Who'd ever think of building a racing BMW? Enter Oscar Liebmann and his Rennsport 500

Amol Precision Special

BY STUART DAVIS

The BMW engine was sitting there, half put together; related parts were all around it on the bench. You could tell that love was an important ingredient of each small sculptured lump of metal.

I was fingering each piece and listening to the soft accent of the man as he drew word pictures, assembling the pieces for me in my mind. The whirring, banging and metallic noises of the shop added emphasis to his explanations.

Talking to Oscar Liebmann, owner of Amol Precision of Dumont, New Jersey, I was made aware that this 3-year-old engine design was the culmination of a long standing project.

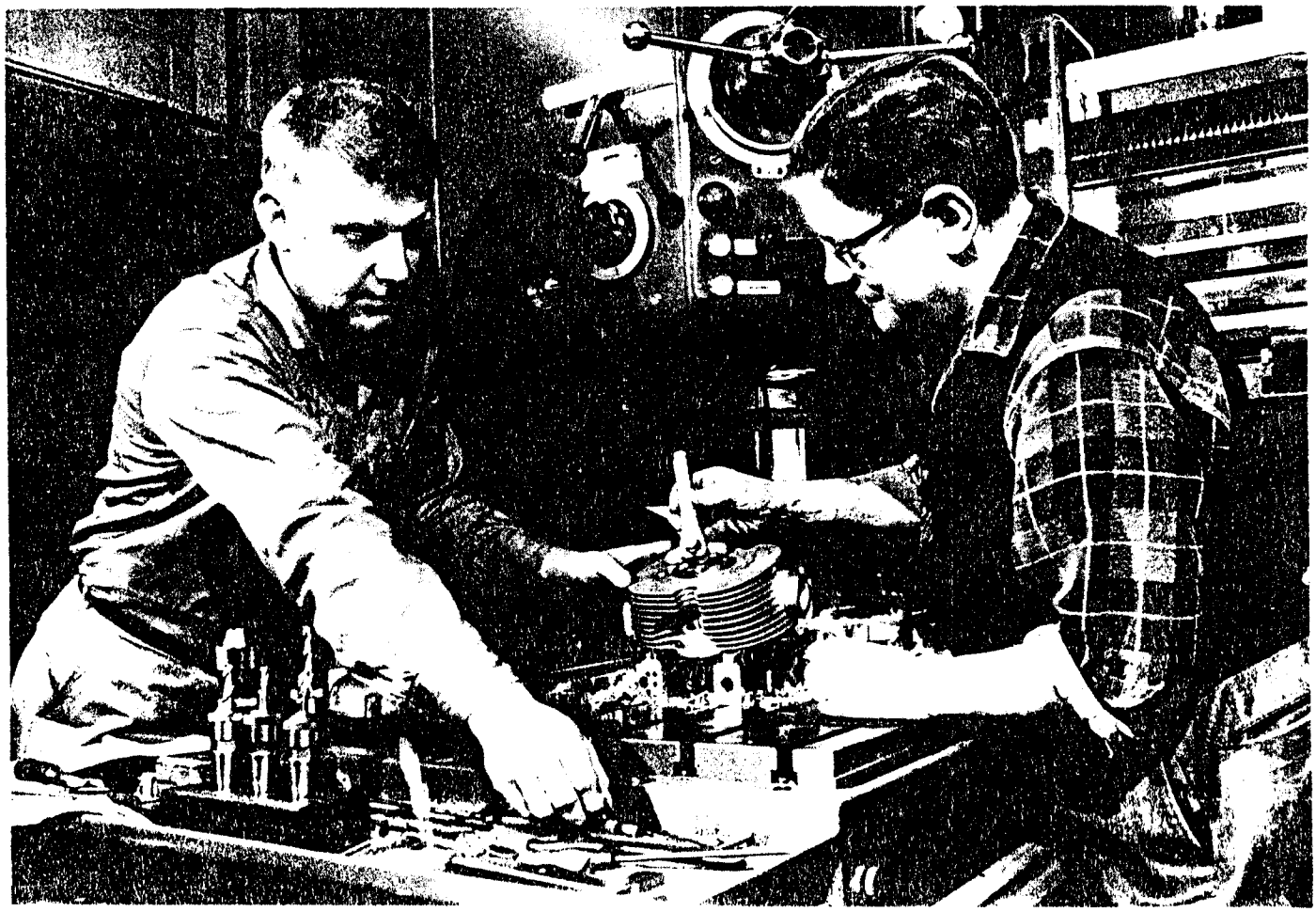
Liebmann's love for motorcycling was inherited from his inventor-father and spans many years. As a youth of 18 in Germany, he designed and assembled his own bike using a 1927 English 350cc Blackburne single. Young Oscar attended the Carl Zeiss Institute in Jena, where his father was Werkmeister, and graduated as a precision craftsman. Somehow he also found time to learn the piano and the accordian and later, after his immigration to America, he began to paint. But his love for the motorcycle coupled with his natural talent as a machinist made the design and construction of two wheel racers almost inevitable.

His two sons, Richard and Kurt, joined their father's interests under Amol Precision Company, now well-known to American racing.

The machine Oscar Liebmann focused upon was BMW. Certainly its design and superb construction struck a responsive chord in his machinist's heart and there was no small pride in the German tradition of engineering excellence. To understand his dream and its slow unfolding, we go back to the early 1950s when Germany first re-entered international racing, fielding their new Rennsport DOHC works racers. This twin carburated machine, with 58 hp at 8,500 rpm, was completely redesigned from the pre-war supercharged machines. It featured a new frame and swing arm suspension for both front and rear wheels.

Two years later the racing department redesigned the works engine, enlarging the cylinder bore and shortening the stroke. This short stroke engine (72mm x 64mm) was only available to factory riders. The production racer, sold to competent customers (one racer per country) still featured the long stroke (66mm x 72mm).

Oscar Liebmann couldn't get a Rennsport racer, so he struck out on his own. Using stock production components as a basis and without factory cooperation, Liebmann's organization built a number of engines. All were push rod operated,



Amol Precision Special

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the overhead cam design was still an unattainable desire. The racing engines built by Amol Precision were uniquely different in that the stroke was 2mm shorter than the factory RS engines. The ultra short stroke was designed to lower piston speed and provide better handling on the solo racers. Tested on his newly acquired dyno, Liebmann computed the engine's output at 52 hp at 8,000 rpm. Using special push-rods, cam followers and specifically better materials, the output was not far behind the factory racer.

