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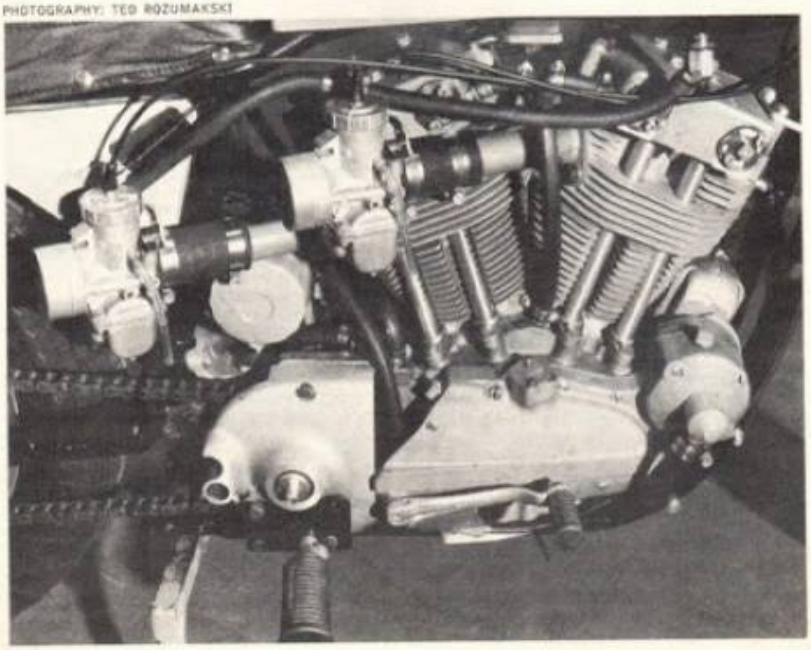
"XR-750", Harley Davidson Wants That Number One Plate Back

XR-750

Harley-Davidson wants that Number One Plate back. Harley means business—and the new XR-750 engine proves it.

BY JESS THOMAS

PHOTOGRAPHY: TED ROZUMAKSKI



The new engine draws mixture through two 36mm Mikunis set on long intake manifolds.

Seen *On Any Sunday*? I had just seen it for the second time when I got a call from Harley-Davidson's racing chief, Dick O'Brien. Although I leave the sanctity of the *Cycle* shop as seldom as possible, O'Brien's description of a few pieces on this month's cover had me at New York's LaGuardia Airport the next morning. Three hours later, I walked into H-D's racing department in Milwaukee. A new 750cc XR dirt racer was sitting on its stand, pointed directly away from me, slim and lithe. I threw a leg over the saddle and, as my hands touched the grips, I got a chilling wooo and the skin crawled on the back of my neck. My mind flashed back to Bruce Brown's incredibly captured action of Mark Brelsford and Mert Lawwill, and it was *me* out there flashing off into a dirt turn at 130 mph.

The original XR, now in its second year of use, was a very hurriedly developed machine; it was hustled into being in response

to an AMA equipment rule change. Going into the 1969 AMA Congress, where the rules for the 1970 season were decided, O'Brien knew that the rules were probably going to be changed to allow 750cc engines, of any production type, to be used in AMA pro racing. Probably. There was also a movement afoot to lower the limit to 350cc. Either way, the British (BSA-Triumph) were covered. The 750 threes had been introduced, and the DOHC 350 twin was already well into development. By that time, however, even the most casual observer could see the folly in trying to beat Yamaha in a straight-across 350cc formula. Even with the cards thus stacked against Harley-Davidson, O'Brien could scarcely afford to invest the million-odd dollars, necessary for production tooling and casting, based on probables. He has seen how quickly and unpredictably things can change on the General Assembly floor of the AMA Congress.

