are bundled into one of the Simcas and the instructor spins a couple of 360-degree loops to loosen everyone up. When Slotemaker first opened, his method of initiating pupils was to spin and correct at about 75 mph. However, most of those participating in such a ride were white-faced and exhausted afterward, and hence the new, gentler approach.

Following the baptism by fire, the instructor blackboards some basic maneuvers, such as catching a car if it starts to slide to the left or right. This done, every-



one goes back to the car, and one of the students drives. The instructor shares the front seat, and as the car comes onto the skid pad at a velocity of about 35 mph, the instructor provokes a skid by yanking on the emergency brake. Re-designed, these hand brakes may lock up left rear, right rear, or both rear wheels at the instructor's preference. Under this stimulating procedure, the student is never sure which way to correct until the slide actually comes.

There are two basic exercises a student must go through, one dealing with halting a sideways slide, the other with controlling a car after it has gone through a complete spinout and is still moving. Braking in the wet is also demonstrated, as being able to throw one of the Simcas into a 180-degree spin at will. With the roads of Holland crawling with slow-moving trucks, Slotemaker teaches this last so that if a car-truck crash does appear imminent, the student will at least be able to take the flow from the rear.

At first the idea of an inexperienced student flinging a car into wild slides — said car being occupied by more inexperienced students and one hapless instructor — seems a good way to drastically reduce Holland's population. However, each student at one time or another gets to drive the school car, and the other students are taken along because in many cases they profit from the mistakes (or adeptness) of the driver. There has never been an injury at the school, except once when an instructor had a car door slammed on his foot.

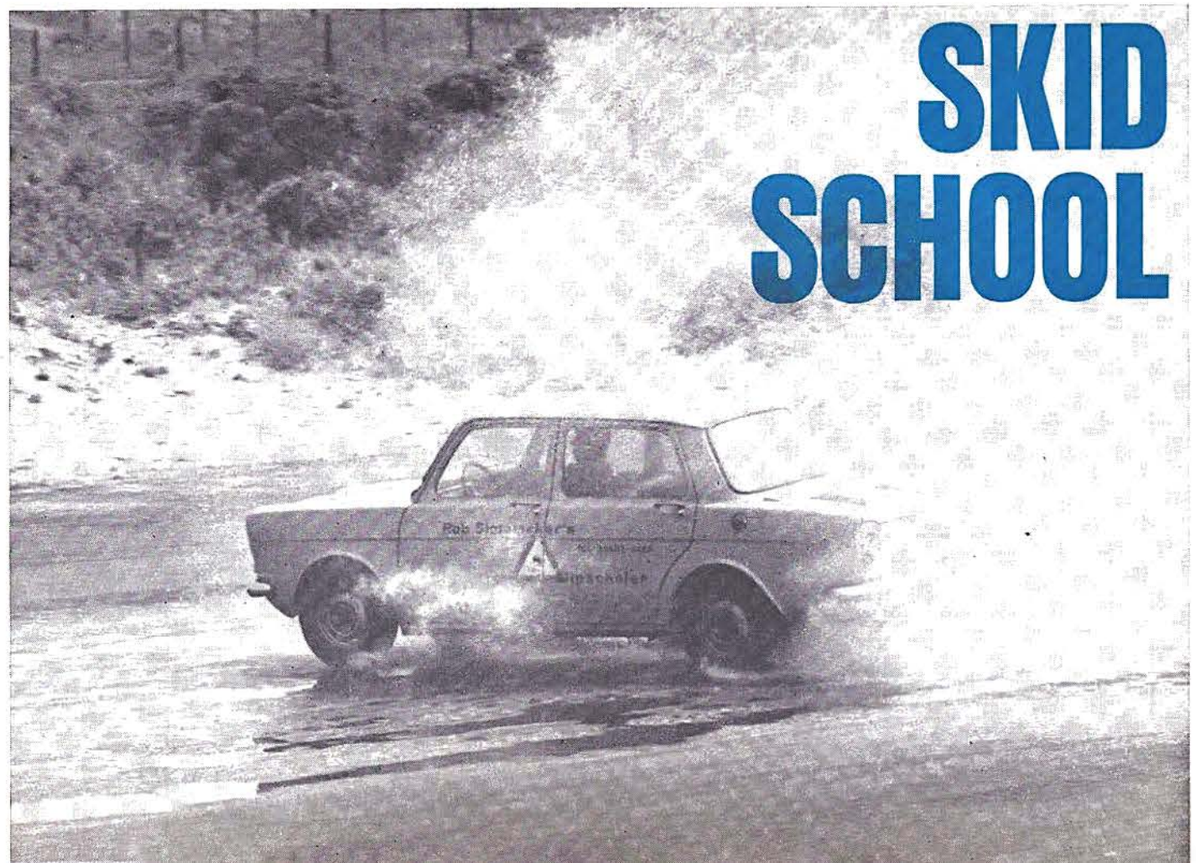
After the course, each student is invited to run through the skid path with his own personal vehicle. Even though it may feel drastically different from the school Simca, "the principles are always the same," Slotemaker says.

Just over seventy percent of the students who go through the school are granted diplomas, which entitles them to a healthy ten percent reduction in their auto insurance rates (U.S. insurance companies, please note) and also allows them to return once a month to hone their skills.

Slotemaker's school is endorsed by both Dutch auto clubs — KNAC and NAWB — and he enjoys what can only be termed a healthy enrollment. Some of his pupils are race drivers, and it is no coincidence that Slotemaker himself learned to race after he'd formed the school. The classic example, though, is one Wim Loos, who as a 12-year-old boy would wash the school cars. Slotemaker frequently let him chauffeur the cars, and when Loos developed a fantastic mastery of the school, Slotemaker appointed him an instructor. Still an instructor, Loos is now 20, and is ranked with Gys van Lenep as Holland's most promising talent. Loos won the first race he ever ran which, by sheer luck, was held in a driving rain. It was strictly no contest.

The majority of those students who lay down the $45 for the one-day course naturally don't have racing in mind, only coping with highways in the wet. Some, after taking the course, have questioned if in the heat of the moment on a public road they'd react the same way they did at school. Slotemaker says of course they would. "It's the same as swimming. Once you learn to swim, you never forget. Falling off a ship in mid-Atlantic is no different than falling into a swimming pool. The water is just colder."

Information on the school can be obtained by writing Slotemaker Slipscholen, Leeuwerkikenstraat 12, Zandvoort, Holland.



# FORMULA 1 FORECAST

*This second year of the new three-liter Formula 1 the winner will be AAR Eagle or Brabham or BRM or Cooper-Maserati or Ferrari or Honda or Lotus or McLaren!*

By John Blunsden

A YEAR AGO, LOOKING FORWARD TO THE FIRST YEAR UNDER A THREE-LITER FORMULA, I predicted a much better season than we had five years earlier when the 1½-liter formula was launched... or should I say, 'given a half-hearted nudge'? That year, only the brilliance of Stirling Moss prevented an almost complete Ferrari dominance with a car which, though unquestionably the best on the circuits, was to prove sadly lacking as soon as it met real opposition one year later.

Now we can look back on another first season of GP racing and see that, optimistic though my predictions may have sounded at the time, they underestimated the quality of the racing to come, the variety of approaches adopted in Formula 1 car and engine design, and the speed with which at least some of these would be brought to a state of race-winning reliability.

The season produced cars from no less than eight factory teams, sharing an equal number of new three-liter engines (plus three undersized stand-ins). Although at one stage the story seemed to become almost exclusively Brabham-orientated, we ended with five teams — Brabham, BRM, Cooper, Ferrari, and Lotus — sharing the victories. All the 'old stagers', therefore, earned a slice of the cake, and, significantly, the only three to fail to score an outright win were the 'new boys' — McLaren and Gurney — and the very late starter — Honda. Maybe their turn will come in 1967.

But the first 'blood' of the new year was drawn by Cooper on January 2, so perhaps it is appropriate that we should begin a review of 1967 prospects with this team. The new F1 car was revealed at the Racing Car Show in London. Outwardly, this car looked much like the 1966 version, but a closer look revealed a number of minor but useful changes.

The bulkheads were in aluminum instead of steel, the rear structure having a quickly-removable member to improve engine and transmission removal and installation. The rear track had been widened four inches, with appropriate adjustment to suspension arms. For test purposes the normal ZF gearbox had been replaced by one of the new ZF units. No decision had been made regarding the choice of transmission for the 1967 races, however. The final-drive line had also been modified, the previous Mercedes-Benz-type sliding shafts having been replaced by one-piece shafts with flexible couplings mounted on their inboard ends — an arrangement which has proved very satisfactory on the Repco Brabhams.

Although the car had completed about 400 miles of testing prior to being exhibited, most of this had been in the wet, and therefore was inconclusive. Apart from any improvements in traction and cornering power which might have been achieved, the car had been lightened by approximately 30 pounds.

Further weight reduction is anticipated before the European season starts at Monaco, and the next car to be built is likely to have a slimmer profile, although the body shape is largely dictated by radiator requirements and consequently cannot be trimmed to any great extent. Maserati, however, has promised a contribution towards a better power-to-weight ratio, and the aim is to find 370 bhp for this season, as well as to save a few pounds from the weight of the power package.

John Surtees, after he left Cooper to join Honda, expressed the opinion that Cooper could do very well indeed during 1967. The team obviously benefitted from his short stay, but the measure of its success during the coming season must be related to the ability of its drivers to continue the chassis-development process throughout the year.

This, of course, is Surtees' major task during his first season with Honda. Against this background, the decision to operate a two-car team with one driver is probably a wise one. Surtees signed before he had even driven the Honda (although he had sat in it and been measured), and he seems to be getting on very well indeed with his new colleagues. With a background of Ferraris and Coopers, he knows a lot about how to make big cars perform. Although he would probably have preferred to go racing with something more compact and lighter, he is probably the best driver to get Honda back into the winner's circle.

South Africa was not a real test for Honda, because only very minor suspension changes were possible before the car was shipped from Japan to South Africa. A more drastic redesign is planned before the next World Championship race at Monaco in May. At the present time there is no doubt the car is a little lacking in roadholding and braking, but, had not dirty oil damaged both engines before the race in South Africa (the two were cannibalized to provide something for the race), Surtees would probably have demonstrated that he had the most powerful car in the entry list.

Honda was not a long way from pulling out of F1 racing at the end of last season, and the company will expect some results to justify its decision to carry on. Surtees must feel confident of the car's potential, because the last thing in the world he wants is yet another change of camp at the end of the year. My bet is that the Honda will be a potential race winner, fair and square, by mid-season.

Another driver with equal prospects must be Dan Gurney. His performance late last year with his V-12 Gurney Weslake-engined (see pages 52-56) Eagle were disappointing but predictable. The plain fact was the V-12 was too new to race (it only ran for the first time at the end of August). It was too much to hope that product development and racing could be carried on simultaneously.

The few months' layoff since Mexico have been valuable to the team, and the late decision not to send the V-12 to South Africa was very wise in the long term. As these words are being written, an intensive program of track testing is under way and is bringing results. The persistent crankcase pressurization troubles have been traced partly to piston ring seating and partly to liner seating. Circuit testing has produced consistent sub-record lap times, indicating the chassis is responding to development.

With Richie Ginther joining the team as a regular driver, the AAR Eagles will have the benefit of one of the most experienced development drivers in the world — an 'item of equipment' which the past season has shown is as important in any team's inventory as a race-winning driver.

BRM has lost Graham Hill to Lotus this year after a seven-year association, but has a choice of three drivers to back up Jackie Stewart. The association with Tim Parnell's Reg Parnell Racing team has been tightened, and between them the two teams will be able to draw on Mike Spence (who drove the second works H-16 BRM in South Africa) and 'new boys' Chris Irwin and Piers Courage.

The BRMs, of course, are still in their 'de-bugging' stage of development, and this year Tony Rudd and his men will be continuing their efforts to build reliability into the latest eight-pin crank versions of the engine (the early 1966 engines, it may be remembered, fired as a pair of flat-8s working simultaneously).

One or two fundamental design errors crippled BRM's early-season chances last year. By the time these had been rectified (the remounting of the clutch the right way and the elimination of cable-operated gear selection were two of the jobs) it was the old story of being back in the middle of a busy racing season, with no time for private testing.

It is still something of a mystery why BRM chose to rush in with such a complicated engine, even though it did mean that a lot of V-8 know-how could be applied to its design (all the top-end gear was similar, for example). It was called a long-term engine right from the start, and for this reason it would have been a lot better (and much easier) to do last year what is to be done this, namely to build a three-liter V-12 out of 'one and-a-half V-8s'.

Such an engine has been in the cars for over a year, but the decision to go ahead was delayed, so that there will be a real rush to have any ready for the start of the European season. The plan is to drop the V-12 into a lengthened-wheelbase version of the Tasman V-8 cars for Tim Parnell to run. This means that when both teams are fully equipped, there will be two H-16s and two V-12 BRMs on the circuits. Until he gets the V-12, however, Parnell is likely to borrow one of the spare H-16s, and possibly use his sole surviving Lotus-BRM V-8 for his second driver.

It is not difficult to visualize a somewhat embarrassing situation somewhere along the way if — as seems quite possible — the V-12 BRMs prove more reliable, and therefore better race material, than the H-16s. If that happens, who takes what? We'll just have to wait and see!

Another person waiting anxiously for the V-12 is Bruce McLaren, the keenest of all BRM's customers for the 'production' F1 power unit. After a dismal year of mechanical ineffectiveness, Bruce and his designer, Robin Herd, are starting with a clean sheet of paper, and will build a couple of new chassis similar in concept to the one we saw in 1966, but built to accommodate the V-12. Despite the lack of breaks in '66, Bruce and the team learned a lot during the season, and a better car can be built by them for this year as a result. No details are being revealed at this stage, but we can expect detail suspension changes to increase traction, some weight saving (not that the chassis itself was unduly heavy last year), and a smoother body profile. No decision has been made regarding gearboxes, and the timing of the first new car is, of course, governed by when BRM can rustle up the first V-12.

Initially, only one car will be run, but by mid-season Bruce hopes to have a two-car team. The man in the second car will be Alan Rees, who has been a fine Formula 2 driver for several seasons and has been doing a very impressive test job for Bruce on sports cars. He has a great deal of

*(Continued on Page 72)*

*TRACK TEST:*

# CAMARO Z-28

*The Mod Bod' with the Quad Pod*

By Jerry Titus

WE SHOOK OUR HEADS IN DISBELIEF OVER THE SPEC LIST HANDED US LATE LAST SPRING on the soon-to-be-introduced Camaro. Had Chevrolet really been out of racing so long that it didn't realize this type of sports sedan had to be backed by a competition image for it to achieve real popularity? Else why would they almost deliberately make it impossible to prepare for SCCA's Group 2 sedan racing? The Camaro was 300 pounds too heavy and didn't have an engine option that came near the proper limit of five liters (305 cubic inches). A few weeks later we had a short conversation with Mr. Estes, Chevrolet Division president. "Yes, we'd like very much to see the Camaro at least eligible for that circuit. Engine size is no problem," was his answer to our obvious question. "In order to get rid of the 300 pounds, though, it looks like you'd have to come up with a special model!" we followed through, figuring Chevrolet and current GM corporate policy would negate such a move. "Hmmmmm!" he answered.

In September, the Camaro hit the showrooms, but so did the Cougar, the new Mustang, and a month later the new Barracuda. In view of the competition, there was no landslide sale of the Camaro, as there was for Mustang when it was first introduced. 'Hmmmm,' again. By the November deadline, a special model of the Camaro called the 'Z-28' was homologated with the ACCUS office of the FIA. It boasted a 302-inch engine and 2640-pound weight. Two weeks later a Chevy van arrived at the American Road Race of Champions carrying, among other models for display, a prototype Z-28 in street, not competition, trim. Chevy PR man, Walter MacKenzie (who many will remember from the 'good old days' as liaison between the independent Chevy-oriented performance shops and the Division) flew out to ride herd on the exhibit, and consented to our trying out the car briefly in the early morning hours before ARRC practice got under way.

First, the Z-28 is not really a special model, but an option package that adds $742 to the list price of the base coupe ($2572). More accurately, it costs $437.10 extra, but the four-speed gearbox and power-assisted disc front brakes are additional, needed options that bring the cost up. Also not included in the price are the very tricky exhaust headers. At this writing, Chevrolet was not happy with header costs and was looking for a way to make the purchase less jewel-like.

