© Punch Torino SpA

“The combustion engine is becoming a commodity”

Punch Torino SpA, formerly General Motors Engineering Center Torino, has developed a state-of-the-art diesel engine for the American full-size truck market. In the interview, Pierpaolo Antonioli, CEO of Punch Torino SpA, explains the potential of diesel engine development, optimized charge exchange and the future prospects of the compression ignition engine in electrified powertrains.

MTZ _ A stormy period lies behind you, I would imagine, after the General Motors Propulsion Engineering Center Turin was sold to the Punch Group in February. Has this fundamentally changed your work?

ANTONIOLI _ Yes, this period has been really challenging for me and for the

Company. At the end of February, the Punch Group has acquired the Engineering Center of General Motors in Turin, thus becoming Punch Torino SpA. The transaction has let the Punch Group to reposition the company with developments for new market segments while

continuing to provide engineering services to GM. The Group wants to become a leader in driveline solutions based on our unique competence to develop and integrate technologies, components or processes into competitive solutions. That requires a change in our mindset

Pierpaolo Antonioli (born 1963) has a technical background in Electric/Electronic, Mechatronic and Control Engineering. From September 2009 until February 2020, he has been Managing Director of the General Motors Engineering Center in Torino (Torino Polytechnic Campus) which had global responsibilities for the development of diesel engines, electronic controls and hybrid technologies for passenger car applications for the whole GM Corporation. In February 2020 the Engineering Center was acquired by the Punch Corporation. Since then Antonioli is CEO of the Punch Torino SpA. Moreover, he is a member of the Advisory Board for the Attraction of Foreign Investment of Confindustria (Italian Industrial Federation) and he is a Vice President of Unione Industriale (Industrial Federation) of Torino. Since July 2016, he holds the Chairman position inside CEIP (Centro Estero per l'Internazionalizzazione Piemonte).

© Punch Torino SpA

and our way of working, passing from a large to a lean organization with entrepreneurial mindset. This has resulted also in a change in our engineering center perspective: from cost center to profit center, from pure engineering to product development for multi-customer, multi-purpose markets. Our products must be excellent in terms of quality, affordable, competitive and “price attractive” for the customer and generate revenues that make them profitable. After the dissolution of Fiat General Motors Powertrain (FGP) in 2005 and my appointment as Managing Director starting from 2009 I have learnt that criticalities can become opportunities. This is exactly the philosophy that I’m applying also in this challenging period, due to the strong impact of Covid-19 not only on the health and safety of the people but also on the global market economy. The strategy we’re applying is investing in technologies that others are considering obsolete, but which support the economy of the products we sell. And, in parallel, investing in Innovation in two ways: re-using innovation in adjacent business – to give you an example, related to current times: we are exploiting the competences of our engineers working on Artificial Intelligence for medical support – and focusing on brand-new products, where competition has not arrived yet.

One of the latest developments was the 3.0-l Duramax, a diesel engine for light commercial vehicles, pick-ups and large SUVs, of all things. Does such an engine still have a place in the current era? Can the move towards a compression ignition engine be understood as a political statement?

This engine for sure has a place in the current and future era. It has been introduced by GM in its most important platform T1 for full-size trucks and SUVs, starting from a clean sheet design. This means a strong commitment in fuel efficiency, well recognized by the market and the international engineering community as one of the best combustion engines with

“It is by definition a future proof engine”

7.13 l/100 km as a full-size truck segment record and Ward’s AutoWorld magazine 10 Best Engines Award for 2020. It is kind of a political statement, being by definition a “future proof” engine – with high sustainability in terms of GHG, pollutants and noise – as an excellent bridge solution toward e-mobility.

What future do you see for the diesel engine and the combustion engine in general?

It is quite difficult to make any forecast in this challenging period where many parameters are not stable, like the crude oil pricing, infrastructure investments, Covid-19, legislation requirement, public pressure, environment concern or customer acceptance. At the same time, we believe in a long-term transition to e-mobility, where the solution adopted will be based on the vehicle segment and on regional markets. The length of this transition and the uncertainty of the extent of it are still suggesting a key role of highly efficient propulsion systems, especially for light-duty and heavy-duty vehicles, for which weight and range anxiety are even more critical. Several visions have been developed by different players, everyone coming to the same conclusion.

During development, special attention was paid to the combustion process.

Can you briefly classify the measures?