O'Brien's problem was unique. All the other factories race modified versions of their production machines. At the time, H-D didn't make anything that could be easily converted to correspond with any of the proposed new rules. If O'Brien wanted to race anything new, he had to produce 200 complete units, in order to comply with the AMA's production-based racing rule. In order for a new bike to be approved for racing, it must be submitted for basic approval at the AMA Congress. Then, anytime during the year that the 200th unit is visually inspected by an AMA official, the new machine can be raced. To cover himself, O'Brien submitted a 750cc OHV V-twin at the Congress. Then on the General Assembly floor, he made an impassioned plea to postpone the 750 formula for a year "to study safety aspects." The other manufacturers ganged up to ridicule the safety question, and the 750 formula was roundly shouted into law. At the same time, a three-year lead time was imposed on any subsequent rule changes that involved engine size.

So it was either build 200 motorcycles from scratch in four months, including development, or race the old 750 side-valvers, or not race. O'Brien didn't want to race. He wanted to stay out and develop the engine for a year. But, under a management edict, production on the 200 racers started on the Monday morning after the AMA Congress. And O'Brien has been playing a catch-up game, while nursing his ulcer, ever since.

The first development XRs began to take form in January 1970. H-D's XLR engine (the racing version of the 883cc Sportster engine) was destroked from 3.81-inch to 3.18-inch, and the bore was retained at 3.0 inch. The crankshafts, thus modified, did not leave enough room to use the traditional anchor nuts on the ends of the keyed tapered mainshafts. So the ends of the shafts were manufactured straight and made a key-located press fit in the flywheels.

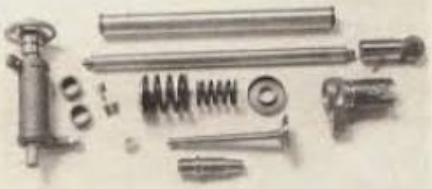
The first production pistons were machined from Offenhauser blanks and set to operate at 9.2:1 compression ratio. Standard Sportster rings were fitted. These pistons oscillated in stock Sportster cast-iron cylinders which had been shortened by half of the stroke decrease.

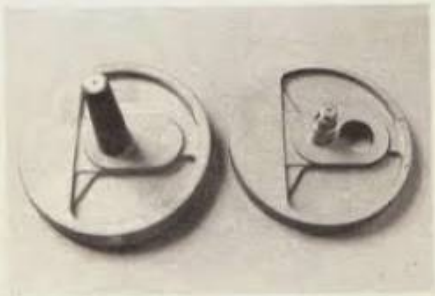
Mega-hours of inlet and exhaust port aerodynamics produced the final breathing configuration for the cast-iron heads. Starting with XLR castings, and using smaller port cores, the cylinder heads were hand-ported and polished to accept the smaller valves that the flow bench demanded. Standard Sportster valve springs, with heat-shielding insulators under the springs, performed perfectly in early tests.

Except for the mentioned component changes involved with the stroke decrease, the rest of the engine remained the same as the XLR: gearbox, triplex primary drive chain, seven-plate clutch, four-speed gearbox, roller-tappet cams and a space-age tractor magneto by Fairbanks-Morse.