Destroking a 327-inch engine is the way they came up with a 302-incher (a four-inch bore and a three-inch stroke) and the very-backdoor word is that this has resulted in a happy and extremely potent screamer. It makes an already reliable power plant even more so, and enables it to work in an rpm range that takes maximum advantage of the advanced intake system they've developed. It is logical to expect a fully-prepared version to produce well in excess of 370 honest ponies and turn 7500 rpm without coming unstuck. A key component is the cast-alloy 'tuned-runner' intake manifold beneath an 800CFM center-pivot four-barrel Holley. (Please not to call it a 'hi-riser' manifold or Mr. Duntov will chew you out good, this being a Ford-coined term and you-know-who had the application first.) In street form, the engine felt as good as a strong 327 and was only moderately noisy with mechanical lifters. The cam is just slightly wild, and the compression ratio is eleven-to-one.

The suspension package is heavy duty (springs and shock absorbers) but we were disappointed to see the single-leaf rear springs were unmodified. They contribute to a keen ride but also to not-so-keen wrap-up and 'tramp' in a competition application. To correct this, Chevrolet has installed a single trailing radius rod on the right side of the axle. It helps, but not enough. Real correction is now a matter of Group 2 rules interpretation. The allowed addition of a rear swaybar could, properly designed, be of some assistance in this area. The rules permitting replacement of any springs, providing the mountings are not altered and the *number* is not increased, could be the real answer if interpreted to ignore the number of *leaves* in a spring. When available, the '67 Group 2 rules should clarify this. Based on our test, however, it only becomes a real problem in getting off the starting line — a problem to which other Group 2 sedans are not completely immune. The radius rod *has* apparently eliminated the tramp obtainable on extremely hard braking with stock suspension. We say "apparently" because the unit was equipped with the low-profile or wide-oval street tires that can't quite develop the braking torque of a specially-designed racing tire.

As shown in accompanying photos, the Z-28 brought to Riverside was decked out with extra trim, like a vinyl top, the RS trim package, center console, radio and auxiliary instrument cluster. Ditto a bolt-on spoiler for the rear deck that gives it a distinctive appearance, but is otherwise as useful as mammary glands on a bull. The racing stripes painted on *are* a part of the Z-28 package. You will note the absence of a hood scoop. It's not needed. Carburetor air is taken in via a plenum chamber beneath the standard grillework just forward of the windshield, where high-pressure air

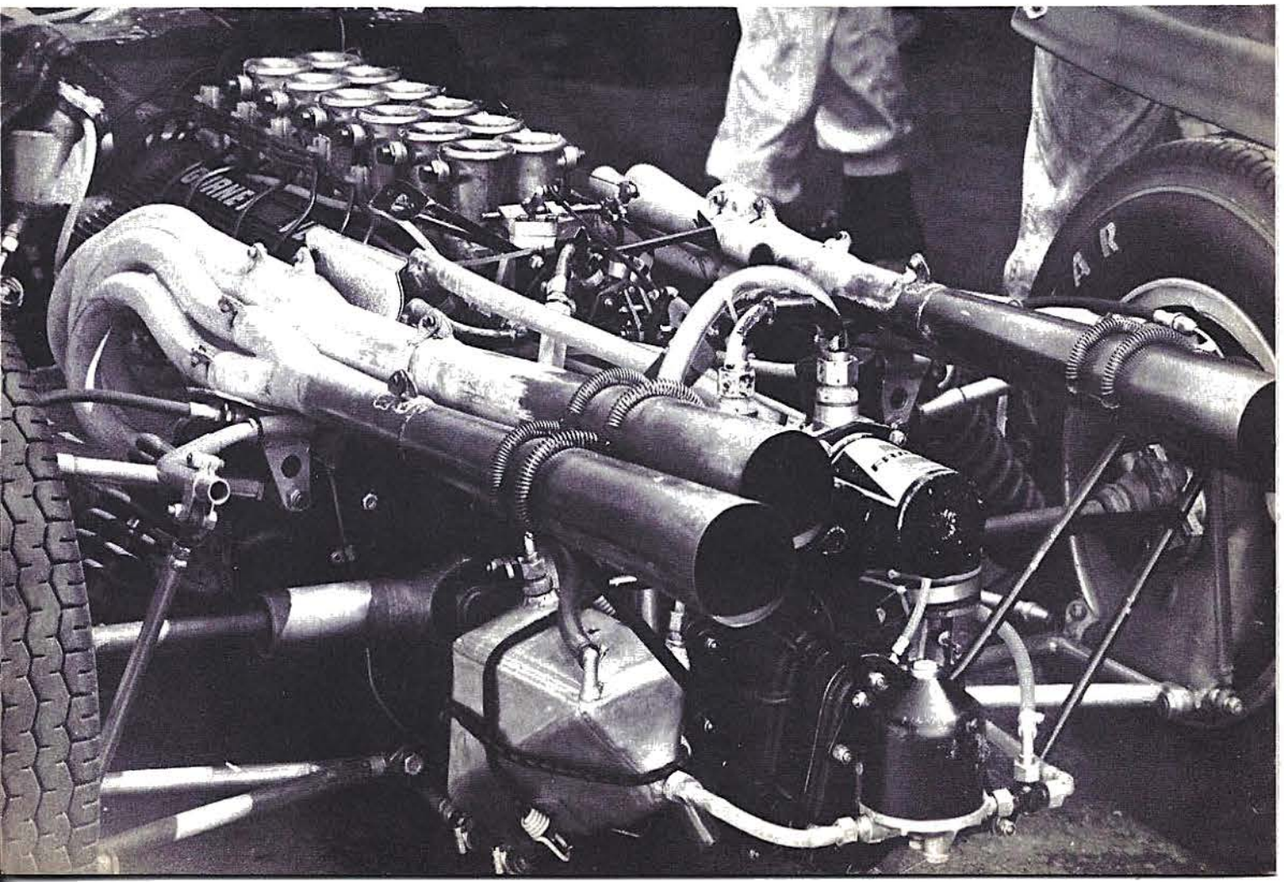
Photos: Fred Enke


**Cornering shots appearing at top right were taken at full racing speed with an unprepared Z-28. Though front geometry is not quite ideal for wide wheels and racing tires, both stability and bite were excellent. Visible in the engine compartment photo is the air ducting, exhausts, and the special intake manifold. The spoiler is, ah, "distinctive," but a non-functional bolt-on item. Extra trim won't be seen on racing version.**

*Engine designer Woods' problems were simple:*
*Make it compact, light, powerful and unbreakable!*

By F. Aubrey Woods

# Gurney-Weslake V-12
# FORMULA 1 THREE-LITER



IT WOULD APPEAR, ON THE SURFACE, rather paradoxical that an American — Dan Gurney — and his American-backed racing team should engage not only myself, an Englishman, but also an English research company with no previous complete engine building experience, to design, build, and develop his new three-liter Grand Prix engine. Certainly apart from myself, no other person other than Harry Weslake had any motor racing experience to call on.

Possibly the name Weslake is not very widely known in the United States. In Europe, however, that name has been associated with many outstanding successes in the automotive field.

During the last few years Harry Weslake and his stepson, Michael Daniel, have been gradually building up their research plant at Rye and installing machinery to enable them to undertake not only test and development work, but complete engine design and construction. It was probably this that impressed Dan when I introduced him to Harry Weslake some two years ago.

I first met Dan during that part of his career when he was a driver for the official B.R.M. factory team. At that time he was their number three driver, and, due to delays in preparing a car for him, we had plenty of time to get to know each other and frequently discussed problems associated with both chassis and engine design. During this period I was engaged on the design of the now highly-successful 1½-liter V-8 engine, with which B.R.M. won the World Championship in 1962. I most certainly did not at that time either envisage leaving B.R.M. or that I would design an engine for Dan.

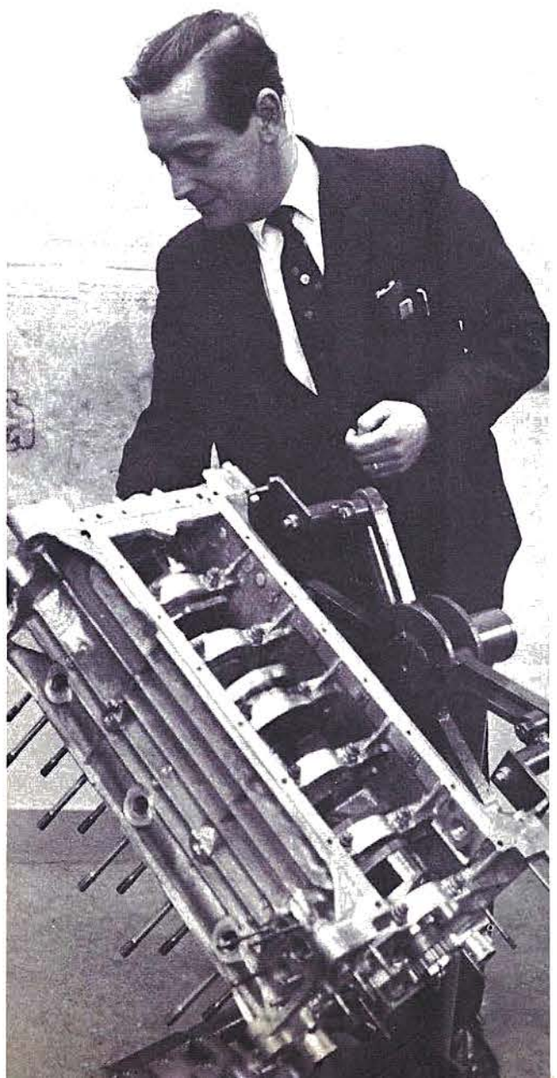
Prior to meeting Dan for the second time some five years later, we at Weslake had been engaged on the design and development of an ultra-high-speed research engine for a major oil company. They had commissioned this unit so that they might study flame propagation at very high revs. During these tests it became obvious that a four-valve layout was likely to provide an efficient configuration and that, contrary to popular belief, could be made to produce a fairly wide power band. Harry Weslake agreed with most of my ideas on the possibility of designing a very light, twelve-cylinder, three-liter unit which would be competitive with the more exotic configurations that were being talked about at that time, and had sufficient confidence in my proposals to order the financing of a design for a 500-cc twin-cylinder test rig to test these theories.

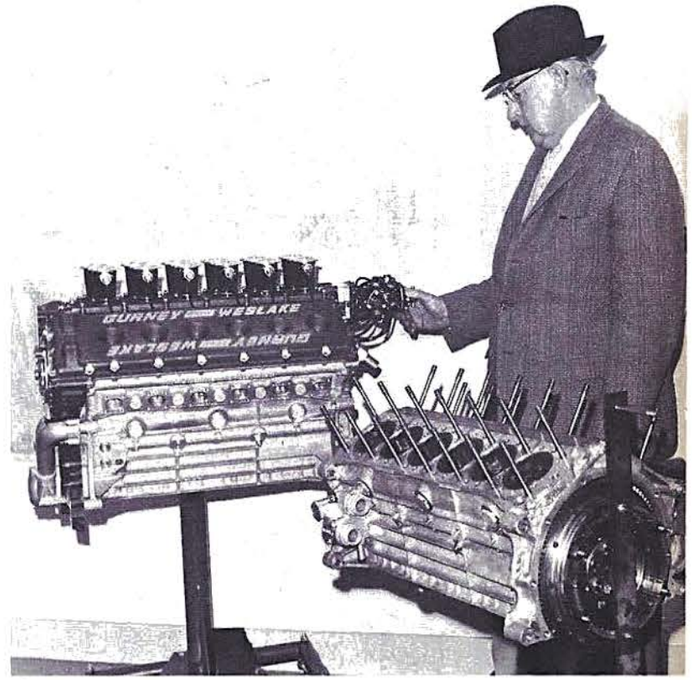
This unit was designed to give the maximum possible scope for investigation into possible bore/stroke and stroke/connecting rod ratios, crankshaft and camshaft variables, as well as the more obvious valve and combustion chamber configurations. Having determined the layout, Dan was approached to test his attitude towards the project. His enthusiasm was really infectious and the outcome was that we would carry on with the program while Dan endeavored to obtain the necessary finances for a full engine.

Basically the rig design consisted of a simple box-type cast iron crankcase, with separate end covers to enclose the ends and carry the two main bearings. These were made detachable so that investigation could be made into the comparative merits of either plain or roller main bearings. I had instinctive distrust of rollers on high-speed, heavily-loaded bearings, particularly in conjunction with plain big ends. This proved to be true in more ways than one. What I had originally worried about was the possibility of skewing due to excessive oil emanating from the big end leak, resulting in bad wear on main bearing pins. What was more revealing was the piston crown overheating due to lack of oil leak from main bearings normal on conventional engines. This feature more than any other was responsible for the decision to plump for plain main bearings on the 12 cylinder.

The rest of the test engine construction consisted of a separate aluminum alloy cylinder block which could be lengthened or shortened to accommodate any change in connecting rod or stroke length. Into this block were fitted wet liners, trapped by a rim at the top of a segmental gas ring. The bottom is allowed to float through two rubber rings; thus expansion did not cause deformation or unsettling of the gas seal. Many different types of liners were tried in different conditions and materials.

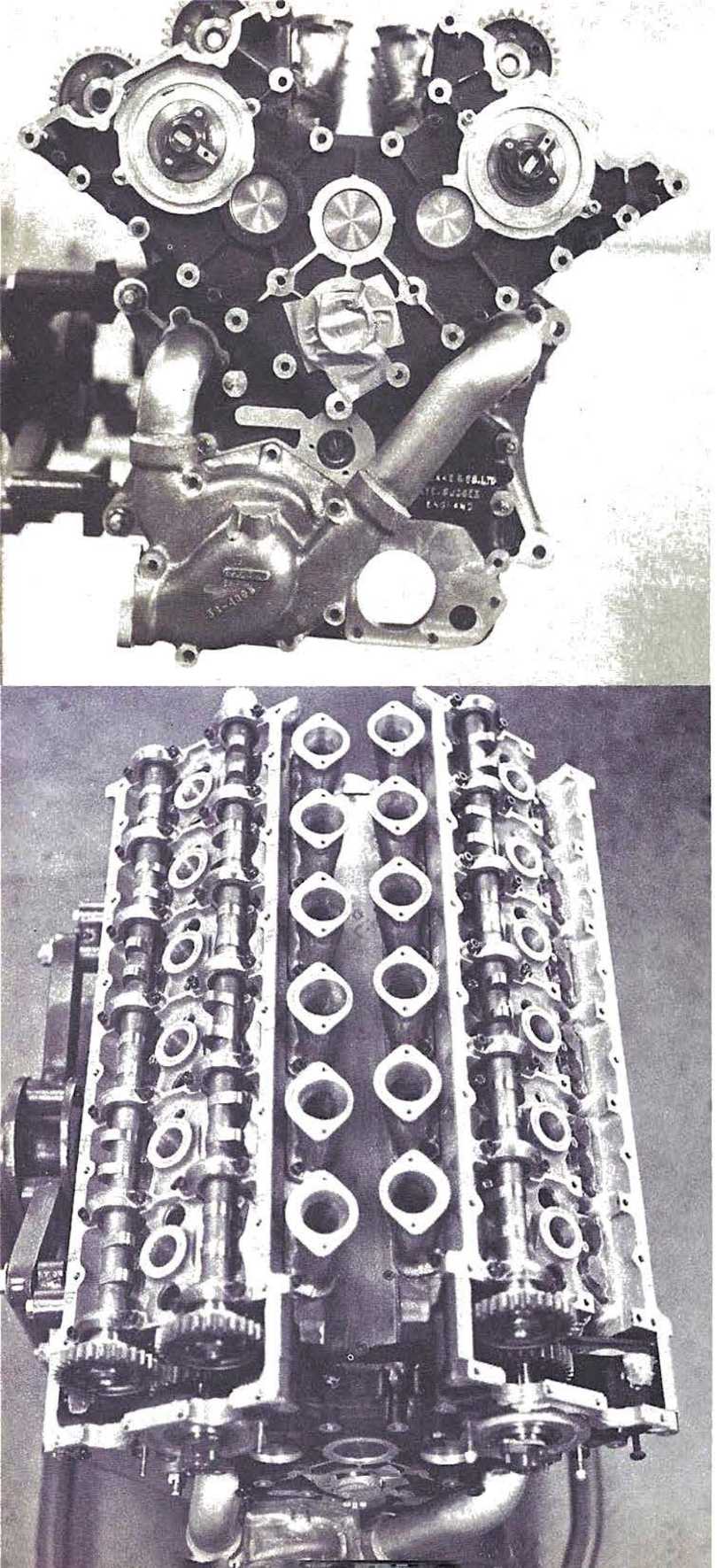
Our Schenck dynamometer is a 10,500 maximum rev units, so it was decided that if future speeds of 12,000 rpm were to be contemplated, some reduction gearing must be incorporated in the unit. Since we needed 2:1 speed drops, a separate gear casing containing a reduction output shaft was designed, together with a toothed-belt camshaft drive output and both ignition and fuel injection drives. At the other end of the crank a triggering mechanism for the ignition and oscilloscope was incorporated.