The last years of the 1950s saw BMW factory participation in international racing cease altogether. Dangerous handling coupled with talk of eliminating the 500cc class from Grand Prix competition finally snapped the lock tight on the doors of the racing department.

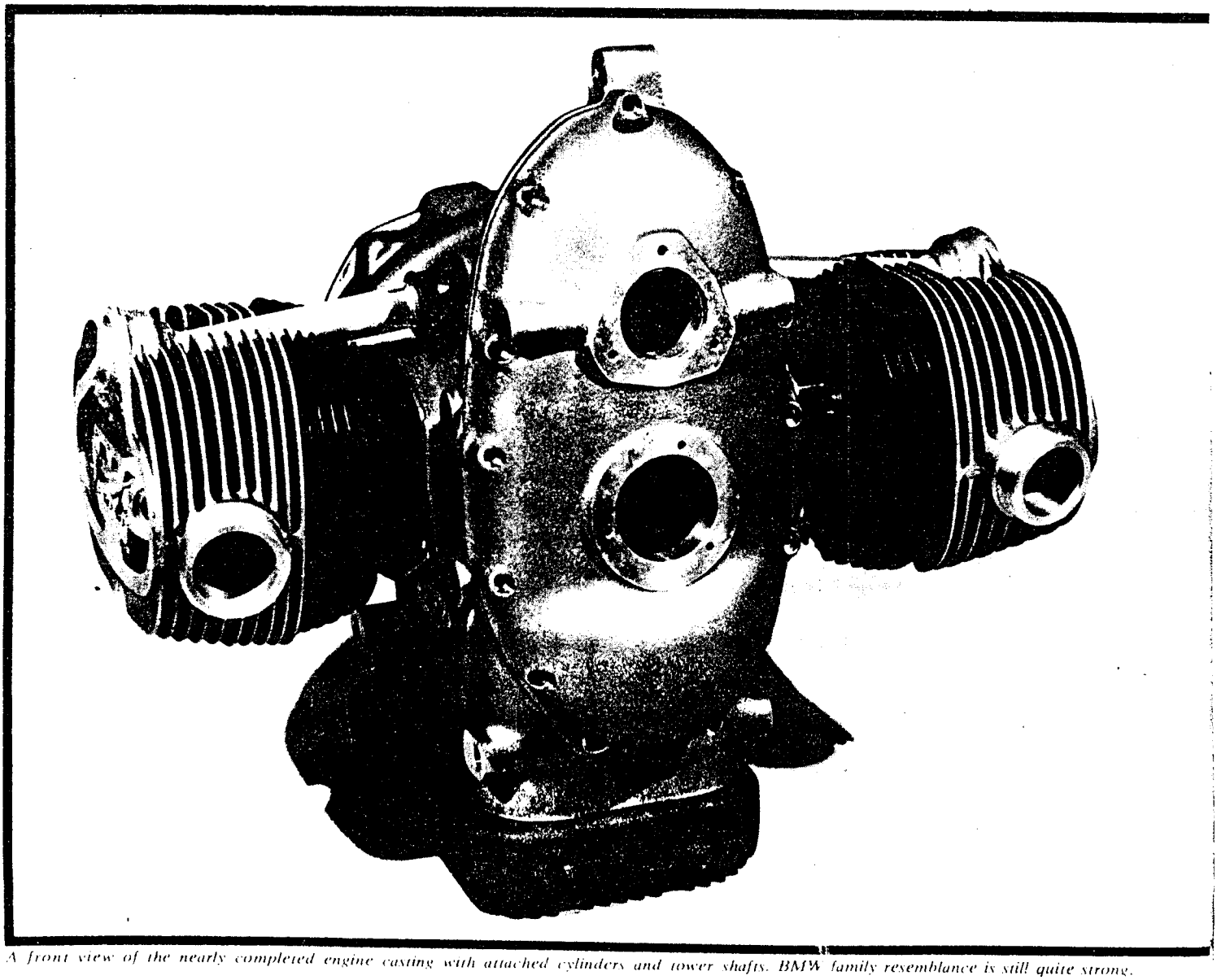
In 1964 Helmut Boensch, a director of the BMW organization and supervisor of the motorcycle works came to America. He had heard of Amol Precision and the energies, talent and money it had devoted to improving the push rod engine. He spoke at length with Liebmann and promised that on his return to Germany, the factory would somehow repay this quiet man's devotion to a dream.

Engine castings of Rennsport DOHC short stroke design were shipped to Dumont. The factory would also provide technical help, drawings and specifications for the asking. BMW's only stipulation was that their name could not be used. The racers would be entered in competition as Amol Specials—little enough to ask of a man whose dream had come true.

The Amol DOHC short stroke engine was designed by factory engineer Ludwig Apfelbeck and modified and refined by Oscar Liebmann. With enough castings supplied for five complete engines, Liebmann and his staff of craftsmen began the slow process of precision machining.

The factory long stroke machines had the nasty habit of grounding valve cover boxes in tight turns. Holes were worn into covers with subsequent loss of oil and engines. To alleviate any possibility of this on his short stroke bike, Liebmann banked both cylinders 2 degrees from horizontal, as much as material in the castings would allow.

The three piece crankshaft made from the newest high stress steel alloy allows 300,000 P.S.I., almost double the figure of material used in older cranks. The length of stroke for this engine is 64mm,



A front view of the nearly completed engine casting with attached cylinders and tower shafts. BMW family resemblance is still quite strong.

2mm longer than the older push rod engines developed at Amol.

Mr. Liebmann explained that stroke was altered because of the new crankshaft size; this in turn limited the space for the crank's oil slingers. He readily admits that they just got by with oiling in the rod main bearings in the ultra short stroke push rod machines.