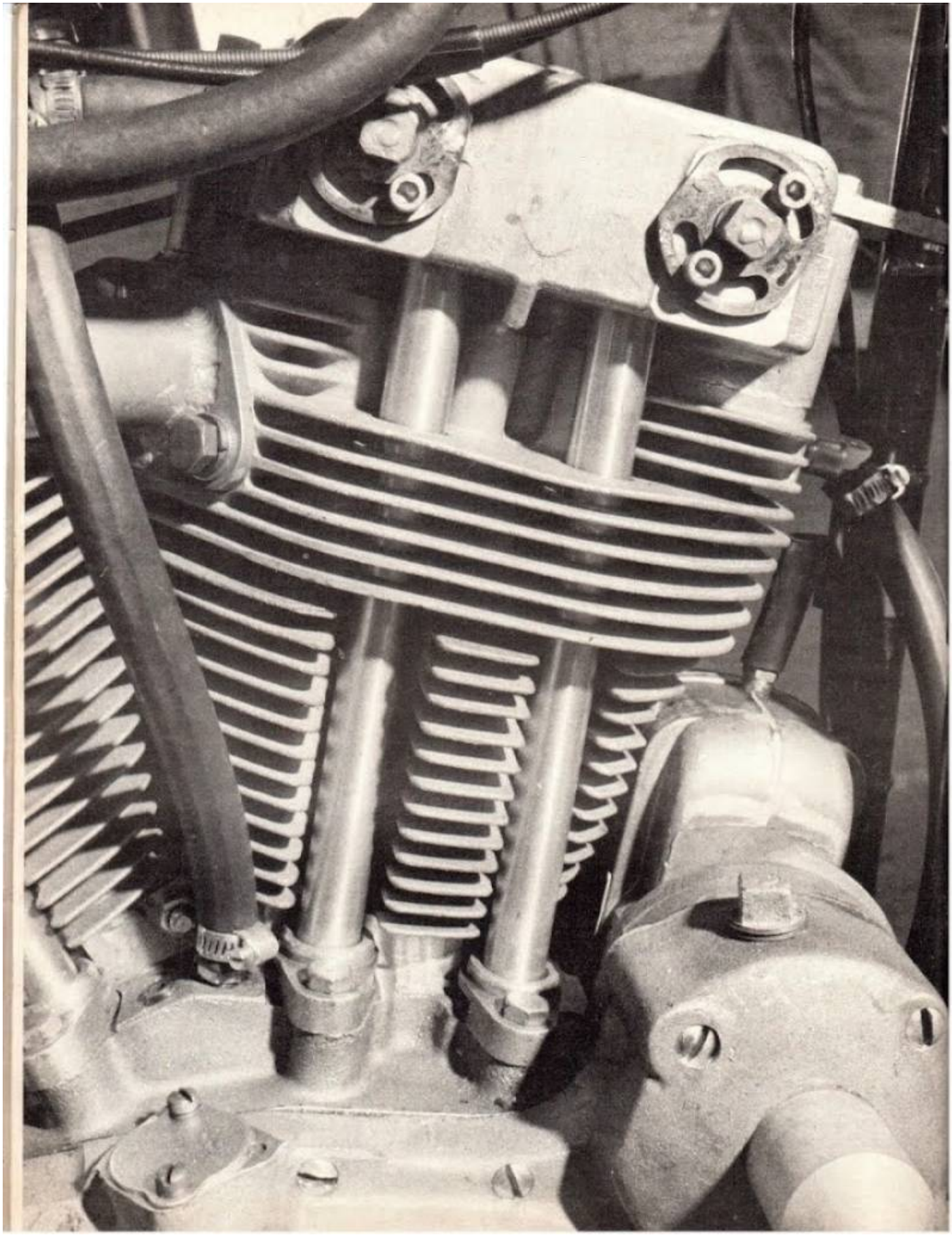
Development on the thin-wall chromemoly frame had been taking place for two years. It was virtually the same as the swingarm TT frames made for the factory team XLR models. Thirteen-inch Girling shocks controlled swingarm movement and Ceriani roadracing forks took care of the front end. H-D's beautiful, light alloy brakeless dirt-track wheels were shod with Goodyear tires: 4.00-18s on both ends.

Looks are a matter of personal pride with O'Brien. He was a model builder as a kid, and now his home is accented with his paintings. Long hours were put in at Wixon Brothers making minute changes in the beautiful seat-fender and tank combination. A hand-made polished aluminum oil tank was the crowning jewel that set off the molded-in orange and black fiberglass.





Different head designs, initially machined out of plexiglass blocks, were carefully flow-tested before head design was finalized. Valve train components include aluminum-bronze guides, valves with chrome-plated stems, Teflon guide seals, Sifton alloy collars and steel keepers, new rocker arm set-up pivoting on needle bearings, and eccentric rocker-arm assemblies. Crankshaft halves and mainshafts are one-piece forgings of 4130 steel. The crankpin is straight and measures 1.5 inches in diameter. Hard alloy valve seats are a shrink-fit in the cylinder head casting.



Word leaked from H-D's racing department that preliminary tests were extremely favorable. O'Brien returned from an extensive Daytona session grinning like a racoon. The first time I saw the XRs run in private hands was at a half-mile race a few days before Daytona in 1970. Most of them melted. It was an ill omen that was to darken the eyes of H-D's legion of racing followers for the rest of the year.