Let me first comment that the combustion development is a core competence of the Torino Engineering Center and I am very proud of it. The combustion system has been instrumental to the achievement of performance, efficiency and NVH of the 3.0 Duramax. It has been engineered at system level, including intake system, patented piston bowl, injection system, charging and EGR. It features very aggressive settings with a compres-

sion ratio of 15:1 with US fuel for achieving ultra-low emissions, with no compromise on fuel economy, 2500 bar of rail pressure for power density and a low swirl ratio for heat exchange reduction.

In your opinion, what is the potential of an optimized charge exchange?

Particularly in terms of emissions and efficiency?

The potential is extremely high and special care has been devoted to it during the engine development, even with a state-of-the-art single-stage charging system. Thanks to a high efficiency ball bearing turbocharger matching, the in-line six-cylinder deploys a wide torque band with his peak torque of 624 Nm at 1500 rpm, 95 % of it available at 1250 rpm. Coupled with the turbocharger, and not less important, is the watercooled charge air cooler to achieve fast response and transient emission at the same time, down-speeding and optimized transmission upshift.

The valve train in particular is used to optimize the charge exchange; how do you see the possibilities here? Is a valve train that is as variable as possible preferable or do you expect to see refinement with fixed timing in the future?

We do see both – the optimization of the fixed timing as a cost compromise, while developing variable timing solutions for specific applications. We do have different variable valve timing solutions under development to enable emissions optimization through exhaust thermal management of the aftertreatment system. There is no preferable solution as cost and reliability trade-off have to be addressed carefully. There is no universal solution.

How do you think the combustion engine will develop in general? Toward ever greater variability or rather toward the simplest possible designs and dedicated areas of application?

The development of combustion engines is strongly affected by the reduction of investments diverted by electrical mobility. So simple design and dedicated areas of market and application could provide an optimized cost for the development and a competitive solution

© Punch Torino SpA

“The mild hybridization proposes a better balance between costs and benefits for diesel because of the higher specific cost of the engine itself,” says Antonioli

“We believe in a long-term transition to e-mobility”

in customer perspective. This could be an enabler to make a hybrid diesel powertrain a viable option where the markets are not ready for huge investment in electrical infrastructure. The combustion engine is becoming a commodity and the standardization could minimize manufacturing and development costs.

What effect on combustion and charge exchange can targeted electrification have?

The Torino Engineering Center executed

several hybridization studies to optimize major attributes of internal combustion engine, like performance, fuel economy, emissions optimization, drivability and NVH. Out of those studies, the mild hybridization proposes a better balance between costs and benefits for diesel because the higher specific cost of the engine itself. The savings add up to about 10 % in fuel economy with an extra cost of about 1000 euros. This is why all major carmakers invested hugely in this technology in the past years, launching multiple applications in mass production. Additionally, mild hybridization with e-boosting is a very interesting proposition, combining performance and cost in an attractive way. It could enhance opportunities for downshifting and downsizing also for fuel economy-oriented applications. Coming to the question of the load point shifting, we believe that the so called phlegmatization offers a better matching with gasoline engines due to sweet spot achievement in the BSFC map rather than with a diesel, where the flat map benefits less from load shifting.

In modern turbocharged diesel engines, the compression ratio is lowered to improve the emission behavior. Couldn't the higher exhaust gas temperature resulting from high compression ratios be used, for example to shorten the cold-start phase and effectively use the waste heat in WHR systems?

After years of development we still believe that a low compression ratio is capable to provide very low emissions. It is also true that an increase of CR would lead to higher gas temperature and faster warm up but with a higher fuel consumption in the warm cycle which is more impactful to the customer. Waste heat recovery is leveraged primarily in long-haul heavy-duty truck engine thanks to the stable and high load characteristics of their emissions. For light duty passenger cars, the prerequisites aren't yet there.

Mr. Antonioli, thank you very much for the very interesting insights.

INTERVIEW: Marc Ziegler

Heavy-Duty-, On- and Off-Highway- Engines 2020

Internal combustion engines
and their alternatives

10 – 11 November 2020
Mannheim, Germany

/ ALTERNATIVE CONCEPTS

Batteries, hybrids, and fuel cells

/ CO₂ AND POLLUTANT EMISSIONS

Legal requirements and solutions

**/ NEW DIESEL, GAS, AND
DUAL-FUEL ENGINES**

Development trends and new components

**HIGHLIGHT
FACTORY TOUR**

to
Daimler Truck AG