TEE-ONE TOPICS

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BOUNCING ALONG IN A SPIRIT

Despite the fact that we often refer to the Spirit as the Shadow III, there are some important differences from its predecessor. The obvious feature is the rear suspension. Whereas the Shadow relies on conventional springs to hold the back of the car up and hoists itself off these springs with hydraulic rams when the car was loaded, the Spirit relies on gas springs and hydraulic struts to keep itself off the ground.

Your Spirit rides on the contents of this sphere – a system developed and well tried by Citroën to this day. They come in a very nice box all with the current Bentley Spares logo but the latest actually have the Citroën logo (arrowed) stamped on them. And no you can't dash down to the local Citroën agent since spheres are actually tuned by gas pressure for particular models!

The Spirit's springs are, by comparison with those under the Shadow, quite small and if all other support is removed the rear of the car will sink quite markedly. The supports of course are the hydraulic struts installed adjacent to each rear wheel. The struts which look very similar to conventional tubular shock absorbers actually perform two tasks. Primarily they are dampers, limiting the antics of the wheels as they belt over bumps and ruts. Secondly they maintain the car at a datum level. This is achieved by pumping oil from the hydraulic reservoirs into the dampers which has the effect of lifting the car with the reverse action taking place when the car is unloaded. The damper then represents a solid column of oil between the axles and the body. To provide absorption of bumps the top of the damper has a sphere screwed into it which is very similar to the spheres or accumulators used for the entire hydraulic system. These spheres are known as gas springs. They have the usual diaphragm across their middle and are pressurised on the non-oil side with about 800 psi of nitrogen.

When the rear wheel of a spirit is pushed up travelling over a bump, the solid column of oil is forced out of the top of the strut and into the gas spring compressing the nitrogen through the diaphragm. The nitrogen in turn pushes the oil back into the strut as it returns to its lower position. Effectively therefore the rear of the car rides on a cushion of gas. Unfortunately all good things come to an end and the gas dissipates over the years just as it does in the main accumulators. As a result the car sinks lower and the system sensing the fall, pumps more fluid into the struts until eventually the rear of the car is riding on a solid column of fluid and the ride is only slightly better than a billy-cart.

Spirit owners are often not aware of this failing which is not unreasonable (a gas spring probably lasts 10 years) and usually let the tyres down to compensate for the harshness of ride. If not corrected it is highly likely serious damage will be done to some suspension components. In addition a rigid rear end makes for a fairly unstable vehicle when put under heavy load. A

simple test for the condition is to lay into the back of the car and bounce it up and down. If the gas springs are depleted the back will hardly bounce.

Sitting on its haunches having had its struts exhausted. Token springs that are holding this car up are there to avoid the Citroën malady of the car collapsing when the suspension fails.

The cure is simple and well within the abilities of an owner with reasonable mechanical aptitude. The procedure is;

- Exhaust the two hydraulic systems – simply pumping the brake pedal a zillion times will achieve this.
- Attach plastic hoses to the rear strut bleed nipples which are mounted on the inside of the body beneath the rear doors.
- Open the nipples and the car will drop about 5 inches as the struts exhaust their oil contents.
- Open the boot. Disconnect the battery and remove the carpet board at the back of the boot which will involve unscrewing the ferrule around the battery cut-out switch. You will now be able to see the two gas springs high up in the boot adjacent to the fuel tank. Remove the battery cut-out switch mount and swing the switch out of the way.
- Put some cloth under the gas spring to soak up the bit of oil that will leak out when it is unscrewed.
- To unscrew the unit you will need a strap spanner – an oil filter remover will usually do the job. If oil starts to squirt out of the threads – you have not exhausted the accumulators but that would be unlikely wouldn't it?
- Using a new rubber seal, screw in the new gas springs and tighten them firmly.
- Reassemble the switch mount and the boot fittings.
- The next task is to bleed the struts and gas springs. Put some weight in the boot to activate the levelling valves, make sure the two hydraulic mineral oil reservoirs are full and that you have plenty of bottles say 6, of fresh oil.

And here is what you will find having got the back of the boot uncovered. This is the right hand side showing the sphere and in front of it the battery switch which clearly needs to be moved to one side. The Factory recommends that the mounting block for the sphere (seen behind the coiled pipe) be removed to unscrew the sphere. . This is unecessary as there is sufficient room to get the thing out without trauma. The left hand side is very accessable

- Open both bleed nipples for the struts (you probably haven't closed them from when you exhausted the units) and start the engine.
- Let the oil flow into containers until it is clear and free of bubbles. Keep an eye on the reservoirs making sure they don't empty otherwise you will be bleeding the whole car!
- When the oil runs clear close the bleed nipples and the car will rise to its correct height.
- Enjoy your new ride and pump the tyres up again!

And here is the mounting block on top of the right hand strut showing the threaded entrance for the gas spring

Fully erect and ready to go. The height of the rear end is no indication of the condition of the gas springs since the self levelling will compensate for any drop in body height.