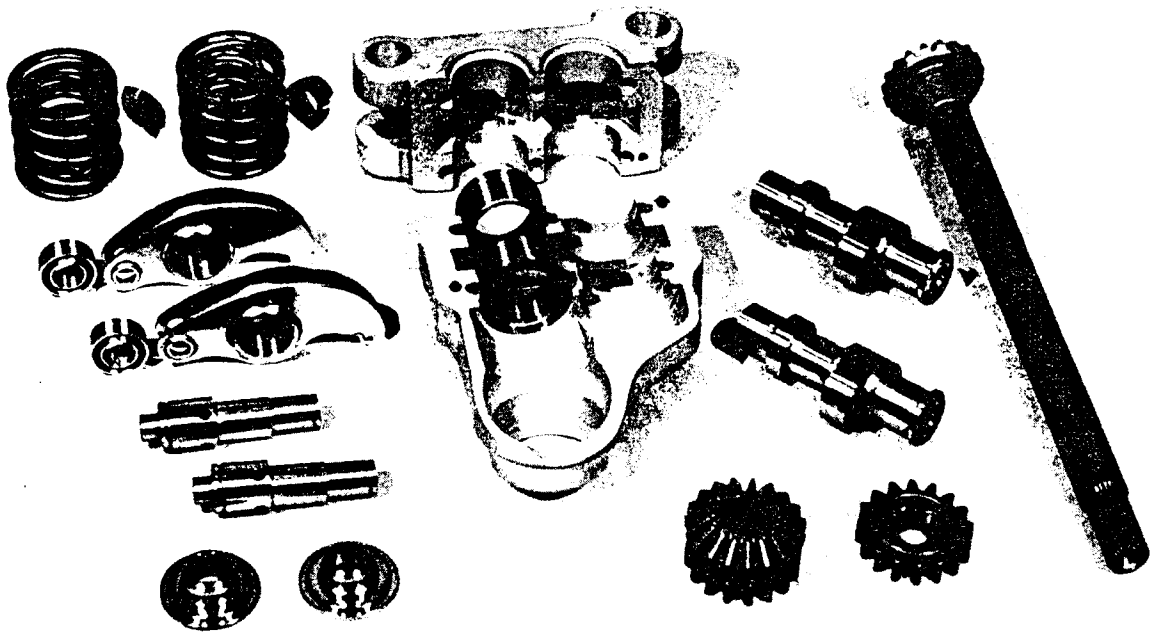
The new, one-piece connecting rods are machined from special aircraft quality steel, with a smaller big-end than stock rods. Through tests, Apfelbeck learned that by reducing the size of the big end bearing, there was a subsequent reduction of friction and a positive gain of 2 HP. The stresses of inertia and sudden loading during firing stroke requires needle bearing cages to be constructed from special aluminum alloys.

The Boss, as he's called by his employees, was somewhat hesitant to reveal the nature of the special materials used throughout the engine. I understood his reluctance and didn't press the point.

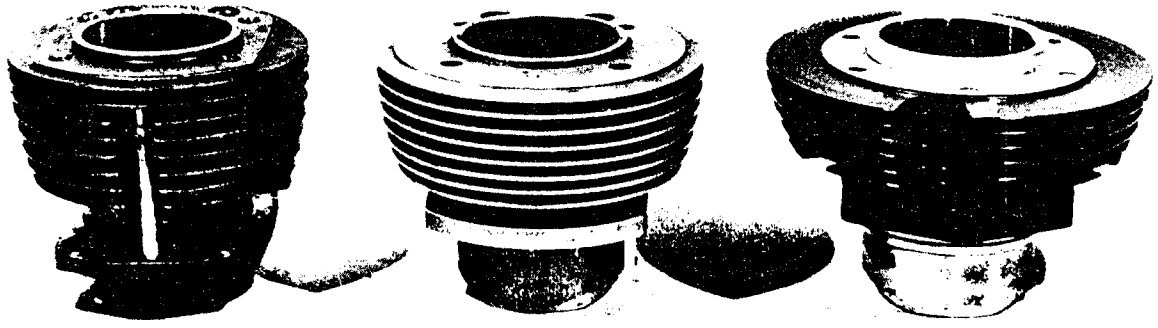
Ludwig Apfelbeck's design was changed in several important respects by Liebmann. The original plans called for heavier rocker arms that were near stock in appearance. The new roller tappet design weighs less than half the original RS rockers and are adjusted by eccentric shafts. As the shafts are turned, the rockers move up or down in relation to the valve stem cap.

The cylinders were machined from a solid piece of special aluminum alloy. They were air-freighted to the Mahle people in Germany for porous chrome plating on the inside of the cylinder bore. The absence of steel liners provides an important advantage. By using cylinders and pistons of the same material, expansion occurs at the same rate. Smaller clearances can be used and better compression is realized, not to mention more efficient transfer of heat and cleaner wiping of cylinder walls.

Mahle was also given the task of casting high dome pistons to Amol's specifications. The new pistons use a Dykes compression ring on top, a normal compression ring in the middle and an oil scraper on bottom. The factory Rennsport engines had serious problems with oiling. Because Castrol racing oil is difficult to wipe clean, having the tendency to climb over compression rings, Liebmann changed the location of the scraper on his push rod design. It was very effective



Components of the only Double-Overhead-Cam layout we know of that uses rocker arms. Outer surface of the aluminum cam box is anodized.



On left—Stock '67 500cc cylinder. Middle—Amol "short-stroke" unit. Right—The new Amol "short-stroke", iron-liner aluminum cylinder.

and should prove trouble-free for the RS engine as well.

The estimated output of 68 hp SAE at 11,000 rpm is certainly due in large part to the overhead cam design. The lightened rockers, stronger valve springs and titanium spring collars that provide the weight of aluminum with the strength of steel, are used to maximum advantage.

