

POSITIVE CHARGE

Peter Watson cops a dose of Handlebar Aversion Therapy...

How would you describe someone who once designed and constructed a motorcycle with a wooden monocoque chassis? Looking back on my description of Don Woodford's Red Shift in 1978, I see that I singularly failed to capture the spirit of the man. Although I was impressed by this obviously gifted engineer's reasons for his bizarre choice of frame material and the elegant manner in which he proposed to tame the harsh vibration of the Triumph twin he had hung below his plywood honeycomb, his character seemed beyond divining or conventional cliché.

Now he has unveiled the product of five more years of sketching, experiment, compromise and after-hours filing and machining. Typically, it owes nothing more to its predecessor than the material chosen for a temporary seat: plywood again. To ride it you must overcome a psychological trauma that engulfs the mind from the moment you grasp its vertical steering levers. Despite all advice not to look down at the unfamiliar mechanical territory below, a hurried glance was my undoing. Jerking the front wheel first left and then sharply to the right, I wobbled to a halt and admitted defeat.

Don had just completed a demonstration of growing confidence on the road. 'You need a brain operation to ride this,' he joked a little earlier. His friend Derek Head nodded enthusiastically at this, for the former racer had spent the previous evening falling over too. All both of us probably need is a course of HAT — Handlebar Aversion Therapy — during which any attempt to grasp the rubbers of a proffered conventional handlebar is rewarded with a jolt of high-tension current to some sensitive organ. On second thoughts, maybe I'll have the operation instead.

Don Woodford is a tall, spare man whose age is difficult to guess. The body is a

reflection of an agile and logical mind. In the space of a few minutes our conversation ranged through car suspension systems, early bicycles, steam propelled submarines and other topics too numerous to mention. For a largely desk-bound engineer who has worked for the Central Electricity Generating Board since time out of mind, projects like Red Shift and Positive Charger are pure therapy. Yet although his interest in motorcycles stems from the simple enthusiasm that takes him to work on two wheels every day, he doesn't shed his professional expertise when it comes to his hobby. Instead, he mocks the results; you have only to admire a solution or a feature to hear its shortcomings expounded and superior

alternatives described in bewildering numbers.

The first thing you notice about Positive Charger is its basic frame structure. Or rather you eye the two large, red-painted slabs of aluminium alloy whose roughly triangular shape dominates the Honda CB550 four sandwiched between them. What can they be? In fact these are twin pannier tanks, connected by three 2½ inch diameter tubes which also contain fuel, contributing to an overall capacity of three gallons. They are constructed from sheets of Duralumin, a brand of aluminium alloy that has proved a favourite with special builders for many years. Wall thickness varies here from ⅜-¼in, with the rest of the chassis constructed from ¾in

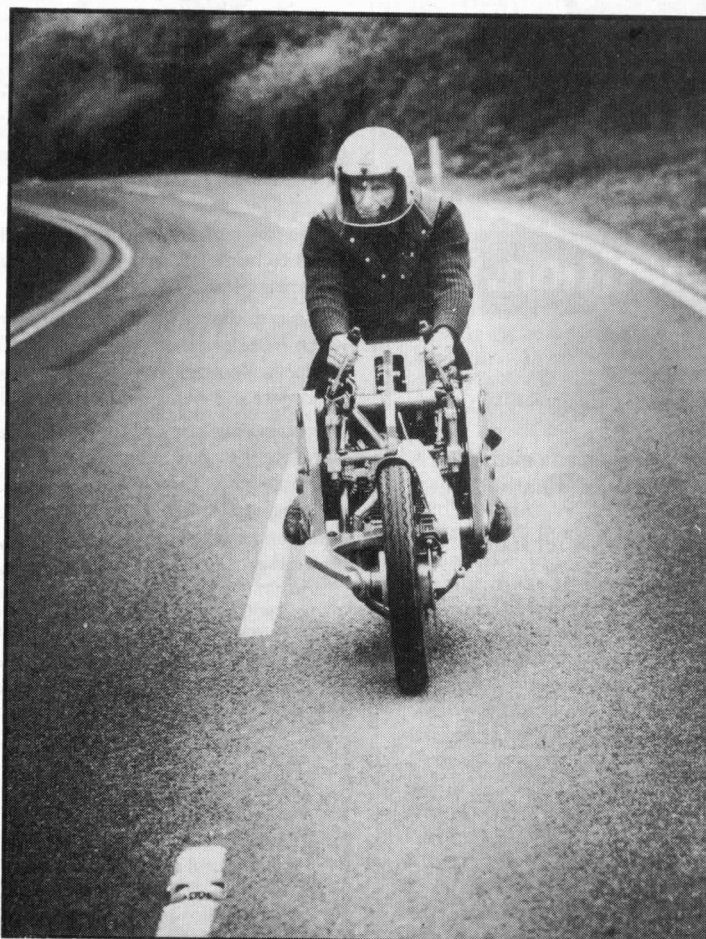
dural and fasteners in stainless steel.