SHOCK, HORROR

Neil Garvey our rabid treasurer recently negotiated a bank account with a local financial institution and was startled to see the bank official recoil when he advised that the account was for the Tee One Group. Seems the Tewun something is on a list of highly undesirable organisations which Mr Bush has been pursuing of late. This will explain why we have followed the bank officials advice and popped a hyphen into the name!

MINDER, MENTOR, MATE.

As we venture into the deeper end of the pond (international now, don't you know) this may be a good time to reflect on some of our not so distant history.

Others will recount the beginnings of the group so I shall focus on what caused some of us to "break away" from the original "self help" entity within the ACT branch of the RROC Inc. Australia. In truth, when we left, there was no functional "self help" entity to speak of in the Branch as most of the doers came away with us.

Over the years, local demand for a maintenance facility for our marque dwindled until finally a few years ago the last service franchise for Rolls-Royce and Bentley cars gave up. That left us with only limited options and they were:

- to drive our cars and hope that nothing went wrong,
- to find a mechanic who would service them for us ("have a look at it for you, mate"),
- to quietly leave the car in the garage if it started to exhibit any malfunctions,
- to drive them to the nearest RR servicing facility (Sydney for us, if indeed the car would travel that far, incurring all of the additional expenses along the way.),
- to sell the car and be rid of the expensive "lemon"

OR

as in we in the TEE-ONE group have chosen to do,

- to break out the manuals, roll up the sleeves and "do it ourselves".

The sharing of information and methods went hand in glove with the "many hands make light work" principle. Bill recording our jobs in the now widely appreciated *Tee-One Topics* and Wayne Wardman documenting many of the tasks on video have gone a long way to ratifying our existence.

There was a concerted effort by a rather introspective group to neutralise the rambunctious element who seemed to be getting an unseemly amount of pleasure in using and fixing their cars, by raising the tired old spectre of "litigation if something goes wrong". Although some of us argued that many, no, ***most*** of the car clubs in Australia (and indeed the world at large) operated on the very principles of helping each other without fear of having the pants sued off them, the inward lookers were determined to carry the day. We got the message and as they did not seem to want our input we 'output' ourselves and have gone from strength to strength.

There will be a number of versions of the above, and really, it doesn't matter whose story one believes, because all one needs to do is turn up at a Tee-One working bee to get the true message. One will see us all squirming with delight as we cover ourselves in grease and Frederick Henry Royce's product in glory and realise that ***it's about the cars, not personalities!!!!!*** If Fred was to magically return, I think that he'd join in, don't you?

Now that I have you either nodding in agreement or gnashing your teeth in outrage, let me get to the main thrust of this article, and that is a profile of our patron,

Robert Skillen Esquire.

Big cap, big car, big happy!

Bob was bitten by the automobile bug long ago. He is not young anymore. In fact, he was born before the New Phantom was, so that makes him pretty "experienced".

There you go Bob, tactful enough for you? Bob introduced his young family to the joys of car collecting by bringing home a wonderful old Packard he'd just purchased. His gracious lady Dawn told me you could have heard a pin drop at home..... for about three days!!!! Anyway, they got over the shock and got about the business of enjoying the car and building memories. When Bob sold it for substantially more than he paid for it, he set a precedent which was followed for every substantial car they owned (and there were lots of them). See the list below.

1934 Packard sedan (purchased 1970)
1939 Packard convertible (purchased 1973)
1951 Delahaye (purchased 1975) What a stunning vehicle that was!!!!!
1934 Phantom II (purchased 1980)
1927 Packard sedan (purchased 1984)
1948 Bentley MkVI body by James Young (purchased 1985) This car was bought and exported to Holland in the mid '90's.
1957 Silver Cloud (purchased 1996). The previous owner traded this beautiful car in on a Toyota 4 wheel drive. Life can be stranger than fiction sometimes.

Bob and Dawn were keen members of the Victorian branch of the RROC and saw many changes in their time. Bob took up the challenge and did a stint as club secretary, so by the time he arrived here in Canberra he was well credentialed. The first member of the RROC ACT Branch the Skillens saw was David Miller who demanded to see the 1948 James Young bodied two door Bentley (one of four made). For those who did not meet David, he was a larger than life, booming and hearty bloke who was likely to sweep you along with his enthusiasm.

Shortly after meeting David, Dawn and Bob became members of the RROC (ACT). They enjoyed the halcyon days of rallies and picnics where they were always on hand to lend one. They were stalwarts when the hard yakka was on and they even opened up their own home to sort out and store the many hundreds of gift bags required for at least two Canberra based federal rallies. A huge effort for a group, let alone a couple. the promised help never materialising. They have too much class to bring that up; I haven't!