Photos: Bill Dunne

Above, Harry Weslake examines the latest product of his engineering firm. At left, major responsibility for the V-12 was left to chief designer, F. Aubrey Woods, shown here inspecting the deep block with seven main bearings.



The cylinder head unit carried only valves and valve springs, and was deliberately made simple and cheap to produce. This made many port variables and combustion chamber shapes to be tried with the least possible delay.

Camshafts and tappets were carried in a separate housing, bolted to the top flange of the cylinder head. Many types of bearings and tappets and material changes were thus possible.

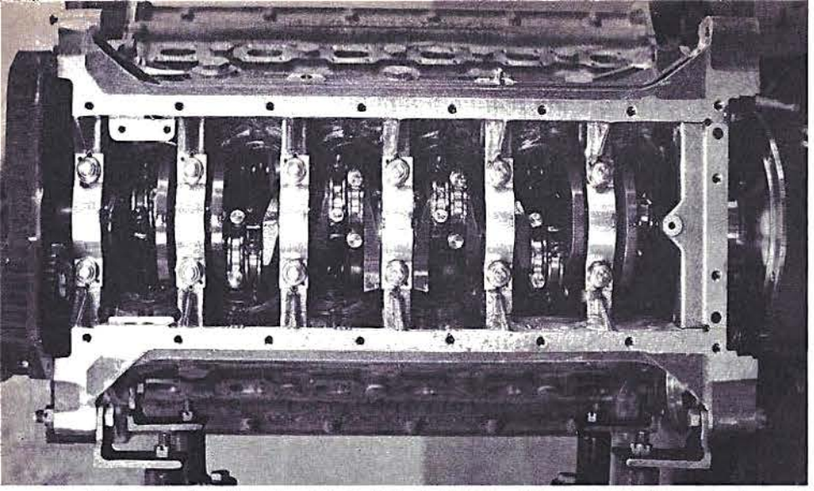
A small gear casing bolted to the end of this carrier completed the main engine features. Oil and water pumps were driven off the engine with electric motors to give a completely independent control of engine requirements. Measurements of both oil to valve gear and crankcase were made and were to prove invaluable when the 12-cylinder design commenced. Water delivery to both block and cylinder head was individually connected and quantities noted, again for incorporation into the larger engine design.

The benefits of this type of approach can be best assessed by the fact that the designing time on the 12 cylinder was cut by at least a couple of months, and certainly development time will also be reduced considerably.

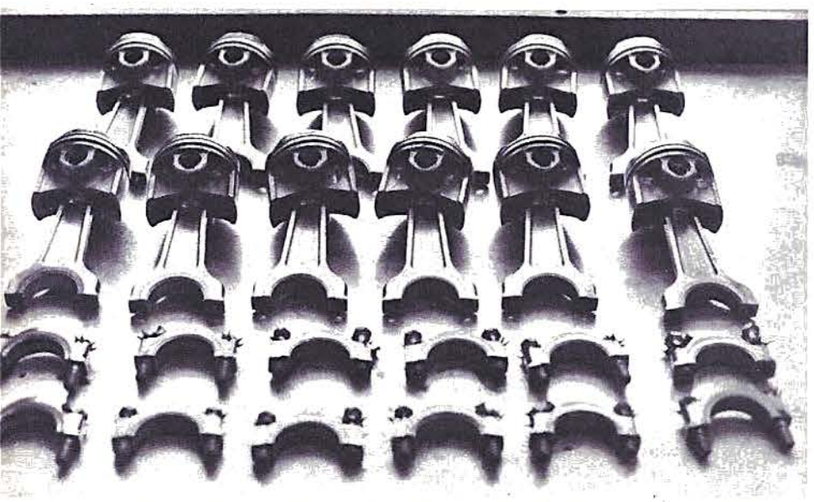
By the time we had completed the primary development stage, a maximum output of 80 bhp was being regularly seen, but more important the power range extended from 6000 to 10,250 rpm. Mechanically, those items we had intended for use on the main engine were proving to be most reliable. At about this time Dan came over from the States with the good news that we could get to work on the main engine, having managed to arrange the necessary finance.

As is well known by now, the basic Eagle chassis was designed to accept the 255 cubic-inch Ford Indianapolis engine. This therefore laid out the general parameters. Quick sketches of the basic engine shape showed that the overall length of a 60-degree V-12 unit could be kept down to the length dictated by the existing chassis if the clutch could be moved to the rear of the gearbox. This meant, however, that we might also have to design and develop a gearbox, since Mike Hewland was not prepared to undertake the production of a small quantity unit.

**Two views of the quad-cam V-12. Accessory drive cover, above, has an ignition rotor for each head already in place. Bottom, four valves per cylinder make for a complicated appearance. A plug well is located vertically above the very center of each combustion chamber. The short intake manifolds are on.**



Bottom-end view shows two rods on each crank throw. Early blow-by problems were traced to loose-fitting iron liners in the alloy block, leading to a build-up in crankcase pressure.



Laid out for inspection after a test run, the narrow-skirted pistons and short, beam-section connecting rods make an impressive array. Note only one oil-control and one compression ring.

An expensive pile of cordwood! Cylinder-head castings are stacked prior to machining. The junction of exhaust ports for each cylinder is cast into the head, but intakes separate.

Since he's in the game to make money, this was a fair enough decision. After tossing around this setback for a while, I decided to take a closer look at the engine design to determine if a more conventional clutch could not be incorporated and a package shortening be affected some other way. After several weeks of designing and tearing up ideas, we removed several of the longer auxiliaries from the front of the engine and pushed them to the rear, saving some three to four inches.

Based on our test rig findings, it was decided to employ what we consider is the optimum bore/stroke ratio of 0.825 and a connecting rod/stroke ratio of 4.125:1. These main dimensions fixed a basic layout, and the next target was at least one horsepower per pound of engine weight. As strength was of prime importance, this posed quite a problem. Since the power output of our engine at present is around 385 bhp and our overall weight, complete with clutch and starter motor, is 390 pounds, this should give some idea of whether we were successful or not, especially in view of the fact that with magnesium casings in place of some prototype aluminum ones, further weight saving of some 25 to 30 pounds will be effected!

When designing the crankcase, as I have previously mentioned, stiffness was a fact which had to be borne in mind. With a chassis of monocoque construction, the engine bay is the weak link, as regards chassis stiffness. It therefore becomes necessary to use the crankcase as a rigid stiffening member. With a timing gear chest being an integral part of the crankcase, this would have had a weakening effect on stiffness. Therefore, I unashamedly swiped the Ford method used on the four-cam engine, a separate magnesium alloy timing gear casing.

In order that the engine be flexible, and accelerate smoothly and rapidly, great attention was paid to both the balance and weight of the crankshaft. The use of fully machined connecting rods and the light construction of the pistons made it possible to really save weight in this department. As on the 'test twin,' separate wet cast-iron liners, inserted in the block and held down to a lip at the top by segmental "Cooper" rings, allowed thin cast sections for the water jackets, again saving much valuable weight. The liners are free to expand at their base, and are sealed by two rubber rings. Rubber rings also seal the water transfer passages between block and cylinder head, ensuring

*(Continued on Page 76)*

## TECHNICAL REPORT & TRACK TEST

## DAF VARIOMATIC TRANSMISSION in the REPCO BRABHAM FORMULA 3

By John Blunsden

# BELTS IN THE BACK

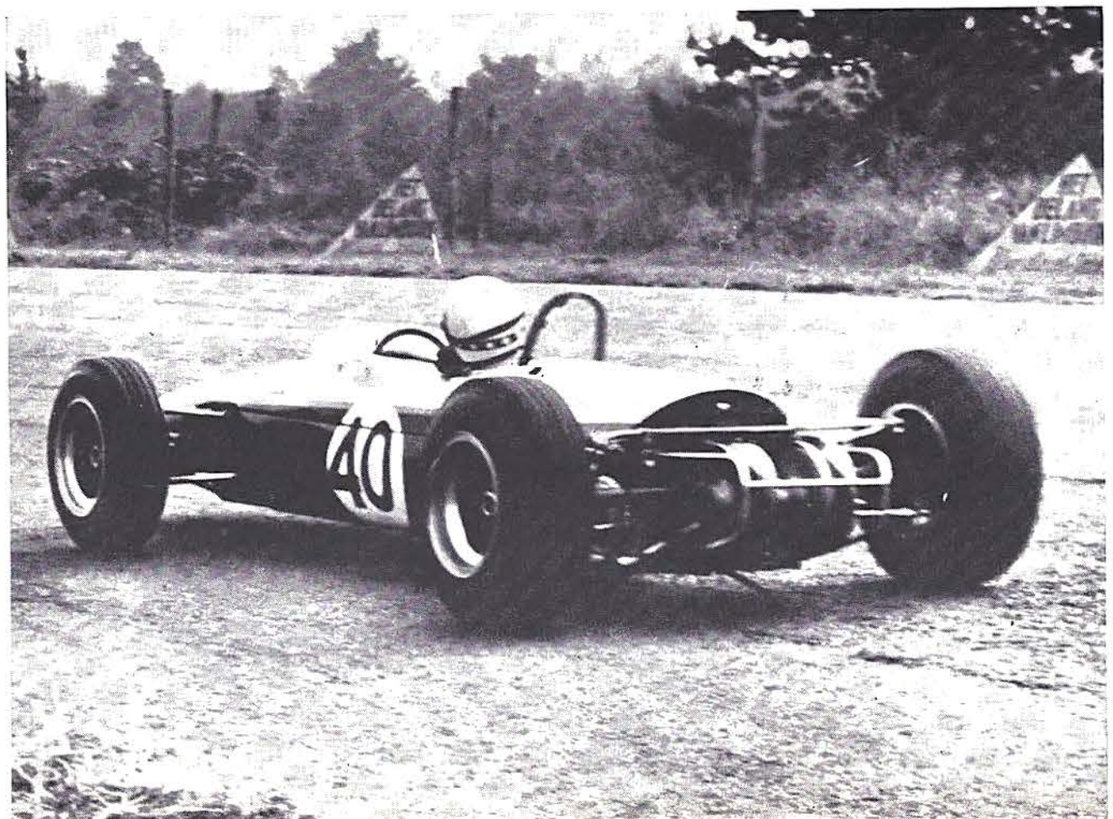
TELL ANYONE THAT YOU'VE DRIVEN A RACING CAR AROUND A 30-MPH CORNER on a streaming wet circuit that you'd never seen before, with 8000 rpm showing on the tach, and like as not you'll be called a lunatic. Add that you kept the car on this little island, and you'll be called a downright liar as well!

But I swear to you I did precisely this last December, and found it was only one of the novel sensations of driving a Formula 3 Repco-Brabham-Cosworth equipped with DAF Variomatic transmission. The transmission, involving endless belts running between variable-diameter pulleys, is no nine-day-wonder gimmick. After two years of track development, it works so well that it is challenging the conventional four-speed manual gearbox in Europe, and by next year may be marketed as a package for power outputs of up to 130 bhp.

DAF is the trade name of the Dutch company Van Doorne's Automobielfabriek of Eindhoven, which started business as a manufacturer of trailers and semi-trailers in 1925, branched out into truck production in 1950, and built its first car — an economy sedan — in 1958.

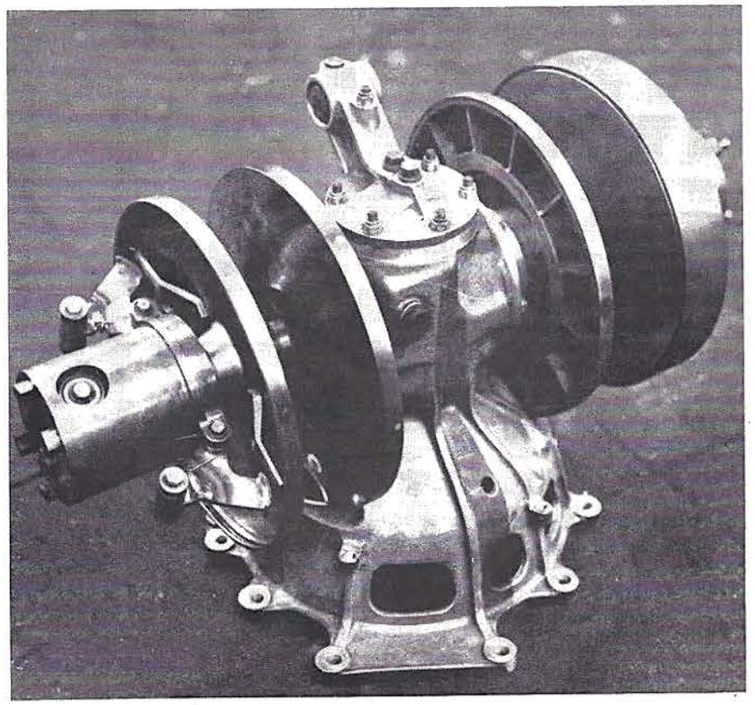
Contemplating the first DAF passenger car, Mr. Van Doorne decreed that it should have an automatic transmission of the simplest possible type, and a talented engineer called Wim Hendriks was entrusted with the job of designing it. He thought first of drive by Vee belts, committed a few ideas to paper, and thereafter never seriously considered using any other transmission media.

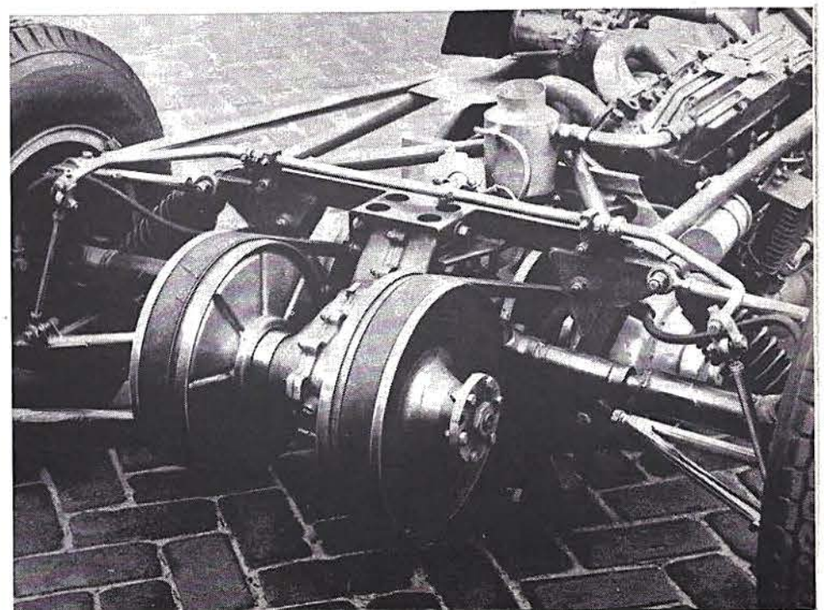
The task of the first Variomatic transmission was modest enough, for the 1958 DAF 600 weighed only 1268 pounds, while the output from its 590-cc, twin-cylinder engine was a mere 22 bhp. Since then, DAF cars have grown in both power and weight, and the latest car — the Type 44 — weighs 1600 pounds, and its engine, now 844 cc, delivers 40 bhp and a maximum of 51 pounds/feet torque. With reservation by the



## BELTS IN THE BACK

The racing version of the Variomatic, directly below, consists of an alloy bell housing for a centrifugal clutch, a bevel-drive gearbox to change power direction to the axles, the basic spring-loaded "variable" pulleys (closed by sets of centrifugal bob weights), and an ingenious peg-&-cage arrangement to provide gear-reduction increase (for engine drag) on deceleration.





company of the numbers '55' and '66' for future model designation, the inference is that larger and more powerful DAFs are on the way and that future requirements of the Variomatic unit will increase proportionately.

