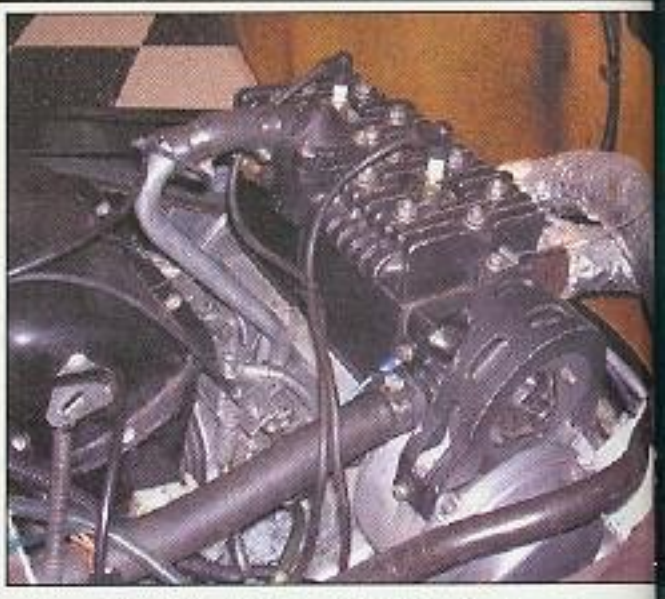
Vintage Rider

1977 Scorpion BullWhip

Look out Cat,
Look out Ski-Doo,
Scorpion is
comin' thru!

By Hal Armstrong



The release to the public of special build race sleds was as anxiously awaited in the fall of 1976 as it is today. Snowmobile race fans can't wait to see what their favorite sled maker has built to do battle on the Sno-X circuits. Almost thirty years ago the manufacturers were building purpose built sleds for the original type of terrain racing - Cross Country.

The winter of '76 saw a big push from John Deere. They were gaining market share by focusing on the ICCSF (International Cross Country Race Circuit) which included the famous I-500 "Winnipeg to St.Paul, MN" race. In fact, John Deere had ended the dominance of Polaris and Arctic Cat by beating them in their own back yard at the 1976 running of the I-500. The brain trust at Scorpion had taken a different approach from Deere. They had been focusing their R & D efforts on the oval track wars during the '75 and '76 seasons, evaluating new chassis designs and a radical new engine.

As development was evolving on the SnoPro sleds, engineering was fine tuning the engine that featured a unique induction system. John Lenertz (Scorpion engineering) was designing the first high performance motor to be used in a Scorpion cross-country performance sled. Yes, Scorpion was shifting gears from oval to terrain racing and the smoke screen they set by competing on the oval track was working just fine. The ICCSF rules (1977) limited engine displacement to 340cc, but not horsepower. This opened the door for some very interesting engine designs and allowed the manufacturers to bring liquid cooling from the oval wars to the x-country circuit. The new motor that John Lenertz was to bring to life would feature rotary valve induction and a new aluminum alloy that was starting to see use in the automotive industry.

The rotary valve induction on the Cuyuna 340 was not a Rotax copy. This design was much simpler and still retained all of the advantages. The engine used machined crank lobes to regulate the fuel/air timing into the engine. Twin Walbro carbs were mounted directly onto the crankcase with no reed valves. The crank lobes were machined to provide .003"-.005" clearance with the inside of the crankcase and also featured machined "scoops" on the leading and trailing edge of the crank lobes to improve volumetric efficiency.

The rotary valve design allows the intake to open earlier BTDC (before top dead center) and close earlier ATDC (after top dead center). This provides up to 200 degrees of intake duration and also allows more time for crankcase compression. All of this adds up to an engine that can pump more fuel through it and deliver a broader power band than a piston port engine, which

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was common in those days. A broad power band makes clutch tuning a lot easier and jetting much simpler. The key to this induction system was maintaining the tight clearances between the crankcase and crank lobes.

The motor also featured an aluminum alloy developed by Reynolds Aluminum called "A-390". This alloy has a high silicon content, which allowed engine builders to diecast cylinders without using iron cylinder sleeves or other coatings such as chrome or Nicasil. This lowered production costs and also provided a couple of advantages related to performance. The struggle in manufacturing included accurately boring the cylinders with diamond cutters and then using an "etching" process to expose the silicon particles at the surface of the bore. One advantage was an engine bore that was impervious to wear, as silicon is very hard and wear resistant. Another advantage of using A-390 was with the absence of a cylinder liner. A one-piece cylinder made of A-390 expands at the same rate, which is not the case for a cylinder made from aluminum with iron cylinder sleeves. The cylinder bore could now stay round due to constant thermal expansion. The end result was an engine that delivered consistent compression as the engine temperature increased.

The other notable feature of this engine was diverting engine coolant around the exhaust ports. The engine really had a double exhaust port, which was machined by maintaining a bridge in the middle of the

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opening. The bridge prevents the piston ring from bulging out the exhaust port and breaking. The only way to maintain the dimensional stability of the bridge was to cool the exhaust port.

How much horsepower was this motor designed to produce? A respectable 70 hp @ 8500 rpm. This was as much power as any 340 motor was putting out back in the late 70's and was a force to be reckoned with when the race action included some lake running.