Bob became Branch President and tells me he enjoyed it immensely. I met him some time after his tenure and as the Branch was in good shape, I can only surmise that he did the excellent job

others tell me he did. My first meeting with Dawn and Bob was at a Branch outing at Yarralumla Park. A beautifully restored grey 1948 two door Bentley wheeled gracefully into the car park with a white Tam O'Shanter capped Bob at the wheel. I've got the cap now Bob, Dawn gave it to me and you can't have it back! I wasted no time striking up a conversation with him as I recognised the awful "inverted bath tub" shape of his car. My own father had owned the 1949 "Wentworth" a unique Park Ward Silver Wraith which looks very similar. There were other similarities too. Both cars had been "display stand" cars at the Earl's Court Motor Show. Oddly enough, I now own a James Young bodied Mk VI two door Bentley which was also a "stand" car at the Earl's Court Motor Show in 1950. Fate moves in mysterious ways.

Glamourous old girl ain't she!

Bob went on to own a beautiful 1957 Silver Cloud (SED 51) which graced the cover of our Federal magazine, a copy of which John Blatchley has personally signed for him. Mr. Blatchley was the designer of that model among others and in a personal note to Bob remarked that it was that model which upon reflection, gave him the most pleasure. What a lovely endorsement of Bob's beautiful car. I have fond memories of SED 51. Bob and I spent many enjoyable hours 'bumping our gums' about everything and nothing as we endeavoured to rid it of over 40 years of grime. The car served them well and although it once failed to proceed on the way to Swan Hill in Victoria, it was merely a faulty fuel pump which decided to fail miles from nowhere.

When the time came for Bob to bow out of the limelight, Dawn took a turn and became Senior Vice President. The efficiency displayed when Dawn chaired the meetings exposed her undisclosed expertise in club management. She had held the post of President of the Yowani Golf Club and was well prepared for our little branch meetings.

A couple of years ago, Dawn and Bob decided that they could not contribute to the Branch anymore so they tendered their resignation. That action was typical of their modus operandi. They do things while they can and then when they feel they can no longer 'do their share' they firmly close that chapter in their book of life. They didn't reckon on my determination to take advantage of every bit of wisdom Bob has gathered over the years though. The body might not be as firm as it was Bob, but the mind is still able. With that in mind, I asked the then infant Tee One group whether we wanted and warranted a Patron. They said "yes" on both accounts and it was my honour and pleasure to offer Robert Skillen the post. He accepted. and I for one am very glad he did.

The years have slowly caught up with Bob and he gradually put away those "toys" which gave Dawn and him so much pleasure. He is less mobile these days and spends most of his time

reading. He "devours" the Tee One Topics (Dawn's words) and continues to have firm views on many subjects pertaining to our group. He was delighted to see how the TEE ONE group developed and has given me many insightful pointers in the course of our conversations.

I'll end this with something Bob told me in one of our many conversations. "Never rust out George, do things while you can so that you will have no regrets when you can't." Now who in their right mind would argue with that?

See you at the next meet.

George

A MENTAL MEANDER

A friend lent me an old publicity blurb which was in pretty poor shape but there was enough of it to appreciate the contribution Citroën has made to the suspension of the cars of the world and more specifically to the bulk of the Rolls-Royces we ride in today. The following is a distillation of the document flavoured with a few of my thoughts!

A COURAGOUS LEAP

The technological leap of the Factory with the introduction of a hydro elastic system of suspension and brakes has to be admired. Historians one day might give an account of the brawls that must have ensued at Board level to sanction such a venture. Noting that the new Phantom has air suspension I thought we should give some publicity to the creators of the hydro elastic system, Citroën. Rolls-Royce used a number of their patents under licence to get the first Shadow on the road and despite some public disasters with the car, used improved versions until the demise of the British car. Air suspension on the Phantom is roughly on the same principle but I suspect they have gone conventional on their braking system.

This may not be such a bad thing as I have often wondered how the Factory managed to convince the world's "RTA's " to accept a braking system that whilst charged up and working was without peer but when left to deplete was utterly useless. The very early cars used a Morris Minor master cylinder in the rat trap to provide 'feel' to the brake pedal and powered a set of pistons in the rear calipers. These were touted by the spin merchants as being a third level of braking. I actually experienced this in a very early 'T type' Bentley many years ago which had lost its hydraulics in both 1 and 2 systems. The efficacy of the 'third system' was equivalent to putting one's foot out the door! Anyway such criticisms are odious. The Factory used the system and we have to keep it functioning.

Citroën were the first to use hydraulic brakes and later disc brakes! Iraq notwithstanding you have to give credit etc. Anyway let's talk about suspension. From a safety point of view, the suspension of a car is fundamental. Suspensions date back to long before the Roman chariots but it was not until the evolution of springs and dampers that speed in ground transport could be considered.