It's a good material, the major plus point being your ability to produce large stiff structures without incurring a significant weight penalty. But, as BMW recently discovered with their wheel castings, unlike steel, aluminium has a finite fatigue life. Overall, PC tips the scales at 360lb (163kg) — with a front/rear split of 90/80kg — but a huge slice of that is engine weight at 160lb (72.6kg). Don Woodford reckons that the term 'middleweight' refers to the fact that such machines carry their weight in between the wheels, and yearns to jettison the heavy starter motor, alternator and associated hardware. Come back the magneto, all is forgiven.

The almost standard sohc Honda unit — it's gained electronic ignition and lost the airbox for the moment — is hung on to the bottom pair of frame/tank tubes via large split clamps and two bolts at the front, one at the rear. Access is remarkably good and, once you've disconnected the stainless steel exhaust pipes and modified Yoshimura silencer, the engine can be dropped out very rapidly. The rear engine-mounting split clamps also serve to locate a tubular subframe for the seat whose top rails enclose all the electrical components including a slightly smaller than standard battery.

By now you'll have also spotted that the fuel tanks — which require an electric SU pump to feed the carbs — also act as location for the front and rear suspension pivots as well as the steering levers. The threaded bosses are designed to locate an all-enveloping dustbin fairing, so try to remember that what you're seeing is a naked machine. The central boss is carried through each tank just in case any engine vibration tends to set up a sympathetic resonance.

Don's original notion included a continuous stressed-skin 'doughnut' around the engine unit, but where this



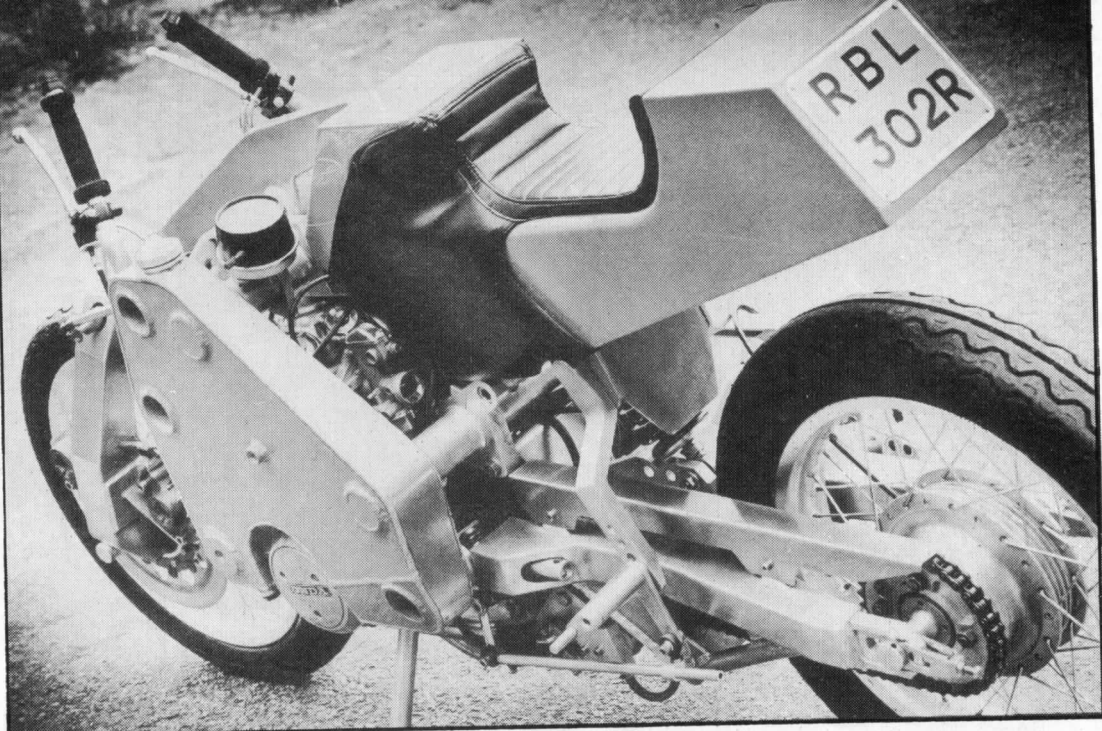
Photography Tony Sleep



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proved impractical second thoughts resulted in a very strong, lightweight unit. The tanks not only protect you and the machine, but they also contribute a low centre of gravity beside acting as a location for engine, steering and suspension.