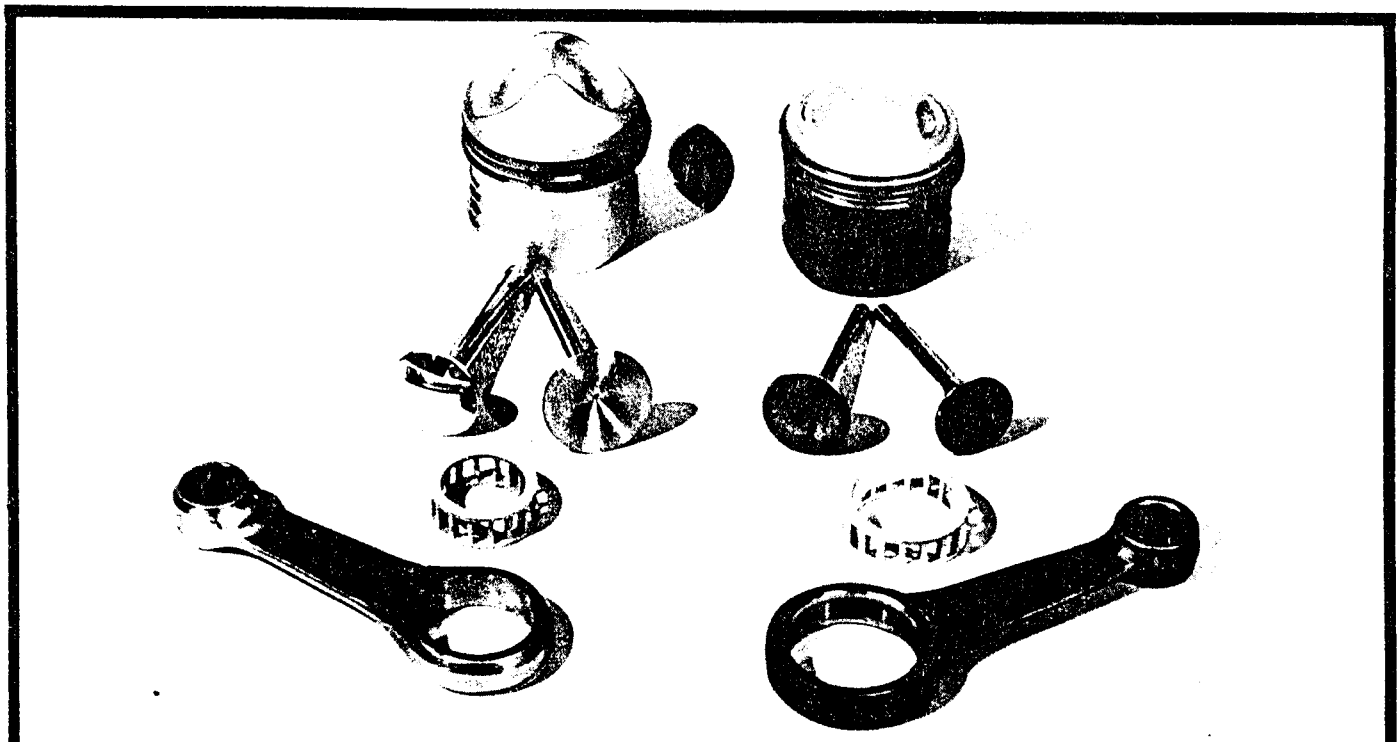
The intake valve is 42.5mm, larger by 2.5mm over former design. Sodium filled exhaust valve remains the same size, but valve angles have been changed.

Gear blanks for overhead cams were made at Amol, but to save time were sent out to a gear cutting house. All angles of bevel gears and lengths of towershafts were changed—the only similarity in the Amol Special and factory RS engine is purely exterior.

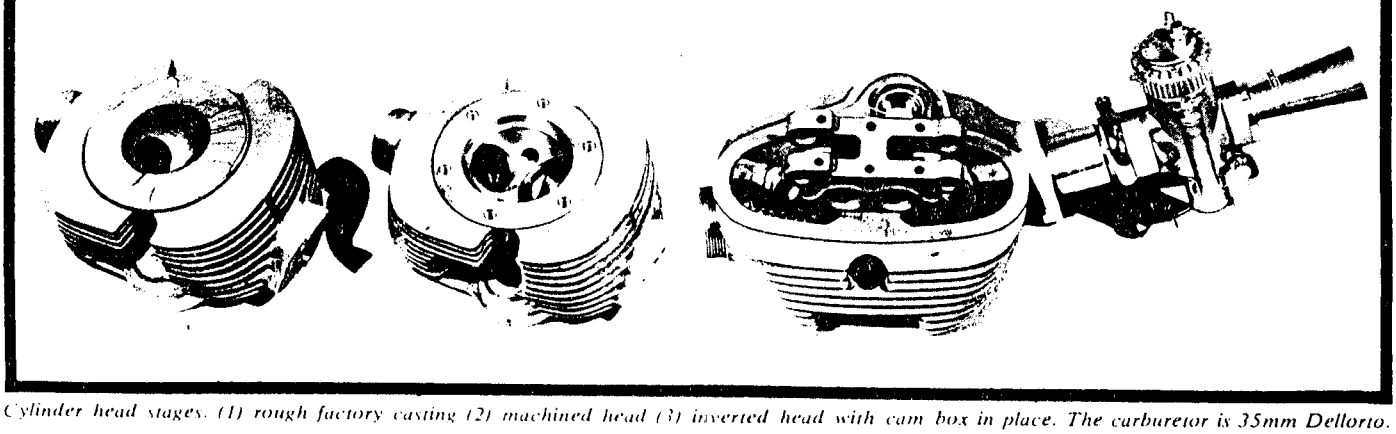
Lack of success of BMW factory racers in solo senior class racing has been attributed to frame and suspension. Liebmann found poor handling a major concern with his "works" racers, but now feels very confident that he has solved the problem.

It's the Boss's contention that poor handling of previous Rennsport designs was the fault of an overweight flywheel. Flywheel inertia, he explained, made it difficult for the engine to respond quickly and cleanly to the demands of the throttle. Deceleration on turns was very poor. Change down meant over-reving and the abuse of brakes made them all but useless after several laps. To correct the problem, Liebmann machined an aluminum alloy flywheel one-quarter the weight of the original factory design. The motion of the crankshaft, he said, adds a great deal of fly-wheel "inertia" by itself. To take the additional horsepower, double plate clutches replaced the former single plate. There had been very little difficulty with previous single plate configuration but Liebmann's philosophy eliminates the smallest possibility of failure to provide the largest margin of success on the track.

The Amol Special will certainly prove to be a serious contender for open class competition. Most of the work has been accomplished after working hours and weekends, and it will be several months before the project is completed. Oscar Liebmann has the craftsman's patience and when he fields his opposed twin racer for the first time it will be knowing that nothing was left to chance. ◉



Custom items left. Amol piston gives 10.5:1 ratio. Note Sodium-filled exhaust valve. 42.5mm Intake valve, and the alloy bearing cage.