The path towards public acceptance of a transmission system 'fit only for a washing machine' was not easy, for not even the unusual flatness of Holland's countryside was sufficient to prevent potential customers from doubting the DAF's ability to belt up a hill, especially in the wet.

In the early days, sales came slowly. It was against this background that the company made the bold decision to 'wave the flag' in motor sport, and silence the doubters by its achievements. The gamble paid off, and today DAFs are becoming a familiar sight on the roads of Europe, and spend no more time off them and in the service shop than the average sedan with a floor stick and a box full of cogs.

DAF's entry into motor sport has been two-fold. An intensive rally program with Group 1 and Group 2 versions of the road car has provided the best possible evidence of the transmission's efficiency and reliability in the toughest of conditions, while the adaptation of the Variomatic system to the needs of motor racing has revealed its versatility as well as its ability to cope with torque levels far in excess of those involved with the DAF passenger cars.

The first race version was installed in a three-year-old Alexis Formula Junior chassis in 1964 and revealed considerable potential in the hands of Rob Slotemaker, who runs a skid school at Zandvoort. In 1965 he finished seventh out of about 30 starters in a Formula 3 race preceding the Monaco Grand Prix, on perhaps the toughest of all circuits on transmissions. A month later Jack Brabham tested the car at Zolder, a new circuit just on the Belgian side of the border with Holland, and, though somewhat appalled by the car's reluctance to go where he pointed it, Brabham was sufficiently impressed with the transmission to agree to adapt one of his F3 chassis to accommodate it. Since then, two more chassis have been made specifically for DAF, and a third is on the way.

During 1966, one and occasionally two factory-backed cars were raced by DAF in conjunction with the British Chequered Flag Team, with a growing level of success in Europe's most hotly contested form of motor racing. The high-spot was a meeting at Zolder last September, where Mike Beckwith won one race and was third in two more against the toughest opposition on a circuit which, though only 2½ miles around, has something of the flavor of the Nurburgring, and offers a considerable test for transmissions. For 1967, a two-car team is being operated, with drivers Beckwith and Dutchman Gijs Van Lennep, who will also be seen in the enduros at the wheel of a factory Porsche.

The Variomatic system used on the passenger cars consists of a centrifugal clutch, spring-loaded to transmit the drive at crankshaft speeds in excess of approximately 1000 rpm, and linked by bevel gears to a countershaft carrying a pair of two-piece pulleys, the effective diameter of which varies as the two halves are brought together or parted.

A set of centrifugally actuating bob weights offers the main adjustment of pulley diameter and gearing, but a further adjustment is effected by the action of manifold pressure on a diaphragm adjacent to the pulleys, so that within certain limits the gearing can be lowered further during acceleration or raised when the engine is on the overrun. A driver-operated switch-over lever is provided, reversing the action on the diaphragm to provide a measure of transmission braking for mountain driving. A simple lever-operated dog clutch on the primary countershaft reverses the drive by bringing the bevel pinion into mesh with a second crownwheel. There is no differential on the passenger car, but a further ratio reduction is provided by pairs of drop gears inboard of the swing axles.

The main changes for the racing application are: the addition of a differential in the final-drive line, overall ratio variation by means of a train of three gears between the secondary pulleys and the final drive, and elimination of the manifold-influenced diaphragm in favor of an ingenious device designed to maintain engine revs at a minimum of 7500 rpm, regardless of road speed. Such a device, of course, is virtually essential when racing with small-displacement, high-revving engines, the useful power output of which is confined to a relatively small section of the available rev range.

Wim Hendricks has designed a gear-adjusting mechanism which operates on the axis of the primary countershaft and ensures that the gearing is lowered automatically, immediately when the engine goes on to the overrun. It consists of a hollow cylindrical cage, through the wall of which has been cut a spiral groove. A peg, located at right angles to the axis of the cage and driven by the countershaft, slots into the groove, while the cage itself is allowed to slide along the axis of the countershaft to the limit imposed by the length of the groove. A thin rod passes through the middle of the countershaft and couples the cage to the outside face of the pulley on the opposite side of the car. Therefore, lateral movement of the cage will have the effect of varying the distance between the two faces of the pulley, and hence the gearing.

With the car running at top speed under full load, the peg will be at the inboard end of the groove, the cage will be extended as far outboard as it can travel and will have pulled the pulley faces together to give the maximum possible gearing allowed by the bob weights (the size of these is varied to give the required maximum engine speed under full-load conditions). But immediately the engine goes on to overrun, the motion of the peg relative to that of the cage will be braked, causing the peg to travel along the groove, which in turn forces the cage inboard, and through the internal rod, pushes the outer face of the far pulley away from the inner face, dropping the gearing.

The centrifugal clutch, which is encased in a steel-lined aluminum housing, has three shoes which are held off the drum by coil springs, rated to achieve an engagement speed of approximately 5500 rpm. The primary shaft gear reduction is 2.54 to 1, and with a 3.25 to 1 differential (3.46 and 3.70 to 1 are also available) overall gearing can be varied infinitely between 5.33 and 17.20 to 1. On the first installation in a racing car chassis, the primary countershaft was behind the secondary shaft and the final-drive line, resulting in a tail-heavy chassis; but by running the primary shaft immediately behind the clutch a more compact transmission package has been achieved, and a favorable weight distribution with driver aboard of 45/55.

The Repco-Brabham chassis differs from conventional F3 specification in having a different tube arrangement in the engine bay, a 2½-inch longer wheelbase with appropriate adjustment to radius arm lengths, and the Cosworth-Ford engine is mounted four inches forward. Dry weight is just over the regulation minimum of 400 kilograms.

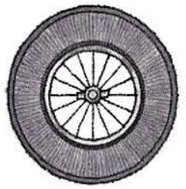
Clambering aboard the latest car for a very wet and cold first look at the Zolder circuit, I found few changes from normal in the cockpit — just a second tachometer, which had been disconnected, but had been used to record road speed as a means of establishing gearing requirements when going to a new circuit for the first time, and a simple push-pull lever replacing the conventional right-hand gearshift. A spring-loaded lock below this had to be released to pull the lever back and engage the reverse crownwheel. Lack of a clutch had enabled a double footbrake to be fitted, so that either left-foot or right-foot pedal could be used. As I was a tight fit, leg-wise, I settled for left-foot braking.

An immediate advantage with Variomatic is found with getaways on a wet track. Starting technique is to run the engine at about 5000 rpm until a second or two before flag-fall, then increase to around 6500 rpm, holding the car back with the left foot. As soon as the flag falls, off comes the left foot and down goes the right — as far as it will go. With no sudden and violent changes in torque, there is no tail-wagging, just a smart acceleration forward as your opponents anxiously watch their tachometers and cope with wheelspin. The take-off, even with the circuit awash, was very impressive.

The sound of a high-revving engine behind me, fluctuating only between 7500 and 9200 rpm, regardless of road speed, took a lot of getting used to. The most difficult thing is judging your approach speed to a corner, and inevitably you err on the pessimistic side and brake too early. Only when you drive this car do you appreciate the extent to which

*(Continued on Page 68)*

# TO MARK THE CROOKED MILES



# RALLY COUNTERS

By Bob Henry

TO THE SERIOUS TIME-SPEED-DISTANCE RALLYIST, equipment is second nature. It is as necessary as the rally car in which it is mounted, and it can take precedence over the necessities of life. If a rallyist feels he needs a new set of factor cards . . . okay, he goes without beer for a month.

To the great majority of people who enter T-S-D rallies, the mere mention of equipment brings visions of a car full of computers. However, true navigation does not require a great expense, even though rallying, to some, may mean navigation with equipment. To most, the challenge is to see how close to the true time it's possible to come by 'seat of the pants' navigation — this is the beloved SOP class of rallyists, who spend an afternoon or evening in competition without thought of calculator or counter.

Ask any one of them to try a navigational event with equipment and you'll get either, "Too much money!" or "I don't want to get my brains beat out!" While their answers may have merit in some events, it simply is not true of the majority. And, their answers are not based on fact, but on misinformation, i.e., the truth about what really is necessary. Let's take a close look at those answers.


Too much money? Well, in what other form of auotmobile sport can you participate with an expenditure (over the price of the car) of less than $250 and have a chance of winning? In fact, rallying is the one 'sit-in-the-car' auto sport where you can economize by building your own equipment — and be extremely competitive!

Beat your brains out? So, okay, if you add two and two and get five, you may have a problem. But there are calculators that take most of the work out of navigation, and a few that takes all of it. The Curta is the prime example of the latter. Anyone can learn the mechanics, and at $50 to $70 used, it's the navigational bargain of the year!

So, if you are the least bit interested in rally competition, there is more to support your going 'navigational' than not. Actually, everyone starts by the 'seat of his pants' to learn the basic fundamentals of the game. But there comes a time when a decision must be made.

Either advance to a navigational class or continue on with the non-navigational 'by guess and by gosh', and hope your luck continues. It's true some SOP rallyists develop the non-nav game to a fine science — assuming they play it legit. However, there's still the luck aspect that can't be denied. Believe me, there is no better feeling for the beginning navigator than to know he has done well, and was right when the true times are posted for the rally.

Very few things of any value come free, and there will be some costs. Yet, don't be conned into believing the articles and pictures showing dazzling arrays of black-box setups that resemble a DC-8 instrument panel. Notice that these cars rarely win rallies (although this is one way to get your picture taken!). This is true because all the navigation equipment in the world will not keep you on course!

The key to the game can be found with the consistent winners: use very basic equipment, and *keep it simple!* Simplicity, even in rallying, has its limitations and, regardless of the navigational system used, it is still necessary to have an accurate measuring device. The standard here is the 100th-of-a-mile counter.

This limitation is required whether you're a beginner or an old pro, and for the simple reason that you have to measure the route just as the rallymaster did for official time. Accurate mileage measurement is mandatory.

Rally counters fall into two general categories: complete units, ready to install, and the assemble-it-yourself units, about which this article is written. With little effort, you can assemble a system worthy of the best, and one that will give a tremendous amount of personal satisfaction. With that in mind, let's take a look at 100th-of-a-mile counters.

The heart of any counter system is the impulse unit, and, sad but true, it will have to be purchased outright. Most impulse units are about $45, making them the highest priced component of the installation.

The impulse unit consists of a housing with a speedometer-cable connector, a set of gears inside, and a threaded outlet for attachment to the back of the speedometer. The gears are given ratios for your car, based on speedometer cable revolutions per mile, and drive a single lobe cam. This, in turn, is coupled to a micro-switch wired into the car's electrical system.

The impulse output, at 100 times a mile, is connected to the counter, which registers the impulses, i.e., the hundredths of the mile. Some units can be adapted to run off a non-powered road wheel. The theory here is that the lack of wheel spin will contribute to more exact measuring. Don't fret too much about this non-driving wheel bit, unless you rally all the time in deep sand, or want to 'psych-out' the competition! Regardless of the installations, the principle is the same.

The materials necessary to assemble a set of counters can vary. What's available? Aluminum, plywood, Masonite? All are adequate. Oh yes, don't forget the instrument panel of your car. For neat installation, always mount your counters directly on the dashboard or on a substitute door for the glove box.

Additional materials are the usual nuts, bolts, screws, found in most sports car owners' garages. You'll also need ten feet or so of 16-gauge wire, some terminal ends, a terminal strip (with at least five posts), and a couple of toggle switches. Then you're about ready to go. Contact your local surplus or radio-TV store and you'll probably find everything required.

Everything? Well, not quite. You still need at least one counter! If at all possible get two. The 'why' will be explained later. The counters pictured here were purchased from a large Los Angeles surplus store for $7.50 each. Prices will vary for these Veeder-Root units, depending mainly on supply and demand in your area.

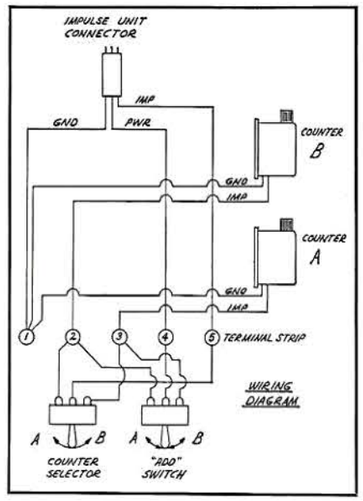
Make sure the counters are at least four digit, electric, and resettable. The standard military units (shown) are six digit, and you'll find the great majority of Veeder-Root units are of this type.

A second primary outlet for counters is the major electrical supply houses, particularly the mail order variety. While the American-made units may be rather expensive, there now are reasonably-priced counters being imported. Some of these will contain plastic gears. This is fine, but don't try to use lights inside the housing. The heat will cause the gears to expand and possibly hang up at a critical time during a rally.

There are also some 'sneaky' places to find rally counters. The new generation of dry-copy printers has great panel-mount electrical counters, as do turnstiles. No, I'm not suggesting you take a screwdriver and wire cutters to the next ball game!

While not going into electrical counter design, a few words should be said on their operation. There is a coil (or two) inside the case such that when voltage is applied a magnetic field attracts a striker plate, which is linked to the digit wheels. Exercise the plate or blade once and the counter registers 000001; a second time will give you 000002, and so forth. And remember, this will be one-100th of a mile.

The war surplus, six-digit counters illustrated came with 220-volt coils. These were replaced with 12-volt coils. Six-volt replacements can be purchased from electrical supply houses (as can 12s), or directly from the Veeder-Root company. These go for about $5 per pair, one pair per counter. Alternately, the coils can be rewound as required for your application.




The first task of the installation is to replace the above mentioned coils. No sweat here, since this is strictly a screwdriver job. Make sure the finished coil installation resembles the original, because the upper surface of the coil determines the stroke of the striker blade.

Next, determine where you want the counters located. Do you want them on your rally board or on the instrument panel? What about the glove box? Maybe the center console? It is impossible to cover all locations or contingencies, but a few minutes spent in the navigator's seat will pay dividends in arriving at a comfortable location.

Wiring the counter circuit is straightforward, with little or no soldering required. The female plug that comes with the impulse unit will need a male mating connector, so make sure you state the requirement when ordering.

There are two switches in this installation, and they are used as follows: The top switch 'toggles' on either the left or right counter. In other words, it selects the counter that is to register the impulses. On the diagram, "A" is the left and "B" the right. Since the counters illustrated are used with a binary circular slide rule, they are switched alternately at each speed change during the rally. If you use a Curta, only one would be used during the event. However, many rallyists change counters at each checkpoint, or for — you should pardon the expression — 'Off-Course Mileage.'

*(Continued on Page 80)*

*Accurate odometers are essential to the serious rallyist. It's both relatively simple and inexpensive to build your own!*

*"...the motions of the viewless winds embodied in the mystery of words."*
*Wordsworth*

An almost classic example of the Kamm theory (chopping a mathematically tapered tail at a specific point) is the slippery Alfa Romeo GTZ.

Part One

# Airflow and the Automobile

By L.J.K. Setright

ALL THE REALLY FAST CARS OF RECENT YEARS HAVE HAD AERODYNAMIC PROBLEMS. The solutions have been weird and wonderful: we have seen cars with long and shapely tapering tails and cars with no tails at all, cars with fins on their rear quarters pointing to the sky and cars with fins on the extreme noses slanted toward the ground. They can't all be right, can they? And is what is right for 120 mph also right for 60, or 180?

Deciding the right shape is obviously not easy. Aerodynamics is a complex and difficult study that has only grown up in the twentieth century, although the laws of fluid behavior (and air is just a fluid) have been in the melting pot for a quarter of a millenium. Like most other branches of mathematical physics, no progress could be made in this science until Newton and Leibnitz, who independently invented calculus at about the turn of the 17th to 18th centuries. Once this was done, the way was open for a couple of other No. 8 hats called Euler and Bernoulli to apply calculus to the problems of fluid motion. In doing so they founded classical hydrodynamics, a science which deals with motion in what they chose to call an "ideal fluid"—a purely hypothetical medium. The classical hydrodynamics promptly became a mathematician's delight, but the engineers had their doubts because they, poor fellows, were condemned to deal with down-to-earth 'real' fluids, and they found that the results they got from these did not at all equate with what the hydrodynamics theories forecast. So the whole thing was allowed to lapse, despite the attentions of the 18th Century ballisticians, who were eager to find out why the artillery of the day behaved in the way that it did.