Mert Lawwill led the Daytona H-D faction into Florida, sporting his big Number 1 plate. None of the factory bikes finished the race. And this ill fortune continued for most of the year. Mert limped in for enough points to get Harley their highest national number with #6.

H-D was down, but far from out. Development during early 1971 had the XRs marginally reliable. Dave Sehl won several half-miles in a row, then Mark Brelsford stunned everyone by gunning down Kel Carruthers to win the Laconia Road Race. Monstrous amounts of oil were being forced through the cast-iron engine and oil coolers. Still the compression ratio had to be kept down to 8.5:1 for any hope of longevity.

During all the '71 National Championship series, Nichols Engineering was contracted to maintain and develop the H-D team road racers. And most of the riders were doing their own dirt track maintenance. Obviously there was a lot going on at the H-D Factory Race Shop to occupy the time of the whole crew there.

As I sat there in H-D's Department 978, imagination-racing the 1972 XR, and looking at the mass of new components spread out on the bench, one of the test engines was straining under an artificial load on a dynamometer two floors below. Dick O'Brien listened intently for a moment before proudly continuing his explanation of the new pieces.

Crankshaft halves and their mainshafts are now one-piece forgings of SAE 4130 steel. In a forging, it is possible to arrange the grain structure of the steel to follow the lines of the loads that will be placed on the component. For a given section, a forging is some 40 percent stronger than a bolted-up assembly. The old tapered and bolted crankpin is replaced by a straight, 1.5-inch diameter crankpin which is an interference fit in the crank half. Because of space gained in negating the nuts on the crankpin, the stroke has been further shortened to 2.98-inch. The aluminum-alloy caged, $^{9}/_{16}$-inch diameter roller bearings, which travel in three rows around the crankpin, are the same trouble-free units used previously. Scrap rate used to be quite high on the critical cage rings before the present tape-controlled boring machines were used to cut the roller slots. The new connecting rods, forged of SAE 8620 alloy steel, are an inch shorter than last year's and have integral bearing races in the big-end in place of the previous replaceable races. Replacement rollers come in .0005-inch increments for rebuilding. With the crankshaft assembled and aligned, aluminum expansion plugs are pressed into the ends of the hollow crankpin to create an oil reservoir for the connecting rods.

By decreasing the stroke, engine-killing piston speed has been decreased by over nine percent at 7500 rpm, and centrifugal loading of the big-end bearings decreased drastically in the bargain. Overall engine height is also down slightly.

Corresponding to the stroke decrease, piston diameter is up to 3.125-inch. The new piston is forged by the same supplier in Northern Italy that made the 350cc Aer-Macchi racing pistons. When I asked O'Brien about the tool marks on the skirts, he chuckled, and relayed that the turned skirts lubricated much better than the customary ground finish. The pistons felt extremely light and were quite thin. Teflon buttons replace circlips in the wristpin-hole ends. The wristpins are taper-bored to reduce weight: thin at the ends and thicker in the center. Only two rings seal the piston's travel. The compression ring has a drastically tapered top edge, to act as a wedge for gas-pressure sealing, and the friction surface is molybdenum filled to insure quick seating. The oil ring is three-piece scraper tupe.

The massively-finned cast aluminum alloy cylinders and heads caused O'Brien's eyes to go a little moist as he cradled them in the crook of his heavy arms and recalled the months of tedious detail work that went into their making. Both cylinders and heads are cast of something known as Spaceage Material #2. Apparently the alloy is quite tricky, and requires some kind of government permit for private use. It has a high silver content, which allows it to suck up heat like a carp on a river bank, and it has 70,000 psi tensile strength at 80 degrees F. Wow! Har-

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(Opposite page) The adjusters for the eccentric rocker arm assemblies are on the righthand rocker-box covers. (Right) The heads, as well as the cylinders, are cast out of Spaceage Material #2. The exhaust pipes duck out the leftside of the engine. The Spaceage stuff has a 70,000 psi tensile strength at 80 degrees F. cylinder liners are spiggoted iron liners. The two-ring pistons are very light—and thin; Teflon buttons replace circlips. The compression ring has a drastically tapered top edge to act as a wedge for gas-pressure sealing.