PHOTOGRAPHY BY THE AUTHOR

Cylinder head stages. (1) rough factory casting (2) machined head (3) inverted head with cam box in place. The carburetor is 35mm Dellorto.

Amol Precision OL Special

PART TWO

BY STUART DAVIS

• A small crowd ringed the trailer, staring at an immaculate short-stroke racer and speculating on its chances of winning or even surviving AAMRR's competitive 500cc and open class events. The O.L. 500 Special was lifted and gently pushed and pulled into place. Tie-downs were wrestled into position and tightened securely, then checked and prodded again to be sure.

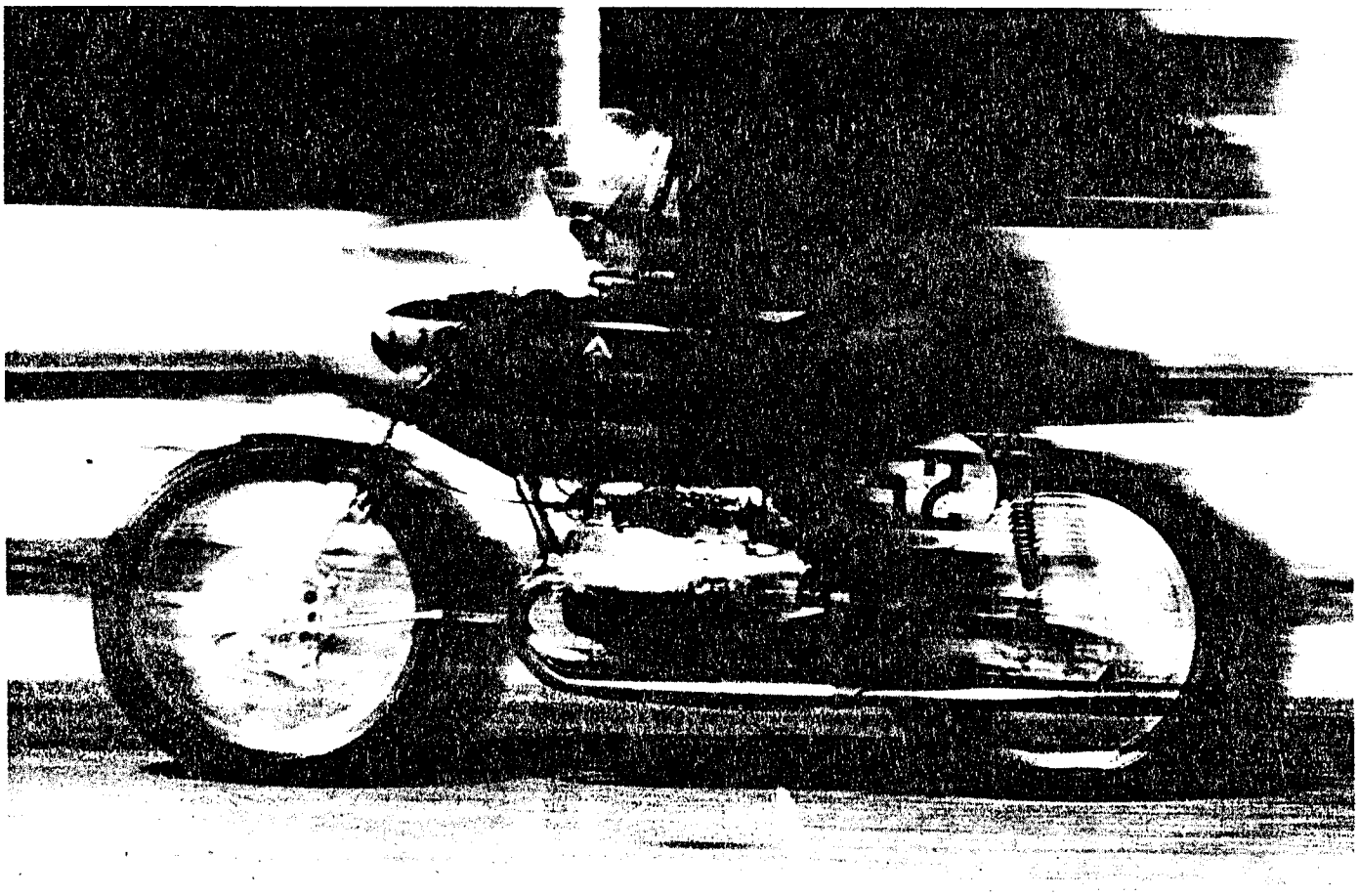
Cheerful banter filled the warm air as Oscar Liebmann of Amol Precision in Dumont, New Jersey, walked toward the crowd. Many thoughts filled his mind. Responsible for the birth of this modified and refined BMW DOHC racer, Liebmann considered the many hours that slowly became years, the money, the decisions and myriad small problems that together shaped and gave substance to the object on the trailer.

This was to be the O.L. Special's first test in competition, the August Gold Cup races in Canada. With the 1967 racing season half finished, Liebmann was eager for combat. There were still tuning problems to overcome, but what better place than on the track and in the thick of things? Soon all was ready. The car and the trailer moved onto the road and the long journey to Harewood had begun.

Rain pelted the racers as they ran the course. Riding was rugged, making adjustments in the pits quite difficult and most uncomfortable. Kurt Liebmann, Oscar's youngest son and a respected rider on the AAMRR circuit, rode the O.L. Special to second place in the 500 expert event. For an untuned machine on its first outing, this was a prodigious feat.

"The weather was awful," Kurt said afterward. "That throttle is very sensitive—difficult on a dry surface and almost impossible on water. I don't think I've ever concentrated so hard." He said that the engine had also shown a disturbing throttle hesitation throughout its rpm range. After father and son had considered several causes, they concluded that the heavy rain was responsible. No carburetion changes were made for the next race.

Race weekend at Nelson Ledges delivered the welcome change of clear dry air. Kurt was rather chagrined to learn that the Special still exhibited the same hesitation he experienced at Harewood. Water wasn't the problem, and to compound his dilemma the engine would not exceed



Precision OL Special

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9000 rpm. With a design limit of 11,000, the full potential was, for the moment at least, out of reach. In spite of this handicap, he was able to finish second once again in the 500 expert class and took third overall in the open event. The taste of near victory was sweet, but what the gods give they can soon take away.