Initially Don drew up a system of coupled suspension. This is well known in the automotive world — just call to mind the Hydrolastic Mini and Citroen 2CV — and designed to limit pitch, that nasty fore-and-aft rocking motion familiar to the owners of short wheelbase vehicles like motorcycles. Unfortunately such systems often limit pitch while



Dural pannier tanks are obviously weird. Plywood seat unit hides its kinkiness under paint

promising and Don has written a simple computer program which could be used to assess the advantages of a necessarily complex coupled suspension over an uncoupled version.

In the event, he dumped the idea, judging that things had become quite complicated enough already. Likewise, he rejected an Elf-type dished wheel and single-sided swinging fork at the rear because he didn't fancy getting involved in the problems of casting, eventually dismissing too a number of lever suspension systems. 'Some of these were rather like the Pro-link design,' he recalls. 'But I thought "this is just extra work and extra bearings and these bearings are all lightly loaded".'

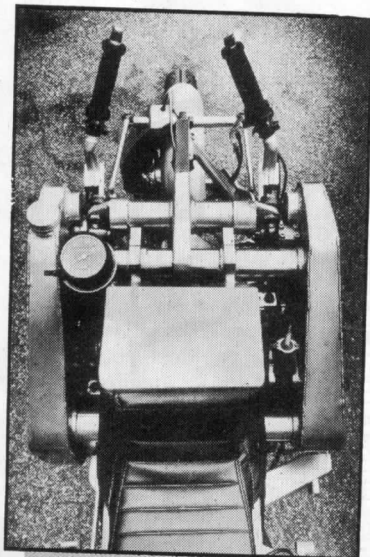
The type of bearing that you discover all over PC is the rose joint, the self-aligning spherical unit with which most people are familiar via its use on gearchange linkages. You can count no fewer than 14 of these on PC, with a pair of large 18mm rose joints supporting the swinging form at the rear whose pivot point is concentric with the output shaft of the gearbox in order to maintain constant chain tension. They are the metal/PTFE matrix self-lubricating type and used here allow for minor welding distortion while avoiding the expensive line-boring dictated by more conventional bearings. Since the 18mm variety will happily accept a load of 25 tons, they are quite up to the job and will shortly be fitted with protective rubber covers.

Apart from the multiplicity of rose joints, what strikes you

most forcibly about PC is the wide range of adjustment visible throughout the design. Check out the way in which the footrest hangers can be swung through a considerable arc and the screw adjustment at the front of the forward suspension arm, itself provided with three locations for its Spax spring/damper unit.

At the rear the fork is controlled by a more expensive

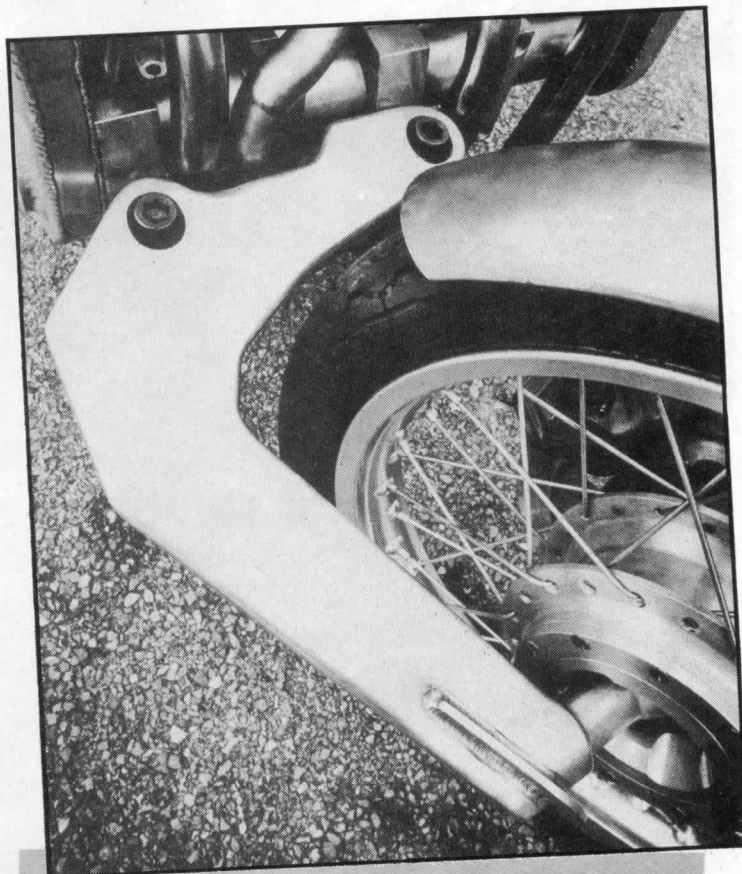
De Carbon unit. As this was originally to sit inside the front of the dural fork abandonment of lever arms meant adding bracing arms and box-section stiffening near the pivot. The inboard ends of both damper units are mounted on 'disposable' plates — incidentally, the spring on the Spax has proved far too stiff — which can be changed in order to vary ride height. At the