About the eighth century the then popular ox-cart was somewhat improved by the introduction of a straw-covered basket that was hung from its four corners on a wheeled platform which

provided some comfort for the occupant. Sea sickness however was a problem as it is I understand in the magnificent gilded coach the Queen rides in from time to time which uses similar suspension. Metal springs appeared in the 17th century,. bodies were still suspended on leather straps, but the straps now hung from the end of springs, the other end being fixed to the under-carriage. The springs reduced the jolts but at a cost – some carriages weighed over ten tons!

This monstrosity appeared recently on eBay for sale. Based on a Chevrolet platform, it allegedly had the blessing of GM – one wonders – anyway it was stopped

The advent of the motor car was largely predicated on advances to suspension systems. Without these no carriage could be suffered on the 'roads' of the times. Coil and double elliptic coil springs were used as far back as the 19th century, torsion bars came in the thirties the following century – again introduced by Citroën.

With the farm cart, basically a wooden frame placed on an axle with two large wheels, the least jolt is transmitted integrally to the body. If the horse drawing the cart walks, there is no problem other than the odd bump. But if the horse bolts, the frequency of the bumps will increase along with their intensity. The vertical force of the jolts is actually in direct proportion to the square of the speed of the vehicle.

The requirement is to prevent the jolts from being transmitted to the passengers. The analogy is drawn to consider people sleeping comfortably. A mattress is placed between themselves and the ground or bed. The softer the springs of the mattress, the more comfortable the sleeper will be

If the sleeper represents the car (the suspended mass) and the bed the wheels (non-suspended mass), it is necessary to place an elastic element, a spring, between the two. The spring must be soft enough to allow for the most violent jolts. This condition introduces the first theorem of suspension: the more elastic the spring, the less the suspended mass will be shaken. Thus, the trend of spring design has been to make them softer and softer and more and more flexible.

Air springing was discovered, which is far more elastic than a metal spring instanced by car tyres which are much softer than the metal wheels or solid rubber tyres. But there is a limit after which this is no longer true, as the springs will eventually collapse if they are too soft. Each individual has to choose the mattress that suits him. The ideal mattress for a weight of 300 lbs will be far less ideal if it has to carry a load of 100 lbs.

Similarly a car's springs have to be designed for the weight to be carried. The car however has to carry different loads so desirably the springs should be as soft as possible but be able to carry the load and cope with load variations. The choice then is a spring which is very hard but not

very sensitive to load variations, in which case the suspension will lack elasticity or alternatively a soft spring, where any load variation will significantly change the behaviour of the suspension.

The solution is to adopt a suspension where its flexibility varies with the load. This solution exists. It is termed variable flexibility suspension, that is its flexibility decreases as the load increases. I think I can see why our new manufacturer chose air for a suspension medium since air seems to be the most suitable medium for this type of suspension. But there is a need to consider some other inherent suspension problems.

GROUND CLEARANCE

The softer the spring the more sensitive it is to load and the more it will give under the load, thus decreasing the space between the car floor and the ground and the wheels and the body. When a driver is alone in his car, the only load is his weight, say 170 lbs. But if five people and their luggage are carried, the load will be about 900 lbs the ground clearance will of course vary with the load. For optimum road holding qualities, the car should always maintain the same position relative to the ground. This calls for a suspension which corrects the car's position due to static and dynamic variation in height. Static variations are due to load increase which causes a spring deflection.

Dynamic variations in height pose another problem. Take a car running on a flat road and coming to a steep hill. The front wheels will reach the hill first and start climbing up the slope. But the suspended part of the car, which was horizontal, will tend to remain in this position, through inertia. The changed slope of the road, caused a dynamic variation which will be greater the faster the car is traveling. Additionally when going up a hill, the car's centre of gravity is displaced towards the rear, and when going down hill the reverse will apply which will affect the ground clearance. The ‘ups and downs’ if close together such as holes and bumps or corrugations, will give the car an unpleasant pitch similar to a ship on a heaving sea. Add these problems to other influences such as side winds, centrifugal force on corners; a highly cambered road, the rearing of the car in a quick getaway; or nose diving when the brakes are jammed on.

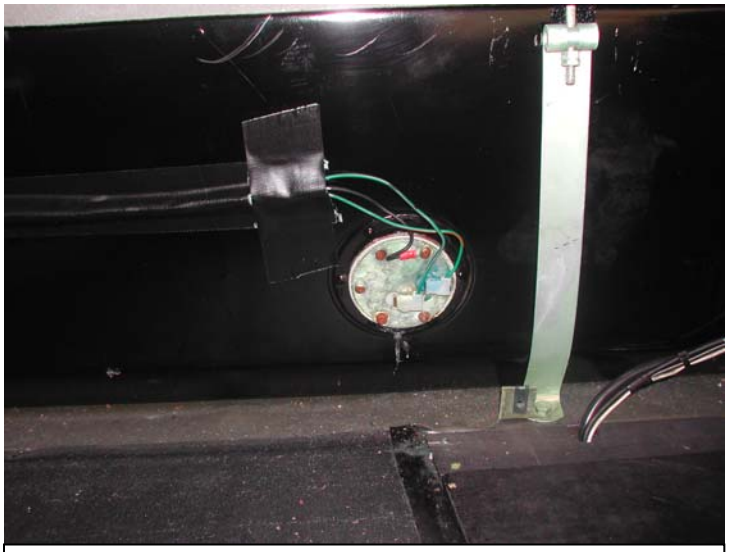
The rear view is little better. Actually in the late sixties, Cadillac brought out a model with an RR look-alike grille in pretty similar dimensions. What really came home to me when I saw these things getting around Washington was that you cannot press the RR shape, it has to be hand worked. This is to follow the principall of entasis and I wonder whether I can regale readers on this subject in the hope that those I bored witless some years ago are no longer with us.