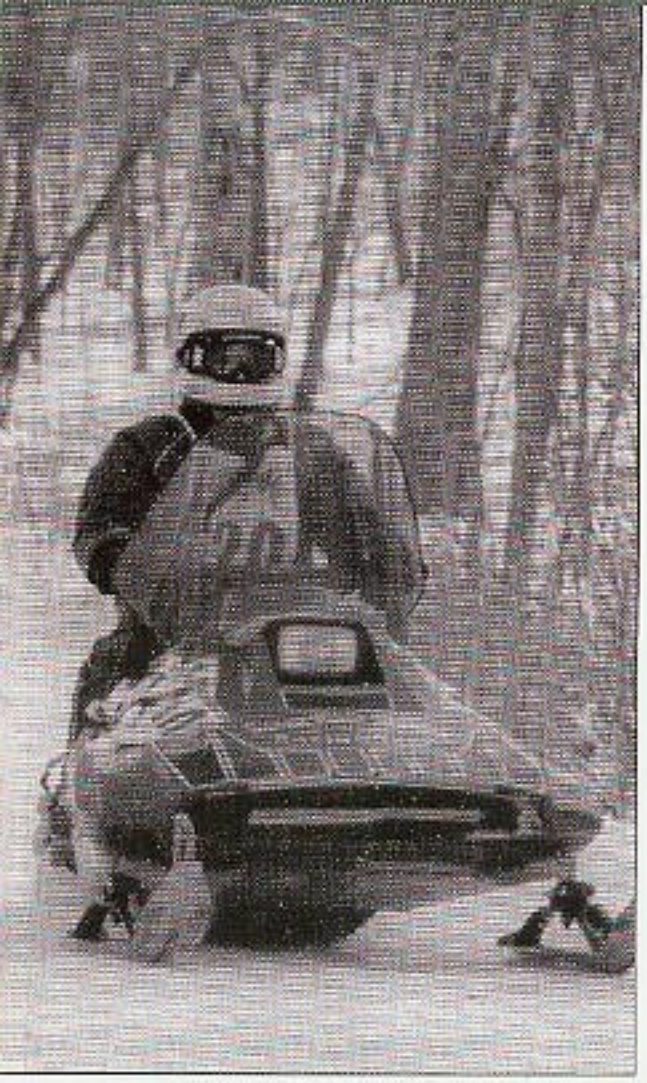
Simplicity is the best form of sophistication. In this case the Lenertz-designed motor had all the bases covered. However, as anyone who has worked in manufacturing knows, introducing a new process to the production floor always has a way of bringing some good engineering to its knees. In the case of this engine, the tight clearances needed between the crankcase and crank lobes were not always within spec. This resulted in hard to start engines and motors that did not produce the power they were expected to deliver. Lenertz came up with a quick fix as the season progressed by installing reed valves between the carbs and intake ports. This improved the efficiency

of the crankcase compression without having to replace the entire engine. In summary, the engine needed additional development time, as we see even today with many new engine introductions. John Lenertz was not given the chance.

To meet the pounding of point-to-point competition, the BullWhip was built around a patented perimeter chassis. The idea behind this design was to build the entire frame forward of the tunnel around the engine to improve torsional rigidity. This was accomplished by eliminating the front bulkhead that supports the engine and steering spindles. The new chassis used a pair of structural "Z" shaped aluminum members that ran from the outer edge of the foot rests to a cross axle that connected both sides and supported the ski spindles. The front end was basically a box, which resulted in the chassis being built around the engine compartment rather than through it. The ski stance was a super-wide 36". The increased torsional rigidity improved drive train alignment and also allowed the motor to be hung between the cross members resulting in a very low center of gravity. The super low engine mounting required the steering column to be routed over the recoil of the engine rather than beneath the engine, as was the norm on every sled built at that time.

The cooling system for the engine was also a perimeter design that was incorporated into the chassis of the machine. The coolant was pumped from the engine along the left side rolled edge of the running board to a heat exchanger mounted above the snow flap. The coolant would then flow along the right side running board rolled edge back to the engine compartment. (Polaris now uses a similar system on their late-model mountain sleds.)

The front suspension consisted of leaf springs with shocks, and the rear suspension used the Scorpion-exclusive Para-Rail suspension that was tailor made for marginal snow conditions. The Para-Rail was simply a pair of aluminum rails that supported a number of wheels. Torsion springs com-



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bined with a single hydraulic shock mounted on the rear arm controlled the limited suspension travel. To increase suspension travel, the rear idler wheels were reduced in diameter by one inch. Of course, rolling resistance increased. The Para Rail claim to fame was that it offered the stability of a slide rail suspension with the go anywhere feature of a bogie wheel suspension. It worked well.

Other standard features included twin fuel tanks (for a total of 10.5 gallons) and hydraulic disc brakes. Power to the ground was delivered by a Gates Power Bite track made of polyurethane.

So, with all this technology, the question that begs to be asked is, "Did the sled put Scorpion back in the winners circle? The answer is no. The reasons are numerous. Scorpion only built 200 of the sleds so at any given race they were out numbered by the competition. The sled needed additional tweaking as the race season progressed. Ask any Sno-X racer today how many upgrades are issued during the winter. Cash flow to continue to invest in a new engine design was not available. Scorpion, like all the manufactures after the winter of '77, was left with many unsold sleds from another poor snow winter. The rotary valve Cuyuna-powered BullWhip project was shelved and Scorpion looked at refining the production of their bread and butter piston port engines for the '78 season.

Scorpion did return to the winner's circle on the SnoPro Oval circuit and for three years (1979 – 81) fielded one of the most competitive race sleds and team ever. The "Scorpion Squadron" brought Scorpion the fame the BullWhip was intended to deliver. The sled that showcased all the technology Scorpion had to offer simply lacked the development time needed to bring this sled from the racetrack to the show room floor.

Jim Solberg's Vintage Snowmobiles
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Scorpion Bullwhip intake port

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Scorpion Bullwhip piston