About ten inches separate the go-go handles, if you can work out which direction they go, er go

increasing heave, so that *both* ends and the middle go *boing*, *boing* together. Well, I did mention 2CVs.

Given that PC was going to have an almost 'no dive' front end, braking-induced pitch wasn't going to be a large problem, but Don aimed to control pitch and heave independently. Front and rear suspensions were to be coupled together twice, once via a horizontal spring/damper unit and again using a pivoted three bar linkage and inclined spring/damper. That is to describe a cunning arrangement in the most sketchy terms, but it looks very

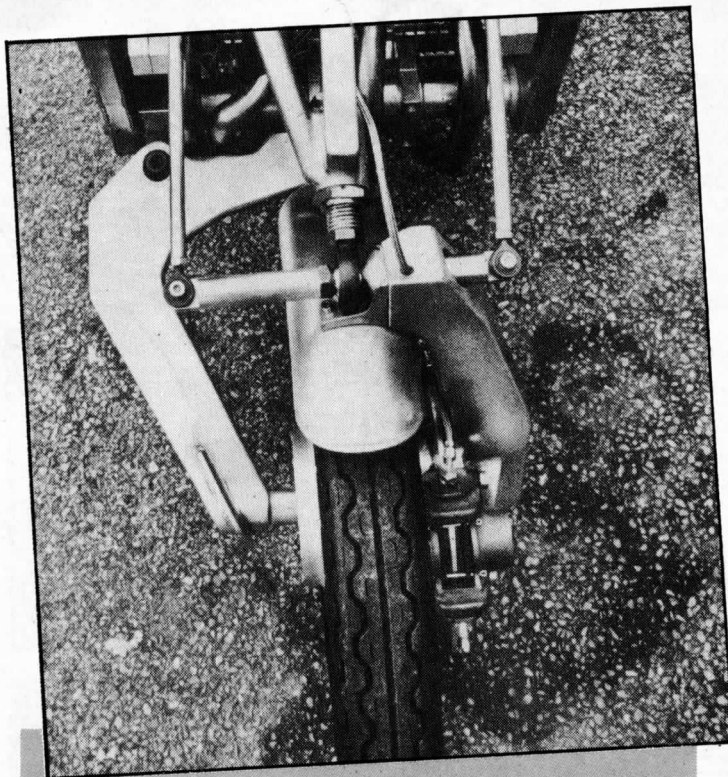


Front swinger restricts lock, but not tragically

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moment the seat is 30.5in off the deck with Don aboard, with the exhaust collector a mere three inches above the tarmac. Undoubtedly the most outrageous aspect of PC is its steering and front suspension. Here, Don Woodford is at pains to point out the way in which motorcycle designers ape automotive practice. In a matter of seconds he filled a page of my notebook with sliding pillar, beam axle, McPherson strut and unequal-length wishbone designs, all the while enumerating example of their adoption by motorcycle designers. 'All motorcyclists are doing is turning the wheel through a right angle in essence,' he maintains.

Nevertheless, he is convinced that the Japanese will soon abandon the good-looking but structurally weak telescopic fork in favour of some form of parallelogram suspension system. He is putting his money on a version of Norman Hossack's design where the wishbones are moved up away from the wheel hub, allowing these linkages to be hidden by a fairing while relatively conventional looking legs protrude below. 'They'll claim it for their own and call it YDVS or something similar, of course,' he adds with a smile.



A plethora, or maybe bouquet, of rose joints hold the steering linkage together

PC's steering is naturally car-type hub centre. The pivot above the wheel is another large rose joint, matched by another inside the hub, a beautiful piece of machining from Derek Head of Headline Engineering. Major drawback with the scheme adopted by Don Woodford is restricted lock, which will be increased slightly by opening up the hub a little more on the right. Twin steering levers — Don once drove a Centurion tank — are connected to the upright one to turn left and so on. Clutch and brake levers are conventional and each steering lever is topped by a button — for horn and starter motor — which

makes you want to put on a Biggles voice and shout 'Bandits, bandits four-oh. Tally-ho, chaps' before making taka-taka-taka-taka noises. Take that, Fritz.