An ideal suspension requires four independently sprung wheels and automatic clearance management which not only re-establishes the car's position as the load alters, but also reacts immediately to road surface conditions and to any change in the centre of gravity.

CALMING ALL THIS DOWN

The elasticity of a spring works both ways. Any stress on the spring will lead to a series of oscillations comparable in theory to those of a pendulum.

At standstill, the spring is in the equilibrium position. In motion, the variations of terrain create a series of oscillations similar to the pendulum, i.e. series of movements going from one side to the other of the equilibrium position. This has two results, the repeated upward oscillations are transmitted to the body and thus to the passengers and the downwards oscillations are transmitted to the wheels which make them bounce on the ground, thus losing adhesion -- the all important factor in road holding.



When the Factory was convinced that Americans were not in favour of being incinerated in their cars after a rear end collision demolished their fuel tank, they moved the tank to behind the rear seat. This put the fuel sender unit on the side of the tank as seen here. One problem has been a tendency for the unit to weep and deposit strange chemicals around the terminals causing all sorts of strange readings and failure of the low fuel warning light. Cleaning the terminals will usually fix the problem. Another problem occurs with removing the tank which tends to glue itself to the boot floor. This is overcome by the insertion of wooden wedges under the unit and gradually driving them in to break the seal.

This is all the more marked because the wheel has its own highly elastic suspension, the tyre, which reacts to road surface conditions immediately. It is vital to dampen these oscillations, both in the suspension and in the wheels, all the more necessary when the road surface is corrugated in such a way that the frequency of the bumps coincides with the period of the suspension (time between two complete oscillations on either side of the position of equilibrium). This will produce the phenomenon of synchronous resonance, which will increase the oscillations beyond limits.

As any compression of the spring makes it store up energy which is gradually released by oscillation, part of this energy must be removed in order to decrease the oscillations. This is achieved by the shock damper eliminating part of the energy the spring has stored. A very powerful shock absorber would stop the motion of the spring entirely obviating the need for any suspension. On the other hand if the shock absorber is very weak it will have no effect at all. The difficulty is reaching a happy medium between a suspension that is sufficiently soft to absorb the bumps of the road and a shock absorber firm enough to brake the oscillations of the body and wheels quickly. According to the type of vehicle, manufacturers have to choose between two solutions:

- for a sports car, where road holding is the vital factor, the shock absorbers will be powerful; thus, the springing will be hard for a luxury Sedan, or
- on the other hand, the shock absorbers will be weak: the suspension will therefore be very soft, but the road holding will not be so good.

A car remaining perfectly horizontal and parallel to the road, whatever the load, the state of the road and the speed, yet having a very flexible suspension and very efficient shock absorbers, would have the ideal suspension. To obtain this, it would need to have the following qualities:

- very great flexibility, varying on the basis of the load, and self-adjusting.
- automatic height corrector.
- independent wheels.
- built-in shock absorbers.

And here comes the punch line the answer to all these riddles it is the Citroën unique hydro pneumatic suspension also, known as Air-Oil Suspension.
The elasticity of steel springs is replaced by the far greater elasticity of a gas.

To be continued/……

The Saginaw manufactured steering box fitted to Shadow I's (sic). The main adjusting point can be seen on the top with its locknut. The large nut to the front is for setting the pre-load on the input shaft. It is very unlikely that you will need to fiddle with the latter

THE ROLLS-ROYCE PHANTOM

(Continued)

This material was drawn straight from the press kit provided at the launch of the Phantom. By now most readers will know that the new car has been a great success. Not without its detractors as with any new model, the event has brought out anecdotes of the attitude of the former parent factory and the result of starving the old company of developmental funds. That the name and ethos of Rolls-Royce has been recovered and the future assured can only be of comfort to owners and admirers alike.

Sir Henry Royce was, first and foremost, an engineer. Perfection was his goal and he was never prepared to accept the status quo. That same culture can be found at Rolls-Royce Motor Cars today.

