Telescopic Handlers – New Transmission Choices

In recent years, OEM's have had two main choices when deciding on transmission technology for Telescopic Handlers. Powershift transmissions with a torque converter and hydrostatic transmissions are popular choices with different performance characteristics.

Powershift transmissions with a lock-up torque converter offer very good roading performance and efficiency on higher specification machines that offer automatic shifting that matches speed and torque requirements. The addition of a torque converter allows torque multiplication for good tractive effort when used in loading applications. The downside of this combination is efficiency losses during loading operations. Directional changes during reversal operations results in losses at the torque converter[1] that have a large impact on fuel consumption in an otherwise efficient and simple mechanical transmission pathway.

Hydrostatic transmissions offer good low-speed functionality and efficiency as there are no torque converter losses as seen with powershift transmissions. However, at higher speeds and in light duty applications, hydrostatic transmissions have poor efficiency due to its inherent design[2]. Two speed hydrostats can expand the operating range and reduce noise levels but at the expense of increased cost and complexity.

It needs to be noted that combinations of a hydrostat and a powershift transmission are starting to enter the market to merge the best characteristics of each technology. While the new combination looks to solve the weaknesses of each technology, the cost and complexity of these new combinations could potentially limit market adoption.

These current transmission options represent mature technologies with minimal potential efficiency improvements and cost reductions. End customers ultimately decide the level of sophistication of these technologies as cost determines the number of speeds and automatic shifting patterns through a wide range of operating conditions. The versatility of telescopic handlers presents a unique challenge to OEM's as the variation of end customer duty cycles can dramatically change the transmissions performance and overall efficiency.

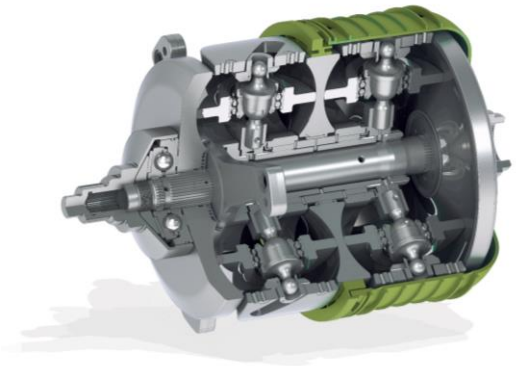

Figure 1. CVTCORP's - CVT Module

Mechanical Continuously Variable Transmissions (mCVT's)
The first telehandlers with Mechanical Continuously Variable Transmissions (mCVT's) are now being introduced into the market. This new technology (Figure 1) has been developed for both the agriculture and construction markets that require ever increasing fuel efficiency while offering operators a very precise, intuitive and easy to use technology.

The mechanical toroidal design of this mCVT, allows the full torque from the engine to be transferred to the ground at a higher efficiency and lower engine rpm than any other current transmission options. The mechanical design of mCVT allows infinite ratios control between a defined ratio span to properly match the speed and loads to optimize complete driveline efficiency[3]. Engine efficiency gains of 6-9%[4] can be seen while using a mCVT versus traditional powershift and torque converter technologies. The simple mechanical design pathway also minimizes parasitic losses through the powertrain. The mechanical nature of this toroidal CVT allows a wide range of mechanical and electronic engines options to be used for different worldwide specifications and platforms.

Figure 2. CVTCORP's Complete Transmission

Two other design features (Figure 2) make the mCVT attractive for future OEM consideration. The first is the integrated powershuttle for forward and reverse directions. This feature allows for quick and precise direction changes, increasing equipment productivity and more importantly, increased operator ease of use. The second design feature is the use of a powershift clutch between the hi/low ranges that allows for seamless acceleration from

idle to top ground speed, without any operator intervention. This feature also mimics the function of a torque converter in loader situations providing excellent tractive effort. These two features combined allow any inexperienced operator to use a telehandler at maximum efficiency. Once the engine is on and the direction is selected, the mCVT automatically chooses the correct ratio based on speed and load requirements.

OEM Considerations

The overall efficiencies of the mCVT allow OEM's to reconsider the engine requirement for use in a mCVT equipped powertrain. The improved efficiency and overall tractive effort of the mCVT can allow an engine to downsize while maintaining the performance level of current machines using more powerful and more expensive engines with older transmission technology. This downsize potential can offer cost, overall engine size and exhaust treatment advantages.

Overall, the development of the mechanical CVT by CVTCORP reduces the compromises that OEM's have had to make with traditional transmission options for telehandlers and other similar products like backhoe loaders, graders and wheel loaders. The simple mechanical design and overall efficiency allows for superior equipment utilization from high speed roading to low speed precise positioning operations.

Moving Forward...Quickly!

CVTCORP has already demonstrated the technology of mCVT's in the prime power generator applications for many years. Over 500,000 hours experience of durability and reliability has been gained in this application. The lessons learned and the simple mechanical design are now being adapted into different configurations for multiple powertrain options for the agriculture and construction industries.

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