The parallelogram suspension, with cantilever actuation of the rear-mounted spring/damper unit and its attendant steering can be adjusted to give 0-5 inches of trail, which also governs the angle of rake. At the moment the trail is set at somewhere between three and four inches, which Don reckons is about right. He would have liked to have pivoted the suspension actuating arm on eccentrics for more elegant adjustment than the forward screw, though.

Front wheel removal is remarkably simple. 'The bottom arm of the parallelogram is on one side of the wheel and the 'drop arm' — so to speak — is on the other side of the wheel,' he explains. This looks rather odd, but what this means is that the front wheel assembly is very easily dismantled. 'There's just a single tommy-bar driven bolt which you can see sticking out from the bottom of the drop arm and you undo that and the whole front wheel assembly comes apart.'

In order to secure 'adequate' braking, Don went for two of Spondon's single-pot calipers — master cylinder is Z1-R — plus one of their floating discs. At the rear you'll find a Honda 500T hub, with the gearing raised from the standard 12mph/1000rpm to 14mph/1000rpm in top which

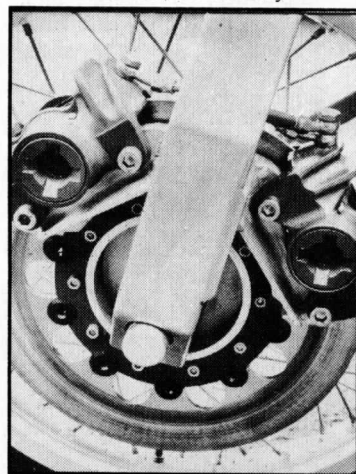
means that fourth is equivalent to the former fifth ratio.

If you forget that PC took five years to design and construct you might be surprised by the wire-spoked DID alloy rims. Had he begun later, Don might have used Comstars with dished spiders. However, it all costs and even the motor was £300, with at least £500 spent on the front hub and brake.

Most of the alloy welding was done by Swaymar Race Engines of Leatherhead, with Don wielding a dreadnought file to smooth down the seams. Margnor of Worplesdon provided the stainless fasteners, but Don feels most indebted to the Horsham branch of J Smith & Sons (Clerkenwell) Ltd who supplied him with any size and quantity of dural which he happened to require.

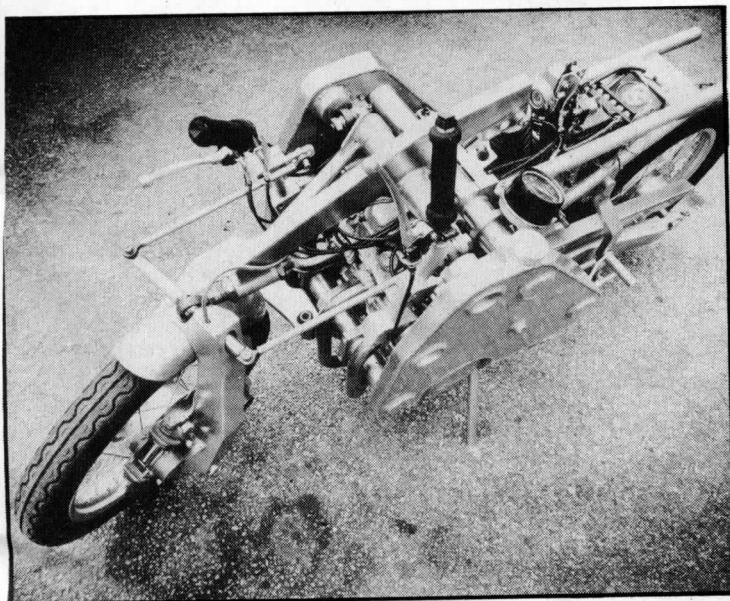
There's no doubt that Positive Charger does everything that its creator intended it should. PC alarms, intrigues and excites. Its steering and suspension show the way that motorcycles should have gone long ago. Others — notably Tony Foale — have designed similar systems, but I doubt that anyone enjoyed the challenge as much as Don Woodford.

As we talked, it suddenly



A pair of Spondon calipers act onto a single floating disc!

struck me as absurd that an engineer from outside the motorcycle industry should have such a clear vision of how to develop the powered two wheeler. Inside the industry it seems so often to be a case of the blind leading the short-sighted, but more probably it's the marketing tail wagging the engineering dog. We left Don declining to leave his power stations and turning over the notion of a large-diameter spine frame for his BMW twin. You see, there's this piece of metal in the workshop that might just do...



Right hand down a bit, skipper, means corner off the port bow