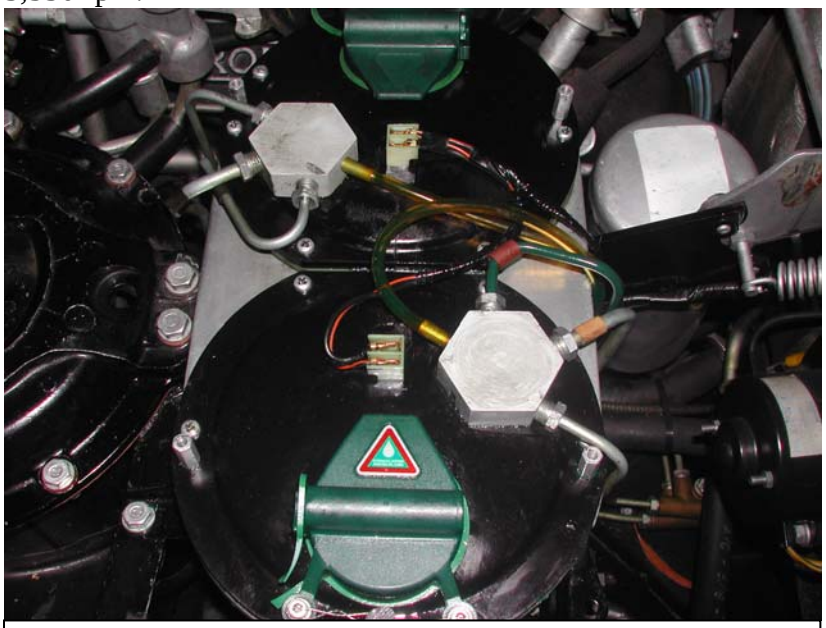
As a result, the Phantom is an engineering-led design, a motor car guided by the philosophy laid down by Sir Henry Royce almost a century ago but which, at the same time, satisfies modern needs.

Driveline
At its heart lies a remarkable driveline assembly – a naturally aspirated 60 degree V12, purpose designed for the Rolls-Royce Phantom. It is mated to a six-speed automatic transmission from ZF.

The engine's capacity of 6.75-litres will be familiar to Rolls-Royce owners – from 1970 onwards, the long serving V8 in the Silver Shadow displaced 6.75 litres – but the levels of power and torque will be quite unlike anything they have experienced before.

In line with the expectations of a Rolls-Royce driver, great emphasis has been placed on providing high levels of torque at low engine speeds – the frantic on/off power delivery of a turbocharged engine is deemed quite unsuitable and out of character.

As a result the torque curve of the Phantom is predominately flat. At 1,000 rpm it is already producing a remarkable 560 Nm (413 lb ft) – 75 per cent of its peak figure of 720 Nm (531 lb ft) reached at 3,500 rpm. From 1,000 to 3,000 rpm, typical city driving speeds, these huge reserves of torque mean that every time the driver presses the throttle, the car picks up smoothly and without hesitation. The power unit is rated at 453 bhp (338 kW, 453 hp SAE) peak power at 5,350 rpm.



Letting the driver know that he is getting a bit short in the brake fluid department calls for some pretty fancy equipment. Cars using RR363 used reed switches which are basically magnets floating up and down a shaft protruding through the bottom of the reservoir. Later cars that switched to mineral oil poked the switches through the top of the reservoir using much the same system. The terminals for these switches lie under the 'nomenclature plate' that normally covers the filler holes. Here they can be seen with the plate removed. The plugs are standard Lucar push on fittings and should make good contact with the terminals in the lid. In the event that they don't the light will come on saying you are low on fluid. The message is if the light comes on and there is plenty of fluid there, go look at these terminals. Usually a good clean will rectify the problem and you may like to put a piece of heavy tape over them before you put the plate back on to help them stay in touch.

To optimise ride comfort the decision was taken to use tyres with tall and flexible side walls. For this reason top speed has been governed to 149 mph (240 km/h) with summer tyres and 130 mph (208 km/h) when all-season tyres are fitted. It takes just 5.7 seconds to reach 60 mph from standstill (5.9 seconds, 0-100 km/h). The 'shift-by-wire' gearbox, too, has been tuned to match the characteristics of the engine. Electronic control means that in normal use the Phantom starts off in second gear with early up-shifts and late down-shifts.

But by engaging the kickdown switch, which is integrated into the throttle pedal assembly, at rest the car will set off in first and the full performance of the engine will be released. Similarly, engaging kickdown on the move allows later up shifts and more immediate response. The gearbox incorporates a low mode, suitable for steep mountain descents. Mounted well ahead of the passenger compartment for optimum sound insulation – a property also helped by the double bulkhead design – the engine itself is one of the most advanced in the world.

