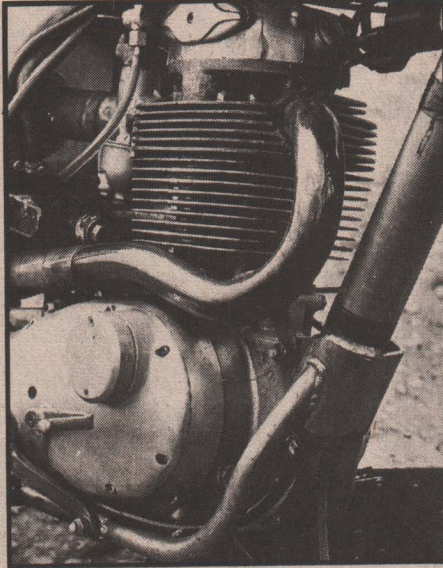


# TITANIUM

In 1977, BSA is just a name in the history books to most motocross riders. The factory's former glories have been forgotten and now riders look to the technical expertise of Japan and Germany as the innovators in motorcycling's toughest sport.

But it wasn't always so. Eleven years ago, the centre of the motocross world was Small Heath, Birmingham, home of the BSA factory and its incredibly successful race-shop. In 1966, BSA was not only one of the biggest producers of motorcycles but was also one of Britain's major industrial concerns. The company had the technical skill and finance to pursue any project it desired and if the design exercise happened to be motocross, its engineers could unleash all their imagination.

Jeff Smith had won the World 500 Championships for the factory in 1964 and 1965 and had done so on a relatively small budget. Competitions manager, Brian Martin, had five men working on the motocross project and supplemented his fairly tight financial constraints by having work done for him, unofficially by other department heads within the Small Heath labyrinth. The team was tight-knit and knowledgeable and by making use of BSA's almost limitless facilities, they produced the finest moto-



The crankcases were in magnesium while the head and barrel were alloy. Timing gears, con-rod and even rockers were in titanium.

to BSA and were one of the few companies in the world who were familiar with the properties and manipulation of titanium. Speedwell had already successfully cooperated with several firms on the use of titanium in sports cars and also in the aircraft industry, so were the obvious choice. They were also heavily involved in the production of fail-safe components for the nuclear energy industry and so if it were possible to make a frame in titanium, then Speedwell were the firm to do it.

When the BSA design arrived, Speedwell threw up their collective hands in horror for what they were being asked to build was a titanium copy of a steel frame. Since titanium has markedly different characteristics from those exhibited by CDS tubing, it was obvious from the outset that the frame would not work.

At the time, much was made of the difficulties in producing the titanium BSA, but Speedwell's chairman, Mr. Markey, insists that the actual manufacture was straightforward. All the techniques used were well understood in the aircraft industry and it would have been possible to have made a very sophisticated frame without stretching known technology beyond safe limits. In fact, from receiving the order to producing all the components took only twelve weeks and from then on, about one frame per week was produced until the 20 had been completed.

There were difficulties in fabrication for one of titanium's many unusual properties is that it absorbs oxygen and hydrogen from the atmosphere when it is heated and then becomes weak and brittle. To avoid this problem, all the welding had to be carried out in a sealed chamber which was filled with inert argon. Equipment like this was limited to a few workshops in the world and could not easily be found in motocross paddocks, as the BSA team were to find out during the forthcoming season.

Other than changing the BSA design to meet the specialised needs of working with titanium, Speedwell had to accept the design with a mixture of concealed mirth and resignation and ploughed on to make the best of a difficult job. In fairness to BSA, the frame design was based on proven race experience — something which Speedwell did not have — and since no-one had built a Ti frame before, there was no experience on which to draw. Four years later, Husqvarna and Speedwell did build a Ti frame which handled well but even this was prone to breakage and that was conceived at the expense of BSA's hard won, and expensive, knowledge.

Not only was the frame built in titanium but the rest of the bike was made as light as was technically feasible. Many parts were machined from solid at the Small Heath works and most of the engine's internals were produced by hand. The timing gears, con-rod, engine sprocket and even rockers were made in Ti whilst dural was used for

## TECHNICAL SPECIFICATION:

Single Cylinder Four-Stroke 82mm x 93mm. Alloy head and barrel with hard chrome liner.