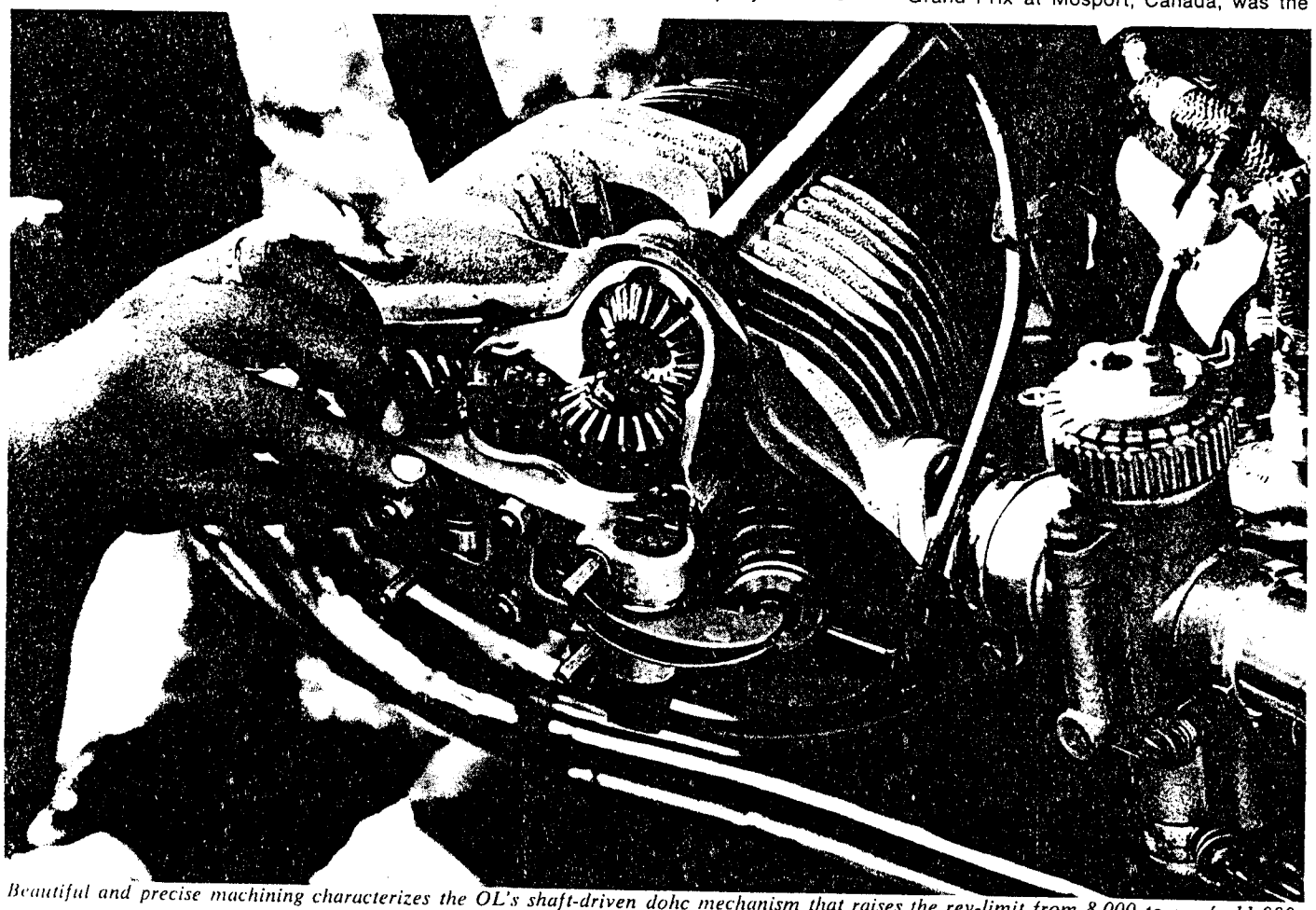
On return from Nelson Ledges, Oscar, Kurt and their mechanic Julius Vicze reviewed their difficulties to no avail. The senior Liebmann decided to cut through guess-and-by-golly solutions by calling the BMW factory in Germany. Unable to speak to Ludwig Apfelbeck, the factory engineer responsible for the original design, Liebmann discussed his problems with engineer Max Klankermeier. He was assured by the old side car ace that advancing ignition and leaning the mixture even further would cure their troubles. Subsequent trials proved Klankermeir quite accurate in his diagnosis, but there were other problems that needed immediate attention.

Oscar was also convinced at the time that high frequency engine vibrations upset float bowl operation, causing fuel starvation. His arrangement of securing the float bowls and coils to a sheet metal ring bolted to the engine casing was discarded in favor of the BMW racing department dodge of using flexible but rather stiff tubing in place of rubber hose from tank to float bowls. After the changes, the Liebmanns sought a test course for further sorting out. Adequate facilities for high-speed testing are almost nonexistent in the New York metropolitan area. With the exception of the Lime Rock sports car circuit, available only one day a week, there are only back roads during available hours of little use.

Kurt eventually got permission to run the Special at a small private airport. "With a wind sock for company and a few infrequent landings," he grinned, "we were able to make a number of banzi charges down the strip." It soon became apparent that the real problem was ignition and had been from the beginning. Coils and condensers were changed in an effort to smooth out the upper end, but results were far from satisfactory.

Back in Dumont, New Jersey, Kurt explained the problems encountered to all concerned. Richard Liebmann, Kurt's older brother, decided to replace the points. Convinced that the engine's high speed breakup was caused by point flutter, he removed the English unit they were using and substituted Honda's 305 assembly. Another trip to the airport confirmed Richard's theory. The machine accelerated beautifully to the upper end of the scale. The Liebmanns were now of one mind, that fine tuning was the only limiting factor in developing the engine's considerable potential.

The Special's third race in the Canadian Grand Prix at Mosport, Canada, was the



Beautiful and precise machining characterizes the OL's shaft-driven dohc mechanism that raises the rev-limit from 8,000 to a safe 11,000.

first outing for Liebmann's R.S. Long Stroke machine. Almost identical in outward appearance to the Special, the Long Stroke had considerably less performance, but ably ridden by Fred Simone, manager of Amol's motorcycle sales department, the slower bike proved to be more reliable throughout the season. Meanwhile, the seemingly endless task of jetting was sorted out to the satisfaction of father and son. All concerned were confident the Special would lead the privateers to the finish line.