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ley-Davidson has gone from cast-iron to Spaceage Material #2 in one year.

Liners for the cylinders are spiggoted iron sleeves. The sleeves protrude from the cylinders and fit snugly into the crankcase openings. Due to the increase in bore size, the boss on the crankcase castings has been increased almost an inch in the diagonal measurement of the corner areas. Long through-studs, made of SAE 1146 "stress-proof " alloy screw into the crankcases, and the studs go up through drilled holes in the cylinder castings.

To facilitate investigating the feasability of different head designs, several different concepts were first machined of plexiglass blocks. These versions were then exhaustively tested for flow capability on several different flow benches. The layout decided on as final has a 68 degree included angle between the valves (the old head was 90 degrees), with the inlet valve being 35 degrees off the vertical. O'Brien's flow studies have reached the computer analysis stage. With this ability in hand, he has been able to decrease inlet valve head diameter from 1.93-inch to 1.65-inch diameter. Exhaust is down from 1.75-inch to 1.38-inch. Inlet and exhaust flow are now correctly in proportion, and the streamlining has allowed removal of excess valve weight. A lot of mechanical power losses have been reduced in the new heads. With lighter valves, lighter spring pressures could be used.

The valves are manufactured for H-D by Eaton Valve, and have chrome-plated stems. The valve seats, made by Wassau Metals, are a very hard alloy and are a shrink-fit in the head casting. Number 8 Ampco aluminum-bronze guides hold the valves concentric with the seats. Very short H-D valve springs are compressed between Sifton alloy collars and steel keepers. Because of the large volume of oil being pumped through the valve spring cavities, Teflon lip seals are used at the tops of the valve guides.

Identical, except for the angles of the drilled pushrod tube ways, the heads fit down over the through-studs and are secured by nuts in recessed sockets. No gasket is used between the cylinders and heads: a lapped joint seals all. The heads must be fastened before the rocker boxes are installed.

New rocker arms, with a 1.48:1 ratio, pivot on four needle bearing assemblies each. Valve adjustment is accomplished with the use of eccentric rocker-arm spindles. You stick a feeler gauge through an inspection cover hole, and rotate the spindle until the right clearance is obtained. The eccentric spindle removes the need for a screw-type adjustment on the tappet or rocker arm end, making the whole assembly a lot lighter. The long, tubular pushrod covers have O-rings at each end which jam into the tappets and rocker boxes to form an oil tight seal.

The engine (17 lbs. lighter than the cast-iron XR) has a very clean, yet massive, look. With 73 percent more fin area, the cylinders practically touch. With the 36mm Mikuni carburetors in place on one side, and the upswept, flat black, reverse-coned exhaust pipes jutting out the other, it's a hard looking instrument indeed.

Several details were not yet final. A pile of test camshafts was on a bench, and several possible aircleaner layouts were being studied. And a new breather-valve and oil separator were in the works.

The chassis has been changed very little. After two years' use, the steering head angle is being brought back to 26 degrees (instead of 27), and the head itself moved out just enough to keep the front axle in the same position as before. The Girling Road Racing rear shocks have been shortened an inch to 11.9-inches between centers. Subtle but tangible jacking that the pros Harley hires can feel on a warm-up lap.

It has been two years since the National Champion wore orange-and-black leathers. Not one of those men down in department 978 likes to get beat. And not one likes the long looks that the team members have after a race. When I left, they were harrassing each other about minor mistakes found. And that engine on the dyno was still pumping under full load with 10.5:1 compression ratio. ◉

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article posted by Dr Dick of the XLFORUM
https://www.xlforum.net/forum/sportster-motorcycle-forum/sportster-motorcycle-era-specific-and-model-specific/ironhead-sportster-motorcycle-talk-1957-1985/170346-send-the-wife-and-kids-out-of-the-room/page5