The odd thing about classical hydrodynamics was the way it proved fluid drag to be zero! A theorem demonstrating this was known as 'D'Alenbert's Paradox,' because everybody knew that a fluid (be it water or air) presented a resistance to a solid object passing through it. Everybody knew, but the scientists persisted in proving that this was not so. As the English physicist Lord Rayleigh summed it up, "On this theory the screw of a submerged boat would be useless, but, on the other hand, its services would not be needed."

This spectacular inability of hydrodynamics to predict drag arose from the fact that it could take no account of the viscosity of the fluid with which it was dealing. The impasse was resolved only as recently as 1904, when the German mathematician Prandtl introduced a new word, "Grenzschicht", to the world. The word means "boundary layer", and you are unlikely to find a modern treatise on aerodynamics that does not deal with boundary flow.

The essential idea behind the boundary-layer theory can easily be understood if you look upwards on a cloudy day. The clouds scurry across the sky at an evidently considerable speed, but you on the ground feel little or even no breeze. The air close to the surface of the earth is stagnant, and the wind velocity rises with height until at two or three hundred feet above the ground it becomes stabilized. The same thing happens on a smaller scale with a body in an air flow: the air directly in contact with the surface is stationary relative to that surface; a minute distance from the surface the air is traveling relative to it, albeit slowly; a bit further out, there is an undisturbed stream. The velocity gradient — the charge of velocity of air from zero at the base to that of the undisturbed stream at the top of the layer — is caused by the viscosity of the air. The layer is usually extremely shallow, a small fraction of an inch thick, so that despite the low viscosity of gases such as air, there is a marked velocity gradient, which means large shearing stresses in the layer. These in turn mean there can be quite a lot of friction in the layer, even when it is moving over a flat, smooth surface.

Having sorted all this out, the physicists went to work again and soon deduced that resistance to the motion of a body is composed of two parts: first, form drag, which arises because the air flow does not close in completely around the tail, but separates to form a wake because of the shape of the body; second, friction drag, which is caused by air sticking to the surface of the moving body and forming a boundary layer because of the air's viscosity.

This second type can be reduced, but never eliminated, by making the surface of the body very smooth — but this is a complete waste of time and effort unless the body is streamlined.

'Streamlined' is a popular bit of jargon nowadays, as likely to be applied to corsets or cutlery as to anything else. Strictly, it means a body that is carefully shaped so that it leaves behind only a very small wake. In other words, a body which is designed to have as little form drag as possible. Fish provide some of the best of nature's examples of streamlined bodies, the tunny family and the swordfish (some of them can do 70 mph) being outstanding. Of man-made objects, among the first to be given a streamlined shape were the dirigibles built at the beginning of this century. They were intended for comparatively low speeds, comparable to those of a quick touring car today, and are therefore worth studying.

Dirigible designers found that the ideal, streamlined shape was not a long, pointed body (this does not become a good proposition till you are getting close to the speed of sound), but one that begins at the nose with a slightly rounded point, the line then sweeping backwards in a sort of half ellipse and then starting to taper inwards again in a steady curve towards the pointed tail. They even got as far as working out that the ideal ratio of length to thickness was about six to one, a longer body creating unnecessary friction drag, and a shorter one being unsatisfying from the form-drag point of view. One example of mathematics being used to create a purer and more efficient line than ever a draftsman could scribe, is the Jaguar XK120C sports-racing car that was built for the fast Le Mans circuit in the early 1950s. The center line of this car's hood was a mathematically derived curve. Its lap speed was in the region of 105 mph, not dissimilar from the speed of a good dirigible. The dirigible designers also proved that, at the speeds with which they were concerned, the shape of the tail was rather more important that the shape of the nose, which explains why in early 20th century writings on streamlining you will find so much importance attached to a long and shapely tapering tail.

This, unfortunately, is the point at which the aerodynamics of automobiles begins to diverge. It is not a bit of good having a shapely tail if the flow of air is going to be wrecked by unavoidable things like wheels and windshields. Because of this limitation, long tail-fairings have proved of very little value on high performance cars. Designers have concentrated on getting the nose right and keeping things well behaved as far aft from it as possible. A car needs to be wider than it is high, so they could not adopt the simple and perfect circular cross-section of aircraft; but many took a tip from the Zeppelin experts, starting with a rounded nose leading into a sort of half-elliptical line that sweeps backwards to create

## Technical Report: Wings, Spoilers and Laminar Flow

a gradually increasing cross section.

The reason for the good behavior of the Zeppelin shape is to be found in studying the three different types of airflow that can exist. First, there is smooth flow where the boundary layer is free of turbulence. Then there is turbulent flow, usually to be found downstream from the smooth laminar flow, although it is still in the boundary layer. What happens is that at a certain point the layer begins to thicken and, reaching a certain combination of velocity and viscosity, can no longer maintain its laminar nature. At this transition point the flow becomes turbulent within the boundary layer, although there is still a very thin, laminar sub-layer immediately in contact with the surface of the body. Third is what we might call stalled flow, where the air just cannot follow the shape of the body at all, but breaks away in eddies and causes a tremendous amount of drag. Now, so long as the airstream has to accelerate over a body of increasing cross-section, it will follow its contours closely. With a pointed or blunt nose, the acceleration is not constant and the airstream will break away at the first opportunity; but the half elliptical nose, if slender, has the desired effect of producing constant acceleration over the surface.

Obviously the shape is an ideal one, which cannot be obtained practically in a vehicle which is still capable of being driven on the road, but there are at least some clues here as to the shape at which a designer should aim. Looked at from the side, there is no reason why the outline at the front half of the car, ahead of the windshield, should not be something like a half ellipse.

Looked at in this way, the car body takes on some of the characteristics of an aircraft wing. Thus there will be a tendency for lift to be generated as pressure builds up under the nose and drops away above it. It was long supposed that the way to avoid having the nose of the car take off as speed increased was to keep the leading edge as close to the ground as possible. But, odd as it may seem, it is often found better to raise the leading edge somewhat because the bulk of the lifting is done by the low pressure above the upper surface, the high pressure below doing less harm.

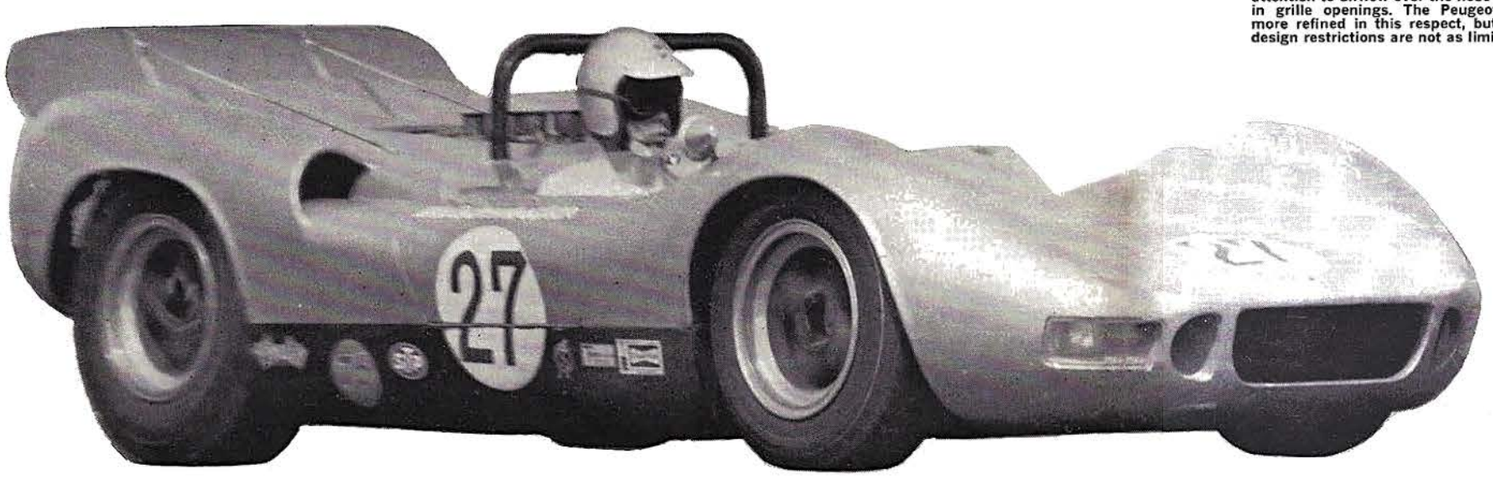
There will be more to say about the tendency to drift at high speeds later on, but at this point it is worth mentioning another advantage of the steadily increasing cross section, an advantage that makes itself apparent when there is a need for air intakes to direct cool air to carburetors, brakes, or transmissions. It is obviously no use placing an intake where the air flow has already stalled, so that there are whacking, great eddies all over the place, low pressures, and irregular flow. On the other hand, wherever the air stream is kept accelerating, the pressure will be relatively high ('relatively' because it may still be actually below atmospheric pressure) and there will be some sort of boundary layer at the surface.

This means that you do not have to build ugly great scoops on to the sides of the body in order to gather in the desired draft. All that these scoops do is to create a lot of unnecessary turbulence and spoil the penetration coefficient of the body as a whole. Instead, you simply make a hole in the surface: since the air has a fairly high pressure, it will find its own way into the hole and can easily be conducted where it is required. Obviously some holes are a better shape than others, and for this sort of duty, what is known to aircraft designers as the N.A.C.A. intake is ideal. This hole is roughly in the shape of a narrow triangle, with the apex pointing forwards. The shape ensures that air is positively rammed into the duct, while at the same time the turbulence that invariably follows any aperture in the surface is neatly rolled into two fairly small vortices, instead of spreading over the sides of the body and creating more drag.

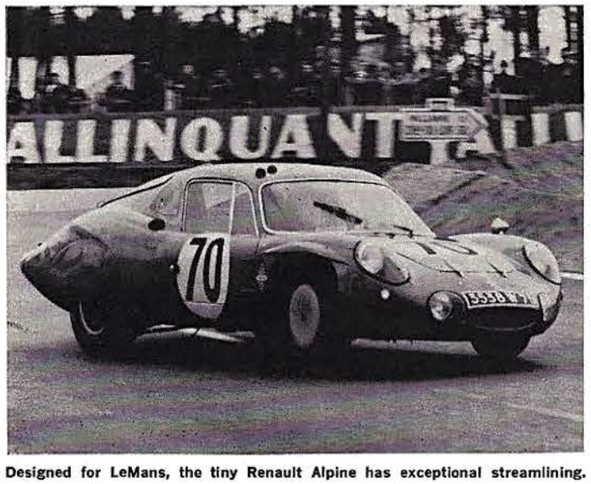
Harking back to the mention just made of turbulence and vortices, there is no harm in considering the importance of these if anybody ever does succeed in creating a body so well shaped that friction drag becomes important. You will remem-

*(Continued on Page 73)*

# Airflow and the Automobile

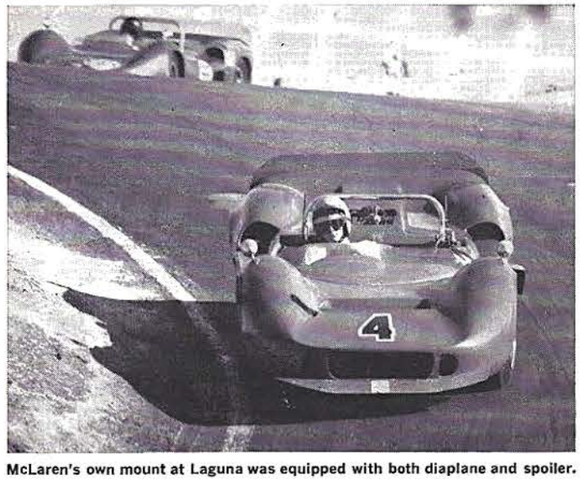



**The LeMans CD Peugeot, at right, and the McLaren at left, both show attention to airflow over the nose and in grille openings. The Peugeot is more refined in this respect, but its design restrictions are not as limited.**


**Designed for LeMans, the tiny Renault Alpine has exceptional streamlining.**


**The C-Type Jaguar had classic nose design for proper air-guidance over it.**

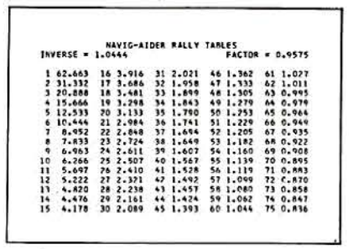



**McLaren's own mount at Laguna was equipped with both diaplane and spoiler.**

**Front view of the Alfa GTZ; ideal airflow is achieved with its configuration.**

# NEW PRODUCTS


FLEX-ARMOR CEMENT provides a permanent bond on leather, vinyl, canvas, etc., yet leaves materials pliant. Check in your local hardware store for a handy two-ounce tube that retails for $1.39.



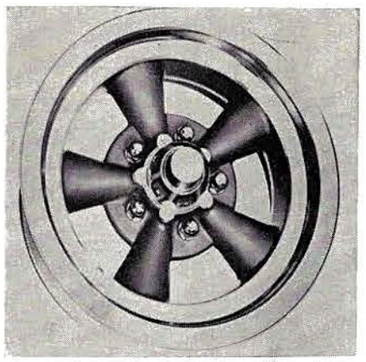
NAVIG-AIDER RALLY TABLES

INVERSE = 1.0444 FACTOR = 0.9575

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 62.663 | 16 | 3.916 | 31 | 2.021 | 46 | 1.362 | 61 | 1.027 |
| 2 | 31.332 | 17 | 3.686 | 32 | 1.958 | 47 | 1.333 | 62 | 1.011 |
| 3 | 20.888 | 18 | 3.481 | 33 | 1.899 | 48 | 1.305 | 63 | 0.995 |
| 4 | 15.666 | 19 | 3.298 | 34 | 1.843 | 49 | 1.279 | 64 | 0.979 |
| 5 | 12.533 | 20 | 3.133 | 35 | 1.790 | 50 | 1.253 | 65 | 0.964 |
| 6 | 10.444 | 21 | 2.984 | 36 | 1.741 | 51 | 1.229 | 66 | 0.949 |
| 7 | 8.952 | 22 | 2.848 | 37 | 1.694 | 52 | 1.205 | 67 | 0.935 |
| 8 | 7.833 | 23 | 2.724 | 38 | 1.649 | 53 | 1.182 | 68 | 0.922 |
| 9 | 6.963 | 24 | 2.611 | 39 | 1.607 | 54 | 1.160 | 69 | 0.908 |
| 10 | 6.266 | 25 | 2.507 | 40 | 1.567 | 55 | 1.139 | 70 | 0.895 |
| 11 | 5.697 | 26 | 2.410 | 41 | 1.528 | 56 | 1.119 | 71 | 0.883 |
| 12 | 5.222 | 27 | 2.321 | 42 | 1.492 | 57 | 1.099 | 72 | 0.870 |
| 13 | 4.820 | 28 | 2.238 | 43 | 1.457 | 58 | 1.080 | 73 | 0.858 |
| 14 | 4.476 | 29 | 2.161 | 44 | 1.424 | 59 | 1.062 | 74 | 0.847 |
| 15 | 4.178 | 30 | 2.089 | 45 | 1.393 | 60 | 1.044 | 75 | 0.836 |

NAVIG-AIDER RALLY TABLES, for use with a Curta Calculator, consists of 401 4" x 6" minutes-per-mile cards with odometer factors from 0.9 through 1.1 in speeds from 1 through 75 mph. Set is $11 from Al's Trophies, 13112 S. Izetta Avenue, Dept. G, Downey, Calif.


RAPID GRIP AUTOMATIC is a whole set of ratchet wrenches in one tool. It fits 12 nut sizes from 7/16 to 1⅛, also ratchets various hex and square sizes. For details write Tanguy Tool Co., Dept. G, Glen Mills, Pennsylvania 19342

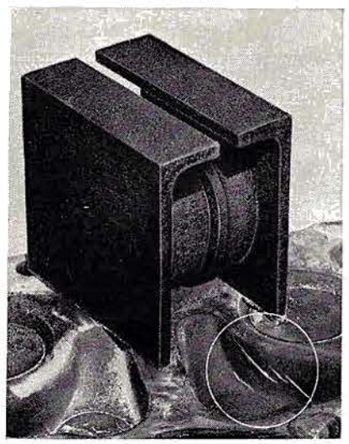


THE "T.E." MAG is a permanent mold wheel that bolts directly to the brake drum, fits any 5-lug bolt pattern, and can be used with tubeless tires. Send $1.00 for catalog to Ansen Automotive Engineering, Inc., 13715 So. Western Ave., Dept. G, Gardena, Calif. 90249.