32mm Amal Monobloc Carburettor. Crankcases cast in electron with electron side-cases.

Clutch drum machined from solid dural. Engine sprocket titanium. Rocker arm, con-rod and many other internal engine parts machined from solid titanium.

Engine power characteristics (all gearbox readings):

Max power at 6,000rpm 33.5bhp.

Max power at 4,000rpm 25bhp.

Max Torque at 4,500rpm.

Engine pulling cleanly at 1,200rpm.

Max revs. 6,500.

Frame fabricated entirely in Ti alloy, with oil bearing capacity in top-spine.

Wheelbase 54". Ground Clearance 7½". Width 33½". Seat Height 32". Steering head angle 63°.

General Data: 20" front wheel, 18" rear with 3.00 x 20 and 4.00 x 18 Dunlop tyres respectively.

Magnesium sliders used on front forks with 5" of travel. Standard oil damped Girdlings at rear with 3½" of travel. 6" steel, single sided front brake, extensively drilled, at front and 5" Airheart disc brake at rear.

Total weight of bike complete with oils and half a tank of petrol 212 lbs. This compares with the best steel framed bike built in 1968 of 224 lbs.

cross machines in the world.

Unfortunately, they were the victim of their own success for after winning two world championships, senior management became interested in motocross and decided to help the competition department capture their third title. The budget limit was cancelled and BSA's senior designers formed a committee to build the best motocross machine the world had ever seen.

This increase in status would have been welcomed by Brian and his men were it not for the fact that the task of designing was taken out of their hands. Neither Martin nor double world champion Jeff Smith was consulted about the new world beater but instead were confronted with a *fait accompli* and told to go out and win the world championship on it.

The committee's reasoning was simple. If a lightweight 440cc bike won races then an even lighter 500 would do the same job even better. The answer, to these skilled engineers, seemed obvious — build virtually the whole bike from titanium!

The titanium alloy which BSA chose for this exercise was 65% lighter than steel on a strength for strength basis and only eighty times more expensive. Worries about expense, the executives said, would not taint this project.

Having decided what to do and how to do it, the senior designers stood back to watch their efforts come to fruition whilst Brian Martin was given the task of turning the ideas into metal.

He consulted Speedwell Gear Case Company of Birmingham who already supplied

# TRAGEDY

The story behind one of the most expensive flops in motocross history

BY FRANK MELLING



# TITANIUM TRAGEDY

the clutch drum and magnesium for the engine cases and fork sliders. Fabricated Ti box sections were used for the fork crowns and whilst these were extremely strong, their cost was astronomical.

The one question which no-one can now answer is what the project actually cost. Part of the difficulty is that at BSA, race shop work carried on in-house was not costed so that a top-class craftsman, earning prime wages, might spend thirty hours machining a con-rod from a solid billet and the cost would be "nothing". How many thousand man hours it took to manufacture all the bits and pieces for the engine and frame will never be known but all these costs were lost within the vastness of the BSA empire.

Speedwell too, have allowed their records to go, for after a seven years' lapse, a project is declared dead and the relevant data disposed of. However, each frame cost approximately £3,000 and BSA ordered 20, all of which were completed but very few were used in competition. If the cost of producing the frames alone ran to £60,000, then the rest of the project must have conservatively cost this much, for as well as the machining and manufacture of the engine parts, every conceivable item was produced in Ti or magnesium, including the wheel rims, which were specially rolled by Dunlop and then welded by Speedwell.

Again, taking a conservative point of view, prices must have doubled since 1966 so the exercise probably cost BSA something in the region of £250,000 in present-day terms, an indication of just how much the factory wanted to win the world championship.

It would have been nice to say that all the efforts of the team succeeded but in fact the Titanium BSA was one of the worst motocross machines ever produced by BSA and proved to be the bane of Brian Martin's life. The problems came from the fact that there were just too many unknown quantities incorporated into the design for the team to have a chance of racing the bike in the GPs, although being totally committed to the project, they did just this. The Ti BSA was in fact a mobile research lab instead of a serious racing machine and whilst it provided an immense amount of information it also reduced those who had to race it to tears.