Remarkably compact, the all-aluminium unit has four valves per cylinder, 48 in all, twin overhead camshafts per cylinder bank, four in all, and a long intake manifold for optimum low end torque. It features direct fuel injection, fully variable valve lift control and variable valve timing. Direct fuel injection has been used to boost power and torque. By injecting an exact amount of fuel directly into each of the 12 combustion chambers rather than into the intake manifold, greater thermal efficiency is achieved allowing a higher compression ratio to be used. Sensors monitor the combustion curve in each cylinder, ensuring exact management of the combustion process with no pre-ignition of the fuel which would lead to engine knocking.

Other technically advanced features of the engine include variable valve timing and sophisticated variable valve lift technology. The latter highly efficient system allows the inlet valves to regulate the amount of air entering the cylinders thus overcoming the inherent inefficiencies of the throttle butterfly, a component that has been an integral part of the internal combustion engine since the beginning. The result is improved fuel consumption at low and steady speeds as well as instant throttle reaction and enhanced smoothness no matter what the engine speed.

Considering the size and performance potential of the Phantom, fuel economy is exceptional: over the EU extra urban cycle the Phantom returns 25.7 mpg (11.0 ltr/100 kms) with a combined figure of 17.8 mpg (15.9 ltr/100 kms). The fuel tank has a capacity of 22 imperial gallons (100 litres).

Body structure

In the way that the monocoque-bodied Silver Shadow ushered Rolls-Royce into a new era almost 40 years ago, so the Phantom does the same today. Even though it is physically bigger and more extensively equipped than any Rolls-Royce saloon before it, the Phantom is no heavier yet structurally more rigid: the entire body-in-white weighs just 550 kg.

I am told that arguments used to rage over the correct placement of the coolant label on the steam valve of postwar cars. This one on an S2 is fairly straight forward, read while you fill it. But have a look at your Shadow header tank and decide on the variations available there and the most preferable replacement. On such weighty matters whole evenings have been squandered.

Torsional stiffness at 40,500 Nm/degree means body rigidity exceeds that of conventional unibody designs by far. It is estimated that the Phantom's structure is twice as stiff as an average steel-bodied saloon: a remarkable figure given the size of the motor car.

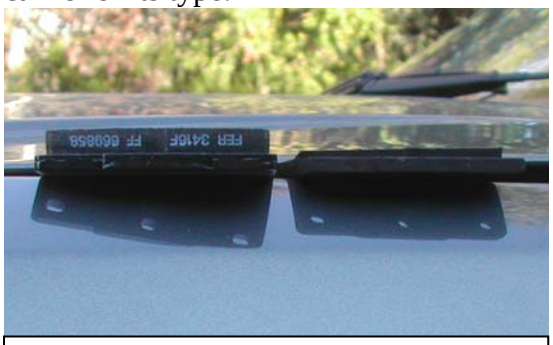
These achievements have been possible thanks to the adoption of a sophisticated aluminium space frame – the largest in the automotive industry – which is then 'dressed' with panels mostly made from light weight aluminium or composite materials: only the boot lid is of steel.

Its use also means the Phantom is the only vehicle in its class to be built on a unique platform rather than one shared with another model. The space frame concept was identified early on in the project as the best way forward: indeed, the proposed overall package dimensions of the Phantom meant that the only way to achieve the required rigidity while keeping within set weight targets was by using an aluminium space frame.

Comprising more than 200 extruded profiles and more than 300 sheet metal parts, the space frame arrives at the Rolls-Royce Goodwood facility pre-assembled. It is hand-built by skilled specialists at the Dingolfing plant in Germany, which is the BMW Group's competence centre for aluminium space frame technology. It is the only facility in the world capable of meeting the exacting standards set by Rolls-Royce.

Once completed, the structure – which includes 150 metres of MIG welds in more than 2,000 separate locations – is placed into a machining centre where critical fixing locations are optimised ensuring door, engine and suspension mounting points are accurate to within +/- 0.5 mm. The implementation of the coach door design depends on such accuracy. The front and rear doors open independently, and at their closest point are just 2.7 mm apart.

As the space frame is fully structural, it means the outer panels are simply fastened to the frame itself. The bonnet and rear wings are aluminium, while the aluminium radiator grille, in common with other exterior brightwork, has a Sterling finish. The doors feature an aluminium skin bonded over aluminium pressure die-castings and sheet metal parts. The front wings are sheet moulded composites (SMC). As well as offering greater resistance to minor traffic scrapes the material permits transmission of electro-magnetic waves and thus is where the antenna for the satellite navigation system is housed. The boot lid is steel, while the instrument panel (IP) carrier is a lightweight magnesium alloy casting – the first one-piece full depth and full width carrier of its type.



Another reminder to keep brake pads in mind. Seen here new on left worn to the limit on the right.