MINIATURE high intensity 12-volt lamp is ideal for map reading, under-hood work, tire changing, etc. With plug-in to cigarette lighter, 10 ft. cord, and magnetized base, it costs $7.75 from J. C. Whitney & Co., 1917 Archer Avenue, Dept. G, Chicago, Illinois 60616.

WELL-DETAILED 1/25th scale kit of the beloved 'Beetle' has wads of operating parts for a stock VW version or an AA/altered coupe complete with Hemi. Not recommended for beginners, kit retails for $2.00, check with Industro-Motive Corp., Dept. G, Troy, Michigan 48084.

A LINE of Datsun goodies including a wood-rimmed steering wheel, tachometer, wood-grained stick-on dashboard, and a radio for the PL-411 sedan are now being marketed by EMPI, Dept. SC, P.O. Box 668, Riverside, Calif. 92502.



DO-IT-YOURSELF metal crack inspection device called Crack-Tec converts walls of the crack into poles of a magnet that attracts test powder. Price is $49.50; get yours from IECO, Dept. G, P.O. Box 25142, W. Los Angeles, Calif.

EDMONT DRIVING GLOVES, made of vinyl-treated fabric, come in small, medium, and large sizes in black with yellow or orange day-glow inset. Cost is a mere $3 from MG Mitten, Dept. G, 1163 East Green Street, Pasadena, California.



## DAF VARIOMATIC

*Continued from page 61*

you normally drive by ear as well as by your pants. Gradually you learn to disregard what you hear, and concentrate on the car's feel.

Back off and the needle will drop back to 7500 rpm; put the power back on and within a second or two you are back on 9000, after which I found I needed the long back straight to get the final 200 rpm. Racing performances have proved the Variomatic-equipped car is competitive on acceleration with manual-transmission Repco Brabhams, but of course you get a false impression of clutch slip coming out of a slow turn at such high engine speed. This makes you feel you're going slower than you really are. All well-sorted-out F3 chassis handle like dreams, but this one seemed unusually kind in the wet and over the rough patches.

Of course you lose the message the subtle variations in engine note give you about what the back wheels are doing, and I spun the car on one occasion because I was lulled into a false sense of security by the even engine note and was just a fraction late in reacting to a rear-end breakway as a result.

Because the transmission gives you the correct gear all the time, your chances of a power-induced breakaway should be diminished, but when it does occur it is likely to do so quickly and calls for smart reactions. Drivers who have raced with Variomatic like the transmission the more they use it, and no one disputes it's the way to get off the mark, wet or dry.

Reliability has been almost 100 percent. The Titanium pulleys give no trouble at all. Belts are changed after two races. Not because they are worn out, but because it is pointless not to do so (first tell-tale signs of wear are knife cuts in the base of the notches on the inner surface). Clutch wear is indicated by the speed at which the drive takes up, and when this rises to 6500 rpm it is time for a strip-down. The heavy rain throughout the test day had no effect on belt grip. Even when an oil union leaked lubricant on the belts, the only result was an intermittent increase in maximum revs to 9600 rpm and a momentary upward surge in revs as the power was reapplied after a period on overrun.

Only the size of pulleys and bob weights governs the power and torque limits with which a Variomatic-type transmission can cope, but its main application, in view of the space factor, must be in the up-to-200 bhp class. So far, its racing activities have been confined to single-seaters, but it would seem to offer equal potential in the back of a lightweight Group 4, 6, or 7 car—in other words, a small-capacity Modified.

DAF's aim is to market its racing

*(Continued on page 80)*

## SOUTH AFRICA

*Continued from Page 26*

Jack Brabham, who had Surtees breathing down his neck in the massive white and red Honda, which was sounding beautiful pulling 10,000 rpm through the gears and tearing down the long straight at close to 170 mph.

Locked in combat, Brabham and Surtees went through Crowthorne corner side by side on lap three, with Brabham on the outside and not on the correct line for the following right-hander – Barbecue Bend. Surtees took the inside line while Brabham tried to scrape around on the outside, then started to lose it. He ran over Surtees' rear wheel, which sent Brabham flying into the air and into a couple of hairy spins as he slid off the track. Brabham never faltered for a split second and, as soon as the nose of the Repco-Brabham was pointing in the right direction, he had his foot down hard on the accelerator. He flew back onto the track in fourth place, after letting Surtees and Rindt through.

A few seconds after the Brabham-Surtees skirmish, Jackie Stewart blew the H-16 engine of his BRM in the biggest possible way, with plumes of smoke pouring from the engine as he entered Crowthorne corner. A rather rudely upset Stewart parked the BRM next to the bank and walked dejectedly back to the pits.

Stewart arrived back in the pits just in time to see the Lotus-BRM of former teammate Graham Hill being wheeled away after a front suspension failure had punctured an oil line. So, with fifteen minutes of the Grand Prix gone, both Stewart and Hill were out of the race with a total of only eight laps between them! It was the end of a particularly disappointing meeting for both drivers, and it appears there is extensive development required for both Lotus and BRM H-16s before they will be competitive.

With the furious pace of the opening laps, the lap record previously held by John Love was broken consistently by the first four cars, with Denny Hulme showing everyone the way around the circuit, lapping consistently in the 1:30 bracket, an average of just over 100 mph.

After a tremendous ten-lap battle, Jack Brabham finally snatched back his second place. He had tried everything he knew to get past Surtees, slipstreaming the big Honda down the straight, but not having a reserve of power to easily get past the screaming V-12. After 17 laps, Clark, who was holding down sixth place, brought the H-16 Lotus into the pits with fuel spurting from the two 'bombs' mounted in front of the radiator. After a short pit stop he re-entered the race, with the nose piece off his car to help cooling. Clark's race lasted only another five laps before he brought the second Team Lotus to retire into the pits with a broken rear brake pipe.

With Clark out of the race, the order was Hulme, driving immaculately with a 40-second lead over Brabham, who was still closely tailed by Surtees, then Rindt, Rodriguez, Love, Gurney, Charlton, Bonnier, Spence, Tingle, Courage, Anderson, Siffert, and Botha. At this stage, Surtees started dropping back as the Honda began to overheat – the overcast skies were clearing and the light rain which had fallen at the start petered out after half an hour. Rindt had Surtees in his sights and was really sending the Cooper-Maserati in characteristic style – with great hands full of opposite lock – through the twisty bits. He eventually overtook Surtees and set out after Brabham, catching him by lap 25.

For the next 14 laps Brabham and Rindt ran only a few feet apart, with Rindt trying desperately to pass, particularly through the corners; but he just couldn't get by Brabham. A suspected dropped valve finished Rindt's brilliant drive on lap 39, just one lap from the half-way point. Siffert's Rob Walker Cooper-Maserati lasted two more laps before the engine blew, and Bonnier's independent Cooper-Maserati had coasted to a halt at the end of the straight with a broken valve spring.

The last H-16 engine car to retire from the race was Mike Spence's BRM, which had been holding a consistent eighth-place. However, on lap 32 the BRM was brought into the pits with a broken oil breather pipe – not a serious ailment in itself – but the Grand Prix regulations prevented the replenishment of the oil which had been lost.

Of the 2.7-liter, Climax-engined cars, John Love and Dan Gurney were the fastest, running nose to tail for 20 laps. They had worked their way up to third and fourth places by half distance, due to Rindt's retirement and the easing speed of Surtees' Honda. The order then was Hulme, Brabham, Love, Gurney, Surtees, Rodriguez, Siffert, Courage, Anderson, Botha, Tingle, and Charlton. However, on the next lap, Brabham coasted to a halt in front of the control tower with a dead engine and jumped out to push the Brabham up the incline to the pit. The trouble, finally traced to the distributor, cost Brabham five places. He re-entered the race in seventh place on lap 42. Next into the pits was Gurney in the Eagle with a damaged rear suspension, which ended a fine drive for Gurney after he had worked up through the field to third place behind Hulme and Love.

Another driver who had been unobtrusively getting on with the job was Piers Courage in the R. H. Parnell 2.0-liter Lotus-BRM, which was in fifth place by lap 50. Two laps later, however, Courage's consistent drive came to an end in the pits with a broken oil line after he had given a good account of himself in his first Formula One drive.

The race order then became Hulme, Love, Surtees, Rodriguez, Anderson, and Brabham, with Hulme in complete command, lapping consistently around 1:35, and with a lead of over 40 seconds from Love.



After holding an undisputed lead for sixty laps, the picture changed dramatically for Hulme. With all four wheels locked up, his car slid sideways into the Brabham pit with smoke pouring from the tires. Hulme's frantic pit stop to replenish brake fluid was long enough to let John Love into the lead, to the roar of the partisan crowd. Twenty-two seconds behind Love was Pedro Rodriguez, followed by Surtees, then Hulme, Anderson, Brabham, with Charlton and Botha circulating at much reduced speed in their Brabham-Climaxes.

With Love in the lead, the pace suddenly quickened. Love and Rodriguez lapped in the 1:32 bracket as the Cooper team realized Rodriguez was now in a strong position to win. Love's Cooper-Climax, however, was going like a train, despite a persistent misfire due to a faulty spark plug. Rodriguez could make no impression on Love's 20-second lead since the Mexican driver was having difficulty getting second and fourth gears and was taking a long time to come up through the long uphill Leeuwkop bend before the entrance to the main straight.

After holding the lead for ten laps, Love was also in trouble as his 'slimline' Tasman Cooper, with a 26 gallons fuel tank capacity, was rapidly running out of fuel. Love had made allowance for this before the race by fitting an extra three-gallon tank, but, when he switched over, the auxiliary Bendix pump failed to operate and Love reluctantly flew into the pits on lap 73, just seven laps from the end. Love's dramatic pit stop to take on the two vital gallons he needed to finish, cost him a minute. Rodriguez was more than forty seconds in the lead by the time Love screamed back on the track in second place.

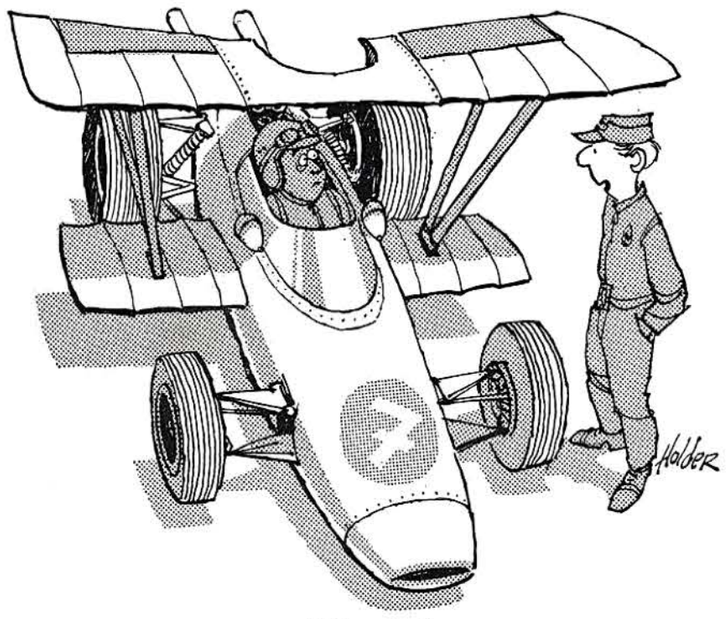
Love immediately dropped his times to under 1:32, while Rodriguez eased off slightly on each lap. Love was unable to make up the loss in the remaining laps and Rodriguez took the flag for his first World Championship Grand Prix victory.

Surtees battled on to finish an excellent third, and, although the noisy white and red Honda was not prominent except in the early part of the race, he did a magnificent job to bring the Honda to the finish line. Surtees began to slow before half distance with overheating and gear selection troubles and, to cap it all, punctured a right rear tire and completed the last two laps with the tire almost flat and devoid of tread! Apart from all this, the intense heat in the cockpit of the big monocoque car was so bad that the pedals had burned Surtees' feet, and he was able to walk only with difficulty at the end of the race. It was a truly impressive drive first time out in the Honda, and there is no doubt that the combination of Honda know-how and Surtees' determination will make an impressive combination for the '67 Grand Prix season.

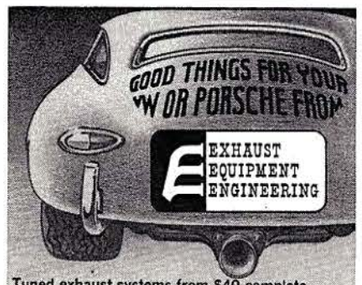
Denny Hulme finished a disappointed fourth. He was the moral victor and untouchable in terms of driving ability on that day. Bob Anderson finished a consistent fifth ahead of Jack Brabham, who soldiered on to finish sixth, some four laps behind Rodriguez and Love.

Rodriguez was in fact a very surprised winner, and couldn't quite believe at first that he had won. After being mobbed by the crowd, he was hoisted onto the victory dais where he enthusiastically drank champagne from his trophy with Miss South Africa, Joan Carter.

Rough, tough, and testing, the 13th South African Grand Prix was a difficult race. As the first event of the 1967 World Championship year, it did not give much indication of the final outcome of the season, except that Honda is the coming car, Lotus is long overdue for a new engine, and the Repco-Brabhams are still the most competitive three-liter Grand Prix cars.




"It's been done!"











## FORMULA FORECAST

*Continued from page 49*

natural talent and looks to be about half the size of Gurney, which provides a weight advantage as well!

Lotus, which means Jim Clark and Graham Hill this year, will be relying on its H-16-engined cars at the beginning of the season, but Ford is hopeful that Cosworth will have the first of the V-8s ready in time to get at least one to the line at Monaco. Entirely new cars are being built around this engine, which is said to be considerably more compact than the Climax V-8 1½-liter —very light indeed — with an initial power potential of about 380 bhp.

When you're promised that sort of package, you build a pretty small car (the engine should not be too thirsty, so fuel capacity need not be too much of the problem). It all adds up to an entirely new car from Chapman and his chief designer, Maurice Phillippe, and, meanwhile, who can blame them for saying nothing about what they have up their sleeves? An interesting situation will arise if and when only one V-8 car is available to race. Who will get it? My guess is Clark, though there is no longer any official number one driver on this team.

Quite a lot has happened in the Ferrari camp these last few months, starting with the Surtees bust-up last June. The most notable happenings recently have been the disappearance from the scene of Eugenio Dragoni and his replacement as racing manager by that affable motoring journalist, Franco Lini. This surprise move went a long way to explain why Ferrari did not hold his annual press conference, where he traditionally reveals plans for the forthcoming season. Therefore, we are more than usual in the dark about Ferrari plans — more so because Ferrari refused to send cars to the South African GP, because the organizers (rightly) declined to pay him twice the appearance money demanded by the other teams.

All we know, therefore, is that the team has an abundance of drivers — Chris Amon, Lorenzo Bandini, Mike Parkes, and Ludovico Scarfiotti — who seem to be joining a queue for the two cars which Ferrari tends to field at all except the Italian GP (where he'll probably run at least three). At Monza last year, we saw the first appearance of the three-valve-per-cylinder engines, which did a good job. But Ferrari is also developing four-valve cylinder heads for his V-12s, and these are the most likely for 1967. The team is definitely contracted to Firestone this year, after a long Dunlop association; so if nothing else, Ferrari will no longer have to scurry from one rubber company to another every time a cloud shields the sun!

Finally we come to the current champions. Brabham will once again have Denny Hulme to back him up, and I fancy there will be less driving to team orders this year — in other words, there may not be a number one in the F1 team so far as race tactics are concerned. South Africa gave us an indication that the Brabham policy now is: 'The man out front does all he can to stay there.'

New cars are being built, but the changes will be minor — slightly slimmer body and a few structural improvements — and inevitably Jack and Ron Tauranac stuck to their space frame policy and presumably will continue to do so as long as they can find enough room for the fuel.

The big change this year, of course, is the Repco V-8 engine, which for the first time has a Repco-designed cylinder block instead of the GM block, and new two-valve-per-cylinder heads. Last year's engine started off with 300 bhp, and ended with something like 335 bhp, or maybe a little more. This season the aim is between 350 and 370 bhp — and in a car the size and weight (last year's car was only 550 kilograms) of the Repco-Brabham, it's going to take a lot to beat Brabham. For the record, the engines Jack and Denny used in South Africa, and which took them to the fastest places on the grid, were 1966 types — like those used in Mexico.