Race day brought cold air laced with rain, certainly not the weather that provides happy holiday feelings for spectators or a full measure of confidence for racers. When the green flag fell, Kurt, in the third row behind the factory hardware, started the Special immediately. Accelerating, he became wedged between two closing machines. Describing the incident later, he said, "Suddenly I was off the seat, the bike falling to the right and me to the left. Somehow, I was able to yank the bike upright, climb back on and screw the throttle wide open."

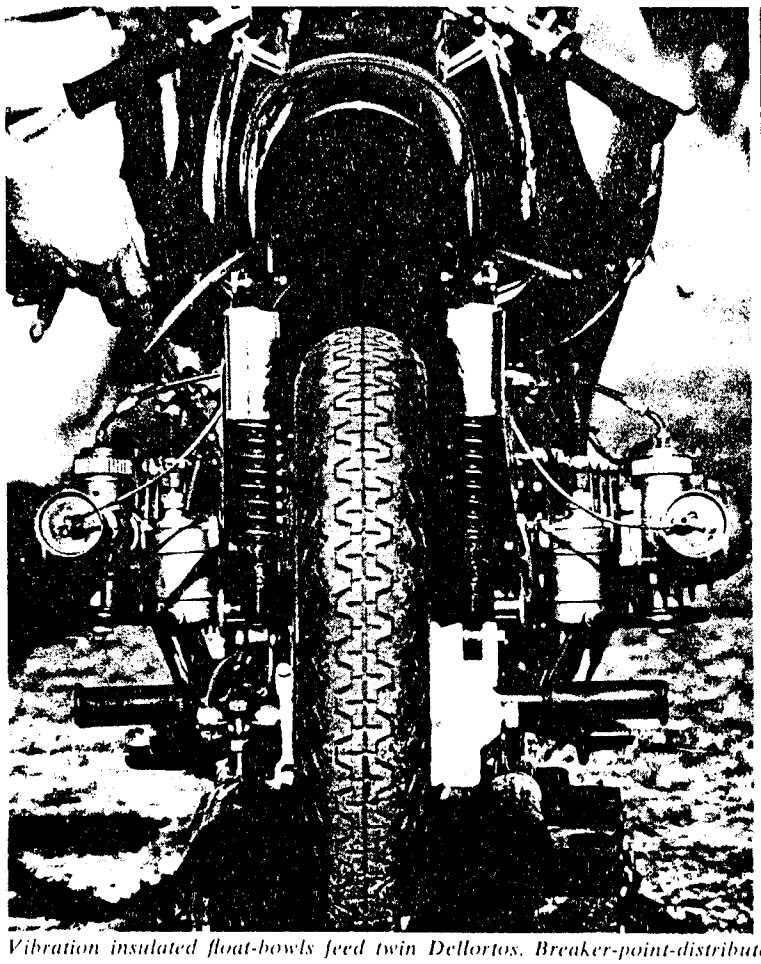
With one of the poorest starts of his racing career, he crossed the start line in 27th place and in 11 laps passed 22 riders. Visions of dicing with Rockett, Georgeades and Lloyd for a place behind Hailwood and Agostini made him more determined than ever. But the gods looked away. In the 12th lap the left cylinder stopped firing. Thinking the worst, Kurt pulled the clutch and coasted into the pits.

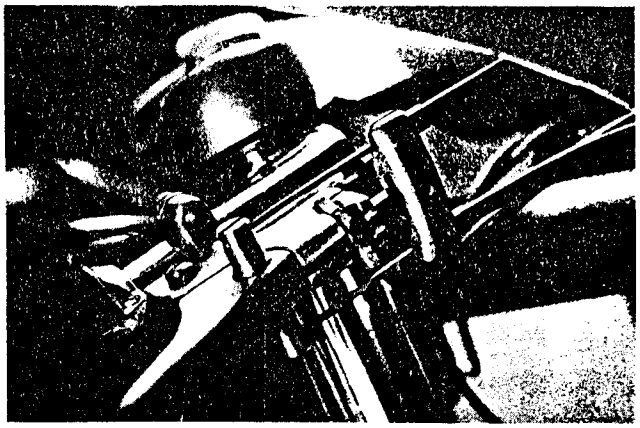
Thinking about the problem on the long ride home, Kurt stopped the car at the side of the road and looked at the points. The left side terminal lug had broken. During practice the terminal fitting on the right side of the point assembly had snapped from vibration and had been replaced. "Who would have thought it would happen again," he muttered, "and so soon."

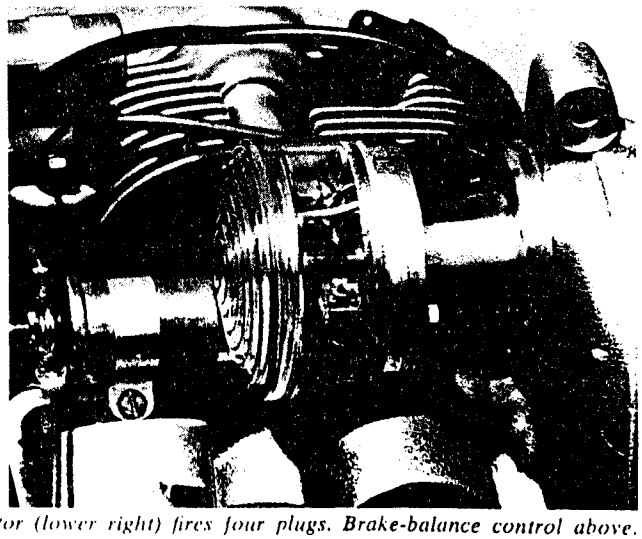
The AAMRR East Coast championship race at Danville, Virginia, a few weeks later was the last official race of the season. The Mosport trouble was hopefully repaired and practice was used to lean the still-rich mixture. The Special was running extremely well on Saturday and later that evening Kurt remarked to friends that the bike was the finest handling 500cc machine he had ever ridden. The engine's higher compression and lighter flywheel allowed the bike to decelerate properly, a characteristic sadly lacking in the earlier R.S. designs.

Fontana double leading shoe front brakes made quick work of pulling speeds down for the track's many corners. "The Special was negotiating the turns faster than any 500 on the track," Kurt stated in an interview. "Once we reach the common denominator for jetting at the various tracks, we'll be the machine to beat," he added with a grin.