The bike's first outing was at the Hants Grand National in April 1966 and from the outset, there were teething troubles. What really worried Jeff Smith, who rode the bike exclusively, and Brian Martin, was that the first GP was only weeks ahead and they were still playing around with an untried machine.

During the first half of the season, which

was as long as any bike lasted in the world championships, it proved to have many endearing traits which any team can well do without. The frame flexed much more than steel and so was prone to wallow in corners and pitch badly over bumps.

Despite all Speedwell's care, this constant flexing caused the welds to crack — as they did with the later Husqvarna frames — causing endless problems because paddock repairs were out of the question. The engine too, was less than successful. The Ti con-rod work hardened when it came into contact with the flywheels and effectively machined them down during the course of a race. The engine sprocket had a habit of welding itself to the crankshaft and the rocker arms would seize at the slightest provocation. The magnesium crankcases were also new and these expanded excessively and caused the bearing houses to turn.

## MY RIDE

Smithy did get the occasional good result, such as a win in Finland but more often he would retire through mechanical problems. What made the situation all the more tragic was that when the chassis was produced in steel, it was a very good one and the new 491cc engine proved to be an excellent power plant producing some 33.5bhp at 6,000rpm. What was even more impressive was that it gave 25bhp at 4,000rpm and peak torque came at only 4,500rpm. Even at 2,000rpm, there was enough urge available to really power out of corners.

So much of the glory of BSA has been lost that it is satisfying to know that one jewel from the crown has been saved. In this case, Len Vale-Onslow, the enthusiastic head of the mammoth motorcycle dealership bear-

**The front fork was new for 1966 with a fantastic — for the time — movement of 5 inches. Front wheel is 20 inches, a size peculiar to the BSA.**



ing his name, saved the Ti BSA from extinction when he purchased it along with other race-shop exotica and several tons of BSA racing parts — certainly enough to keep the Ti BSA running for ever and a day.

Thanks to Mr. Vale-Onslow's generosity, I was granted the privilege — and that is no understatement — of being the only journalist ever to ride this fabulous beast. At present, the bike is undergoing restoration and is not quite in original trim. In place of the troublesome "special" engine, a 499cc "works" motor is fitted, which is of a slightly later vintage but gives indistinguishable power characteristics. The bike itself has suffered much in the vagaries of its mixed life and so is in less than pristine condition.

We pushed the bike downhill and I bumped on to the saddle. From then on, my actions were automatic, programmed by three years of happy racing on my own ex-works BSA. Throttle closed and let the engine suck in fuel. Then just a whiff of petrol and the big single crackled into life with a staccato bark which is pure joy. Anti-social and unreasonable it may be but the BSA barked out a defiant challenge to anyone who dare think the legend is dead.

The Ti BSA, like all the factory's GP bikes is best ridden sitting down. The footrests (fabricated from Ti of course!) are well forward and the saddle so low that the rider sits in the bike like an armchair rather than being perched on top of it, as modern design demands.

In view of the fact that the engine was a hack one, fitted until the original power-plant is rebuilt, the bike performed very well and although not the crispest BSA I have ever ridden, all flavour was retained. From 1500rpm, the motor pulled like a train and I could repeat all my favourite party tricks, such as diving off into cambered corners in third gear and chugging away with the rear wheel finding traction like only a four stroke can.

Just like any 84mm x 90mm BSA motor, it wouldn't rev but whatever handicap this posed was more than compensated for by the way it would pull incredibly high gears and still provide respectable acceleration. In fact, there are few bikes which pull so well even today and in 1966, there would have been nothing which approached it.

The handling left much to be desired and as the bike hopped from bump to bump, with both front and rear suspension fully compressed, I was reminded just how physically tough motocross used to be. Even so the BSA was not dangerous and despite bucking, it tracked as true and straight as any modern bike, although needing more strength and determination from the rider.

On fast smooth corners, the BSA would still take a lot of beating. The low centre of gravity and effortless urge of the big motor meant that it could be drifted round in a controllable power slide which made me feel just like the BSA factory rider I longed to be but never was.

At the end of our test, a young Suzuki rider who had been practising, came across and inquired about the bike, which he believed to be a home built special. Obviously impressed by both the sound and sight of the BSA, he concluded his comments with the observation that "You want to take that bike to a scramble, it's good enough to race." For an eleven-year-old motocross machine, that is praise indeed.