The new engine, by the time these words are read, will have been tried in 2½-liter form in Brabham's and Hulme's Tasman cars in New Zealand and Australia, and probably will not be seen in Formula 1 form until next May.

This year the World Championship contests for drivers and constructors take on a new look, aimed at maintaining interest in the championships right up to the end of the year.

The year's 11 qualifying races are divided into two parts (the first part six events and the other five). The usual points score of 9, 6, 4, 3, 2, and 1 for the first six places (subject to completing 90 percent of the race distance) is retained, but only the best five of the six performances are countable in the first part of the series, and the best four out of the other five performances. This means that after the British Grand Prix, everyone takes stock and calculates his 'part one' score; then all start afresh on 'part two', and eventually add their best four from that to their mid-season best-five total. This should give the 'late starters' a good chance to pick up points during the second half of the season. It should suit Ferrari! In the event that any one of the 11 qualifying races is cancelled, the half-way mark will be after round five, and, in this case, the best four performances would be taken from each part of the series.

Therefore, this year is going to be more open than ever. If I had to back a hunch, I would say the Repco-Brabham team has as good a chance as anyone, but don't be surprised if Lotus comes back into the picture with a real bang during the second part of the series!


"I'd better win that 'Sportsmanship Trophy' or someone's going to get a punch in the nose!"



## AERODYNAMICS

*Continued from page 67*

ber that when describing the turbulent flow in the boundary layer, I mentioned the very thin laminar sub-layer that exists underneath it, right up against the surface. It is this sub-layer that determines whether the surface is rough or smooth in the aerodynamical sense. If there are surface irregularities, such as rivet heads or dead flies, they will make the surface aerodynamically rough if they are big enough to protrude through this sub-layer into the turbulent layer above, where they will cause a serious increase in the total skin friction.

Since laminar sub-layer is very shallow, this means the surface, which is aerodynamically smooth at high speeds, must also be very smooth in the ordinary sense of the word. There is, however, no practical point in giving it what you might call an optical finish or polish, because no further worthwhile reduction will be obtained that way. This is why, when motor cycles were raced with fully streamlined fairings nine or ten years ago, the glossy white fairing of the BMW was no better from the drag point of view than the matt green one of the Moto Guzzi. The real reason for the difference lay in the fact that the Germans, with their traditional insistence on making a thorough and well-finished job of any piece of machinery, were temperamentally incapable of sending a nice Rennsport 'bike out in a scruffy old fairing. The Moto Guzzi designers, who were always rather an *ad hoc* lot, were more concerned with the fact that a fancy paint job represents a lot of unnecessary weight to carry around.

The turbulence caused by protrusions from the surface can sometimes be turned to good account. In certain circumstances, usually where the form of the body is dictated by practical considerations having nothing to do with streamlining, it is not possible for the air to continue to flow as a boundary layer and eddies inevitably form. It is true that eddies once formed will eventually die away because of the damping effect of fluid viscosity; parodying some lines by Dean Swift, a chap called Richardson put it this way:

*"Great whirls have little whirls*
*That feed on their velocity*
*And little whirls have lesser whirls*
*And so on to viscosity."*

All very nice and dependable, but it takes too long and wastes too much power. This is where little excrescences called vortex generators come into the picture. Upstream of the point where the transition from laminar to stalled flow takes place, you stick a few little objects on the surface so that they stand proud of it. These create trails of turbulence. Thus turbulence creates a powerful mixing effect, bringing in extra air from outside to reinforce the waning energy of the boundary air. The result is that, although you now have a turbulent boundary layer instead of laminar flow, the boundary layer extends much further along the surface before eventually it separates from the surface into the big eddies which create dreaded weight. As might be expected, there are heaps of examples of surface irregularities being used to control and modify air flow in this way. Many aircraft developed in the 1950s were fitted with vortex generators, usually somewhere about mid-section on the outer wing panels. Examples can be found nearer home: golf balls have dimples because they can be driven further than a smooth surfaced one — but the dimples have to be the right shape and size.

The idea of bringing in extra air from outside to reinforce the waning energy of the boundary layer is a clue to how to deal with the upsets in air flow invariably caused by the windshield, that somehow it seems difficult to avoid having sticking up from the surface of the car body. The only quirk about the recommended way of providing this air is that in this particular case you take the extra air not from outside but from inside. Any self-respecting car, even if it has its engine in the rear, has its radiator intake for cooling air at the extreme nose, where the air pressure is highest. In most cases, especially in front-engined cars, the air, having passed through the heat-exchanger matrix, is then left to find its own way out, all too commonly being left to thrash around the engine and under-hood space before finding its way to the outside world through whatever holes are available — usually underneath, where airflow is in a big enough mess already. In fact, this sort of inattention to detail can add 20 percent to the total aerodynamic drag of a car. It is far better for the flow to be ducted away from the radiator through a smooth channel and conducted to the outside of the body at a properly chosen spot. The ideal place for it to make its exit is at the base of the windshield, where external air pressure has usually dropped to between half and two-thirds of the maximum at the extreme nose. Bring out the waste cooling air at this point, in a transverse slot across the windscreen base, and it will do a very good job of re-energizing the air flow to encourage it to remain attached rather than breaking away to form eddies and induce unnecessary drag.

You see, aerodynamics is not all just high-flown theories. It is full of practical ideas that can be applied to the motor car to make it better at parting the air.

**To Be Concluded Next Month**

Next month in SCG

**DAYTONA**



## SHELBY MUSTANGS

*Continued from Page 35*

gauges. You can't read them without leaning hard to the right in the driver's seat.

The GT500, with its very efficient automatic transmission (at this writing it still hasn't been decided if this model will be offered with manual four-speed or not) doesn't perform much better than the GT350 in a straight line, but it does it with comparative ease and with a great reduction in noise level. Since the basic chassis in both models is a lot quieter, the solid lifters in the 350 are especially noticeable. This is further magnified at cruising speed because of the low (3.89) final drive ratio. The top speed of both models is nearly identical. The 500 got to 132 mph with a slow-reading speedo. Only the last ten mph came hard. The 350 worked fairly hard from the century mark up, but, even with ignition break-up on the top end, it still indicated 129 mph on a slightly fast speedo. With two Holleys, the 325-hp rating of the 500's power plant is probably conservative. There's nothing conservative about the amount of torque it puts out, however. It is a *very* docile engine and a very responsive one. The carburetion works well in both hard corners and hard stops – the severest tests. We didn't have a chance to check the hot-weather starting, but there certainly weren't any problems in a moderate ambient temperature. The 289 is, of course, in a higher state of tune with its hi-riser manifold and hot cam, so it idles rougher and noisier, but is otherwise quite easy to handle.

On the road, the 500 has a heavier 'feel' to it than the 350, but the only major difference is noticed when you come to dips in the road that really work the front springs and shocks. Then it wants to 'porpoise' a bit. The 350 is exceptional in this respect. It really flies over rough, dippy roads at high speed. Its comparatively better balance and an excellent choice of spring and shock rates are readily apparent. In corners, the 500 demands a considerably tighter 'hand on the reins', but it gets around surprisingly well, with less understeer than we expected. The 350 will go through the same corner appreciably faster, and is less demanding from a control standpoint.

The brakes on both models worked exceptionally well, but a softer-than-previous friction material made itself known by slight fade, squeak, and dive after continued hard use. Recovery was rapid and complete, however.

There is only two hundred dollars difference between the 350 and 500, so the major choice seems to be in the type of car you want. The 500 is a bit hotter in performance (with the automatic), considerably quieter, and more comfortable for normal use. It sacrifices overall handling and cornering power, however, and under-10-mpg fuel consumption is noteworthy in this department. Factory installed air-conditioning is also available this year, and would be far more logical with the big engine. The 350, on the other hand, is really a highly roadable GT, and a long way from uncomfortable or unmanageable in traffic. Our congratulations, to the guys who built it, were shrugged off with, "Wait until you see what we have on the market in a couple of years if you think *this* one is more sophisticated!" Meanwhile, the present model will more than do. It only takes a ride around the block to see what we mean.

## CAMARO Z-28

*Continued from Page 50*

builds up – an ideal arrangement derived from stock-car racing.

Chevy has two close-ratio gearboxes, and the wrong one, at least for road racing, was installed in our test car. It had a barn-door drop between third and fourth gears. A couple of quick runs through the quarter-mile produced a reading of 15.5 seconds; pretty close to GT350 time. This with a spring-wrap-up we didn't take the time to get used to, so it could be improved some. Cornering power and attitude was *very* impressive and, even without racing tires and adequate roll-stiffness, gave plain indication that the Camaro is going to be completely competitive from a road-ability standpoint. Its understeer is mild, braking stability is excellent (though the stock linings quickly gave up the ghost), and out-of-the-corner power can be applied early; all prime attributes in sedan racing.

Now that they've got it, what are they going to do with it? One thing, of course, is sell it. Even with the performance options, it's a comfortable and pleasurable street machine with a very readable price tag. The value is there, making it a marketable car.

Camaros will be running the Trans-Am Sedan Championship series, too. Currently making noises about fielding teams are several performance outfits. Nickey Chevrolet and Bill Thomas have combined on one effort, Don Yenko and Dana Chevrolet on another, with a couple of the Southeastern stock-car shops like Smokey Yunick's planning entries for at least Daytona and Sebring. So there's little doubt the Camaro will have adequate representation on the race tracks. Is Chevrolet back in racing? No. Will it be? Probably not in the immediate future. Where the Z-28 *is* significant is in a breakthrough of the stubborn policy to hold back options and hardware that would enable customers to be more competitive. As far as an assistance program (money-for-results, as offered by other manufacturers) is concerned, there currently isn't any. So it looks like Camaro competitors may have to depend on prize money for support. Yet the vehicle itself will give them a fair shot at it and that, after all, is the name of the game!



## PSYCHO

*Continued from Page 39*

these guys don't particularly like the pre-race socializing, the lots of people and the parties. They are more inclined to be by themselves."

Now that Keith Johnsgard has peeled the racing driver as though he were a Bermuda onion, what is to become of both Johnsgard and his subject?

Johnsgard is more and more fascinated as results come in. "I've had hopes from the beginning. The night I came home from my first race and talked to Ogilvie, I was kind of bounding around and saying, 'Well, I want to take a year off and really go into this thing.' If I ever get some money – and this is the kind of thing Ford Motor Company could profit from – I want to go on the GP circuit and do intensive interviews, interviews in depth with each one of these guys. This could have very wide application."

But what of the driver? Johnsgard, like every scientist, is hipped on research for the sake of research. But he admits to two practical applications. Ogilvie, working with professional football and basketball teams, has found that feedback to the players has been of considerable value to them and to their

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coaches. Johnsgard thinks the same thing could be an enormous help to individual drivers.

Then there is the original object of the whole exercise: to provide a screening device for driver schools and licensing organizations. If even one pathological driver is prevented from going on the course and causing an accident, Johnsgard's research and the time and trouble of the drivers who have taken the tests will be amply rewarded.

Does Johnsgard envision the day when a GP driver will arrive at the circuit with a van, a crew, three near-naked pit popsies, and a clinical psychologist?

"I don't know that it'll ever be that way. You know, 'Brave New Worldish.' I don't envision psychologists taking over and running the world."

But if there is anything wrong with the whole approach, it is in that area. After all, race car driving is a last frontier – a final refuge for the individualist. It is sad to see it reduced to liverish scrawls on an IBM card. It is difficult not to believe that in all this, someone has left out things like courage, and a brave and skillful man's response to speed and danger.

For the sake of the sport, one can only hope the day is far off when a Jimmy Clark is sent back to his herds of sheep because he failed his ink-blot test.



*Next Month in* **SCG:**

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## WESLAKE

*Continued from page 56*

that any blowing of the gas seal rings will only result in atmospheric leak and not to heat up cooling water, thus resulting in engine failure, as had happened so many times in the past.

With regard to the cylinder heads, I felt that as the timing chest was to be a separate item, and that the extra auxiliaries would have to be mounted on the rear, there was little point in right- and left-'handing' the heads. Not only would it be cheaper as regards pattern equipment costs, but also as spares it would not be necessary to carry two sets of rather bulky items. This is further accentuated when one looks at the firing order for the engine; both pairs of inlet camshafts and exhaust camshafts are identical in radial spacing.

The close-angle, four-valve layout employed lent itself very well to the design requirement for compactness. As on the V-8 B.R.M. design, I decided to use the small diameter tappet over the valve and spring, as opposed to the fully enclosing type generally used. Not only did this reduce valve gear inertia, but it enabled me to get the valves fairly close together without being dictated by tappet bulk. This light weight and the small valve lift necessary made the double coil valve springs simple to design and of a smaller mass. Again, since 48 of these are used, a very important feature! Another reason for keeping spring loads at an absolute minimum was the necessity for keeping camshaft torque requirements low, so as to reduce the widths and size of timing gears to sensible though light proportions.

To keep oil requirements for the valve gear down to a minimum, I also decided to use roller bearings on the camshafts and rely on the oil thrown off the cams to lubricate these. Oil can be a two-edged sword, too much resulting in larger pumping and windage losses, as well as creating drainage problems.

The spark plug position dictated by the four-valve configuration could not be bettered. Certainly a centrally-mounted plug reduces flame travel to its absolute minimum, when bearing in mind the lack of natural turbulence, which on a single inlet port is dictated by port inclination, and in the case of four valve configurations it is not possible.

As I previously stated, the camshaft torque requirements were fairly light and, as a consequence, it was possible to really thin down the timing train. Even so, the mere fact of having a gear shaft rotating and carrying only a single gear was galling to me, and I made every attempt to make the gear do a dual job. In the case of the twin-ignition distributors, the standard Lucas item carried two ball-type bearings, a large shaft, and retaining nut, simply to turn a rotor arm inside the cap, and was something like seven inches long. By attaching the rotor to a timing-gear shaft and clipping the cap directly to the timing casing, a saving of about 3½ inches in length and about two pounds in weight was effected.

Since a larger step-down gear, taking total combined camshaft torque, was necessary in the train, this was chosen to drive the alternator. Again the standard item was both bulky and heavy. I therefore dispensed with all but the encapsulated stator and rotor and utilized one of the timing gear shaft bearings to support one end of the rotor and designed a light alloy bearing carrier for the other end. Drive for the rotor is taken through a small spring shaft located at the far end of the timing gear shaft and attached to the front of the rotor shaft. This light spring drive absorbs the energy when engine revs are almost instantaneously reduced.

A thin twin-volume centrifugal water pump was designed to be inserted from the front cover at the bottom of the timing case and is driven off a step-down gear on the nose of the crankshaft. A delivery of some 115 gallons per minute was calculated from the results obtained from the twin-cylinder program. Water is transferred to both sides of the block, into galleries which feed through metering holes to both cylinder liner recesses and cylinder heads, directly under the exhaust port. As on the rig tests, great attention has been paid to positions of water feeds, and sufficient development 'elbow room' has been catered for.

By the side of the water pump, and driven off its shaft via a very light gear drive, has been placed the pressure oil pump; this is a simple twin-gear pump with built-in transfer passages which, as in the case of the water pump, are accessible from the front of the timing case. Again, as dictated by rig tests, a delivery of some 19½ gallons per minute at 85 psi is obtained. This pump feeds directly, via a metering block and relief valve, to the twin oil filters which, for servicing reasons, are placed off the engine and in a more accessible position in the car. Apart from the rev counter drive, which is taken off the right-hand bank exhaust camshaft, this is the sum total of the frontal mounted auxiliaries.

The scavenge pump, which in the case of dry sump racing engines has exceptional surge conditions to contend with when the car is either accelerating, braking, or cornering, is expected to breathe the crankcase at the same time. On all present engines, including ours, the pump is mounted in the base of the crankcase, a drive being taken off the water pump shaft. The pump consists of three spur gears—the central one being driven. Each side of this pump is a separate unit in itself, one side coping with the front of the sump and the other, via a pipe and cowl, with the rear. The combined air/oil output is transferred via the mounting flange through the side of the crankcase. The sump carries nothing but oil, and can therefore be of magnesium, and light in construction.