Sunday's performance was in the money, so everyone thought. With a first place in the open class heat in the scorebooks, Kurt was leading by 30 seconds in the final after Berliner's Norton Special retired. Soon after, the Special began to







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Vibration insulated float-bowls feed twin Dellortos. Breaker-point-distributor (lower right) fires four plugs. Brake-balance control above.

misfire and two laps from a sure win, Kurt pushed the 300 pound roadster back to the pits.

The taste of failure was bitter indeed, especially when the Liebmanns pinpointed the cause to a duplicate of the Mosport problem—the terminal lug had split.

The last opportunity for victory in the 1967 racing season was in November. AAMRR was able to rent the Upper Marlboro course in Maryland as a private club event.

The Liebmann entourage was there to end the year on a positive note. The O.L. Special and its sister bike sat side by side under the constant eyes of fascinated pit personalities.

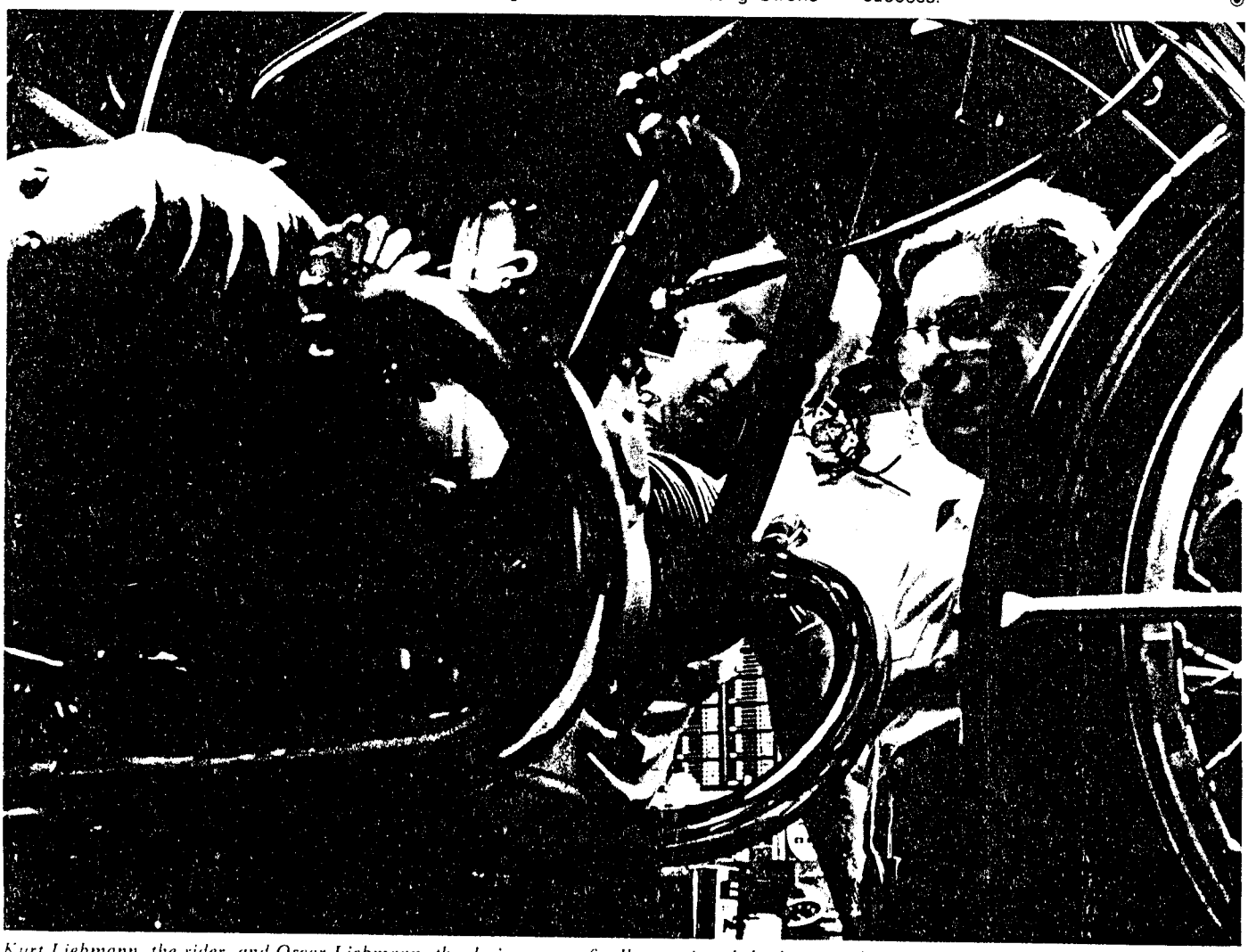
Saturday and Sunday's practice proved once again that performance was outstanding if not plagued by absurd troubles. Shortly before the 500 event, mechanic Julius Vicze started his charge for the pre-race warmup. Running for a few moments the engine shuddered to a stop. A quick glance at the point assembly revealed no breaks in the wires. In moments the problem became quite serious. Vicze then checked valve clearance and ruefully discovered that the left cylinder had none whatsoever.

Removing cambox and rockers, Julius found that tower shaft bevel gear assembly inside the engine had disengaged from the driving gear. A small circlip positioned to hold the two gears in mesh had fractured. A penny item dashed their hopes and defeated them again.

The faces were long and somber that afternoon. After a hurried conference, Oscar agreed that his R.S. Long Stroke would have a better chance on Marlboro's twisty short course if they mounted the Special's lower ratio rear end. The switch was worth the effort. Fred Simone brought honor back to the Liebmann camp, winning a first in class and a third overall in the open event.

With the long winter months behind, and memories sweetened with the patient long nights of teardown, adjustment and reassembly, Oscar Liebmann looks back with a bit more perspective. "We pushed hard," he said. "I sometimes think we should have waited until this year to put the Special on the track. But pushing is always the difference between running well or not running at all."

The Special's two near wins helped considerably to strengthen his philosophy and reaffirm the tenet that only good design and careful assembly can bring success. ◉



Kurt Liebmann, the rider, and Oscar Liebmann, the designer, are finally convinced they've sorted out their Wunderkind for the 1968 season.