Cast in Europe's largest tool of its kind, the IP carrier weighs just 7.6 kg yet provides a robust mounting for ductwork, heating and ventilation and safety system sub-assemblies to minimise vibrations. The vehicle package concept brings with it other bonus features and allows the use of coach doors as well as a double floor, providing an area for essential services without intruding into passenger space. In addition, the extra rigidity provides the highest levels of comfort and quietness as well as exceptional passive safety attributes. The architecture of the Rolls-Royce Phantom's rear compartment, and in particular the adoption of independent coach doors, takes passenger safety to a new level.

Before coach doors could be adopted, however, legislation had to be met: rules are in place to prevent the possible opening of the rear door into the path of travel when the car is moving. To achieve compliance, Rolls-Royce had to develop an entirely new electronic safety system. The coach door latch has its own electronic control unit which enables communication between the lock and sensors installed in the door. In addition, an electrically actuated safety lock has been installed in the rear interior door handle.

Above 2.5 mph (4 km/h) the coach door cannot be opened from inside the car, while with an open or partially latched door the car can only accelerate up to an uncritical speed before it is brought to a halt. Both front and rear doors have a continuous door stop thus remaining open at any desired angle. Automatic soft closing, activated by a sensor in the door lock, when the door reaches a catch point approximately 0.2 ins (6 mm) away from the lock, uses a motor and gear unit to power a rotary latch to close the door completely. Automatic soft closing also operates on the boot lid.

The coach doors also have the benefit of closing assistance from any angle – a switch in the C-post allows rear passengers to close the door electrically without having to lean out of the car. Made possible by the package concept, the double floor offers two distinct benefits: it allows virtually flat flooring in the rear compartment and also permits service functions to be installed

unobtrusively out of the way. The level of the floor, itself a consequence of the preferred driving position, and the inclination of the rearmost end of the propshaft means it has been possible to reduce the intrusion of the transmission tunnel into the passenger compartment – just 3 ins (81 mm) remains above floor level. Passengers step directly onto a flat floor rather than over a sill into a footwell

The space between the floor panel and vehicle underside is filled with the vehicle 'plumbing' – mainly wiring harnesses and air ducts. It is also home to a pair of bass loudspeakers which are mounted under the front seats and whose performance is enhanced by two under-floor 16-litre acoustic resonating chambers. The result helps create one of the finest sound systems fitted to any car.

To be continued

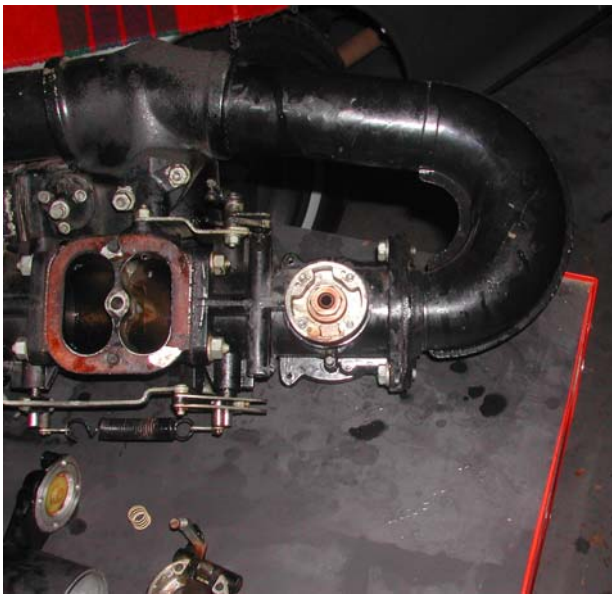
INDUCTION SYSTEMS AND DIAPHRAGMS

Since the advent of the Silver Cloud the Factory has used SU carburetters that employ a synthetic rubber diaphragm to support the main jet. The float chamber pipes petrol into a chamber under the carburetter needle and jet assembly and this flows upward through the jet and around the needle into the main airstream. To adjust the idle mixture on these carburetters involves raising and lowering the jet. With the heat of the engine the diaphragm becomes stiff and eventually cracks allowing fuel to run out of the bottom of the carburetter. In the vee eight engine this can pool in the valley between the cylinder heads and eventually catch fire. There have been a number of engine fires in post-war cars most of which I suspect can be traced to this problem.

Replacement of the diaphragm on the larger engines is not major thanks to a simple fixing method of the induction system. The above picture is of a Cloud III which sprang a leak. Between the two carburetters there is a very long bolt that goes down into the engine. Having undone some pipes and the odd wire, this bolt can be removed and the entire induction system removed.

The second picture shows the underside of the removed assembly. Note the central

intake hole with the central bolt hole within that. The offending diaphragm is under the float chamber mount (arrowed).



The last photo shows the float chamber removed and the diaphragm and jet removed.

This is one of those jobs where a little prophalaxis doesn't go astray. If the carburetters have not been overhauled in memory, you should think about doing this job. I had a diaphragm fail in Adelaide during a Federal Rally. I bounced into the local dealer, demanded a bench and much to the amusement of the staff did a quick diaphragm change there and then. I can't even remember whether I said thank you!

Cheers

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