At the rear of the cylinder heads I arranged for each to have a light cover,

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## WESLAKE

*Continued from Page 77*

which also contained the oilways transferring oil from the main block gallery to the valve gear drillings, which run the whole length of the cylinder heads on both sides. These covers also have mountings for the ignition trigger mechanism and magnetized triggers. The trigger disc is driven directly off the right-hand exhaust camshaft. On the right-hand inlet camshaft end is a toothed-belt pulley for driving the injection system metering unit. On the left-hand bank only one end of a camshaft is used, this, the exhaust one, drives the mechanical pressurizing fuel pump. To blend into the general engine proportions I took a standard Lucas element and fitted in a body of our own design. This pump can deliver, at maximum revs, 42 gallons per hour at 140 psi and should be more than adequate for our particular requirements. For starting, a smaller electric pump is mounted off the engine and is only necessary for priming the mechanical pump. After this it can be switched off to save current consumption.

The induction system almost fills the center of the Vee. Siamese-ing elbows were designed to bolt directly to the cylinder head port faces. On top of these small individual castings we bolted a slide throttle plate carrier which contains three rows of rollers on which slides the throttle plate. A further casting covers this plate, and the intake trumpets are individually mounted on this. The injectors were designed to use the needle and spring off the Lucas units and are so shaped as to have minimal effect on airflow. It was a fairly straightforward job to visualize the ease in mounting the metering unit and controlling fuel supply from the end of the throttle plate via the operating mechanism.

The water outlets were designed to occupy the only available space in the Vee of the engine and fit snugly under the induction system, to peer out at the front of the engine.

As can be seen from photographs accompanying this article, my attempt to keep the engine as compact as possible has to some extent been successful, as has the intention to keep external pipework to a bare minimum. Naturally, as any designer will admit, if he is honest, there are certain features about which – if it were possible to start again from scratch – he would modify or use a completely different approach.

As the final building of the prototype engine approached completion, we had to think seriously about the testing facilities. Previous ideas on using existing test cells had to be abandoned due to the noise level problem – after all, Weslake had many other projects in hand. The mere thought of employees stopping work and running for cover at the first sound of the V-12 firing up was too horrible to contemplate. We therefore agreed to utilize an existing separate building and convert this to a purely racing engine test cell.

Our dynamometers consisted of two Schenck units coupled together. This gave us the potential of over 800 bhp at speeds up to 10,500 rpm – certainly more than enough for our needs. Water and oil cooling are taken through twin heat exchangers; both these and the dynamometers have electronic remote controls which enable the engine to be operated from a glass-fronted booth. During tests, stub exhaust systems have to be used, as on the actual car, and fumes are therefore a very serious hazard. At B.R.M. I recollect one technician being seriously affected by carbon monoxide poisoning under these same conditions. To alleviate this problem we acquired a large diameter extractor fan and mounted this in the wall of the test house, directly in the path of the exhaust emission. Subsequent tests have proven this system beyond our wildest hopes.

To start and 'run in' the engines we employ a small diesel engine, driving through a 'step-up' gearbox and dog clutch. In this way we are able to check oil flows and pressures before firing up. Oil and water leaks can also be cured on a cold engine. Anyone who has handled a 'hot' engine will vouch for the many uncomfortable situations experienced under those conditions.

When 'the day' finally came, frankly I must admit I was rather apprehensive about the whole thing. At Bourne, the B.R.M. technicians more or less took over the engines and we, the designers, got the results, the recommendations, and very little of the troubles. Their experience was also very great compared with the non-existent racing knowledge of Rye. However, as it turned out, our men rose to the occasion and took to the job like proverbial ducks to water.

The first run was made with manual controls on the fuel injection system, a 'calculated guess' exhaust system, and timings based on our twin-cylinder tests. Power figures were indeed illuminating. At the end of the first week we were producing 350 bhp and more. We were now sufficiently confident to want to see just what the engine could do in a car. The Italian Grand Prix at Monza was only one week away, so it was decided to take the car and engine to do a two-fold job: (1) to show the flag and (2) to see what problems would be raised under actual installation and race conditions.

As it happened, we did have one or two problems, both here in the States and in Mexico, but these were slight and will be overcome. I am convinced that by the time the 1967 season gets under way much more will be heard of the 'Gurney-Weslake' V-12 and Eagle car. Indeed, there is much more development potential in this engine, and power outputs of 450 bhp are most certainly feasible. As to reliability – over 25 hours of high-speed power running have been logged to date, with very few minor failures, which all augurs well for the future!



## YOUR HOT ENGINE

*Continued from Page 42*

two-fold. By lightening, the inertia loads are reduced, allowing higher engine rpm without valve float. By improving the shape, gas flow around the head of the valve can be increased.

About this time it's a good idea to measure the amount of wear in the valve guides. If there's any at all, they should be replaced. Most guides are pressed in, but in some engines they are integral with the head. In the case of the latter, you'll have to order valves with oversize stems, and the guide bores will have to be reamed to size.

The next step is to face the valves and grind the seats in the head. Here again this is a job best left to the pro. There's more to it than meets the eye. Besides, you're not apt to have the necessary equipment. This is one area where we can legally 'cheat' a little. By moving the seats on the valve face out almost to the edge, and by narrowing them, a larger effective opening can be had. Every little bit helps. Some are set up to provide radiused intake seats. Instead of a flat 30 or 45 degrees seat and valve, they are actually ground on a radius, with only a hairline contact between them. The result is not only a better shape for flow but also a larger flow area for the same sized valve head. Most pros will use a dial indicator to check seat concentricity, and finish off the job by hand-lapping valve to seat.

Next, the cubic-centimeter volume of each combustion chamber has to be determined – otherwise true compression ratio can't be determined. This is known as "cc-ing" and takes special equipment. The head is secured, usually in a holding jig, with the combustion chambers up and the gasket surface perfectly level. A flat, clear, Plexiglass plate with a small hole in it is clamped over the chamber. Fluid (usually water) is introduced into the chamber through the hole in the plate from a graduated burette tube. If the volume of the individual chambers varies, it may be necessary to grind the smaller ones to get them to match the largest.


Once the chamber volumes are known and matched, final compression ratio can be found by adding together the volume of the cylinder, the volume formed by the head gasket, and the volume of the combustion chamber, then dividing the total by the volume of the chamber. If the piston top is other than flat, it will be necessary to assemble block assembly to head assembly and, with piston at top dead center, 'cc' the actual combustion area.

If the resulting final combustion ratio is less than desired, the combustion chamber volume can be reduced (up to a point) by milling the head or block deck surfaces.

After the combustion chambers are finished, the head is ready for reassembly. Needless to say it should be washed thoroughly and wire brushed with the same care lavished on the block in part two of this series.

Valve springs should be those recommended or supplied by the camshaft manufacturer. Even though they are new, they must be checked several ways before final assembly. First, their pressure must be tested (on a spring tester) at both assembled (closed) length and at open length. Pressures should fall within the manufacturer's tolerances. If an inner and outer spring are used, they should be checked together and switched around until the best combination is found, i.e., some will have less, some more than recommended pressure; find the combo that comes closest.

Next, place the individual valves in the head and install the keepers, but not the springs, on each. The distance from the spring seat in the head to the bottom of the spring keeper is measured. If it is greater than the installed length of the spring (check the manufacturer's specs), shims will have to be used to make up the difference. This distance is never less than it should be, but if it were, the spring seat in the head would have to cut deeper.

Also check the spring length at which the coils begin to bind and make sure this length isn't less than the lift of the valve. If it is, you've got the wrong springs. If everything checks out, the head is ready to go together. *This* you could do yourself if you had a valve spring compressor but, with the bill you already owe for the rest of the head work, you might as well let the pro do it.

Next month we'll get back on the do-it-yourself track as we describe camgrind choice, installation, and the degreeing in of same. In the meantime, bolt the finished heads on the block assembly, referring to the factory manual for proper torque values and tightening sequence.

Next month in SCG
**CAMSHAFTS**

## COUNTERS

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The second switch is used for adding counts or impulses to either the left or right counter. Being directly wired into the car's voltage, through the 'power' pin of the connector, the switch will give a shot of voltage to the counter to which it is directed. This is used to add hundredths if the exact location of a speed change is missed, for example. Hundredths can be subtracted simply by flipping to the other counter for the desired number of hundredths, then back to the 'running' one.

One word of caution: Make sure all connections are secure and that they do not touch one another. This can damage the micro switch in short order. Otherwise, these micro switches have a rated life of over 100,000 miles.

While it may appear that the money saved doesn't justify the added effort, it should be remembered that this type installation gives you much more flexibility in location and convenience of operation. There are many variations in the manner of selecting the counter desired, even to the point of running both at the same time. You know – "why be half safe?"

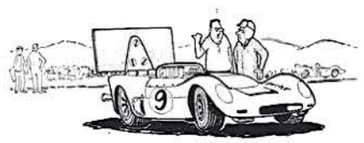
Once you've made the big move to navigational rallying, you won't regret it. If your wife presents you with a Curta and a Sears' Payment Book for Christmas, don't fight it! Take the hint. Build (or buy) a set of counters and, who knows, you may just zero your first rally leg and *know* it before you see the true times!

## DAF VARIOMATIC

*Continued from Page 69*

Variomatic for a price directly competitive with a four-speed Hewland F3 box, which suggests something like $400. This won't cover cost of development, but as racing manager Rob Koch says, "We reckon we've got something to offer motor racing. And when private customers start winning races with it, we'll get our rub-off through increased sales of passenger cars."

So, come on, General Motors, let's have a few of those Chaparral-type torque converters at 400 dollars a throw . . . you'll get your money back on Camaros!



**"It's not a neat installation, but it's safe!"**



## The RALLY SCENE

By Jean Calvin

### Keep the News Coming!

We have had a wonderful response from clubs all over the country, who send us news of their events and their club publications. Travel time and space limitations keep us from covering all the events that catch our fancy, but in the coming season we will attempt to cover an even wider variety of rallies in different areas. So, do keep us posted on your activities, perferably well in advance of the event, as our planning runs at least three months in advance of publication. Send your news to Rally Editor, Sports Car Graphic, 5959 Hollywood Blvd., California 90028.

### GM Rally Car?

A hot-rodded version of the one-liter Opel, christened the Rallye Kadett, is now available in the U.S. The car is based on the standard Kadett Sports Coupe, and mechanical improvements include wide-rim wheels, radial tires, a power assist for the disc/drum brakes, twin downdraft Solex carburetors, and a free-flow exhaust system, plus some engine modifications that bring horsepower up to 68 SAE at 5600 rpm. Inside are good bucket seats and a panel of instruments that has a tachometer, oil pressure gauge, ammeter, and clock as well as the usual items. The model we drove was painted German racing silver with black waist stripes, and the engine hood was also black. Two driving lights of considerable power have been fitted for use as high beams. The hop-up work gives the Opel more urge through the gears, but the top end did not show a great deal of improvement over standard. Different rear-end ratios would help here. The coupe has light-to-the-touch steering, and good directional stability on the fancy European-made Goodyear tires. Opel is rumored to have the homologation papers in process, and this car could be a comer in the small car class of the rally world.

### Hillclimbing in Pennsylvania

The Pennsylvania Hillclimb Association is a unique group of fifteen member clubs, operating in eastern Pennsylvania since 1958. Sports Car Club of America's Competition Rules and Car Codes form the basis of its regulations, with classes modified to fit the hillclimb needs. The sedan classes, in particular, are designated by performance rather than displacement, and it makes for a variety of competitive makes in each of the four groups.

The Association issues its own competition license, for hillclimbing only, and has the singular honor of having its license accepted by SCCA at that organization's hillclimbs in the area.

During 1966, events were staged on nine different hills ranging from 0.7 miles to 2.6 miles, and all were on paved, public roads. Cooperation of local civic groups helps to get the roads closed for the two-day competitions. Quite often, with the help of local sponsorship, spectator attendance will reach into the thousands and the entires average 125 cars.

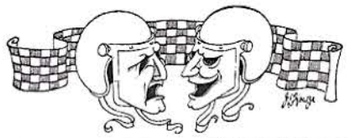
New this year was the posting of prize money at the season's finale at Hershey. A cash award for Fastest Time of Day and prize money donated by dealers for class wins saw this event draw a nearly unmanageable entry, with close competition all the way down the line. The PHA has plans for a similar schedule in 1967, with perhaps more of the prize money bit, and always generous trophies for the twenty-three classes. For more information about this interesting segment of the sport write to Pennsylvania Hillclimb Association, Public Relations, Judy Beattie, 19 Mary Bell Road, Norristown, Pennsylvania.

### Rally for $$$$$$

The National Road Rally Association informs us that the date for the 1967 "Road Rally U.S.A." is set for May 20-21. The rally will start and finish in Riverside, California, beginning in mid-afternoon and running for about fifteen hours on a 600-mile course. It will be a European style event, with half the course consisting of minor and unimproved roads, and plans for a special stage on private property are presently in the works. Approximately $1200 in cash awards will be split among private and sponsored entries, with cash going also to three separate displacement classes and team entries.

The inaugural event last May met with great enthusiasm from the competitors, as the sign and route hunting gimmickry common to southern California rallying was eliminated by the instructions patterned after the Shell 4000 and RAC rally books. These route books are kept secret until the start of the rally, so even the locals have no opportunity to practice before the event. This rally is for the enthusiast; however, a high-horsepower car is not a necessity, as last year's winners were Mustang GT, Karman-Ghia Volks, MG 1100, Renault R8, and Mustang GT 350 in that order. For further information write to National Road Rally Association, Dept. G, P.O. Box 35, La Mirada, California 90638.

## ADVERTISING INDEX



# SLIGHTLY MODIFIED

BY W. R. C. SHEDENHELM

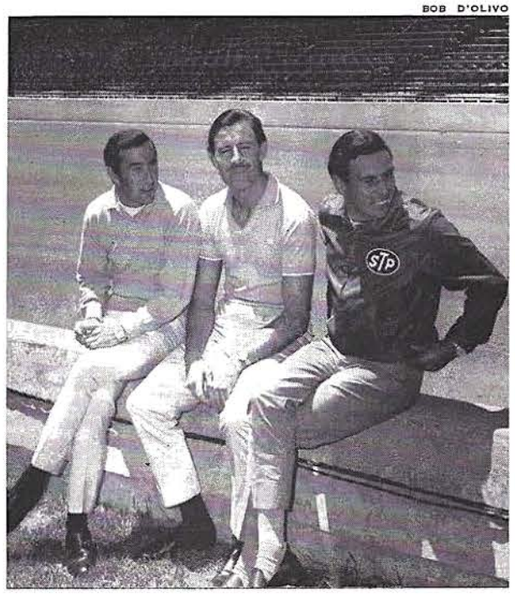
RICHARD GEORGE

PARNELLI JONES AT RIVERSIDE:
**"Oh, for crying-out-loud! I just asked for a simple opinion of my driving and I get a whole production number!"**

FRED ENKE

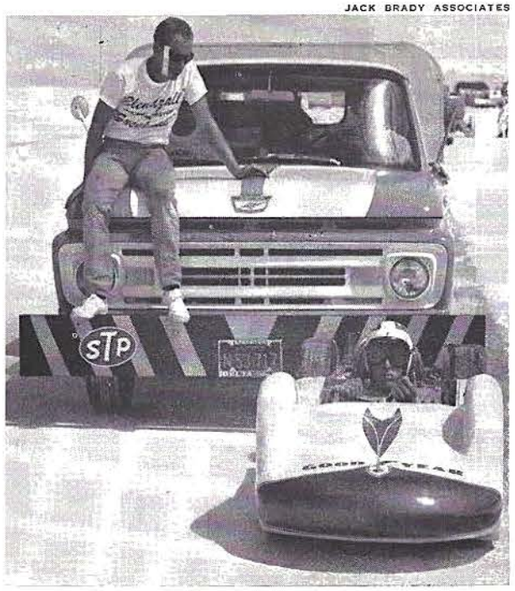
SCG's TITUS AT THE RIVERSIDE TRANS-AM:
**"You mean he's still out there, trying to catch me!"**

BOB D'OLIVO



STEWART TO HILL AND CLARK:
**"That Mr. Agajanian seems a nice enough chap, but I think we'd better check to see if the race is really May 31st this year"**

JACK BRADY ASSOCIATES



THE SCENE IS BONNEVILLE:
**"Oh, good grief! Here I am setting a Land Speed Record and they think I've stalled my engine!"**