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The Technical Benefits of Smartmatic for the Car Maker

Background

It is believed that the car industry is now ready to embrace a new generation of automatic transmissions that offer genuine fuel economy improvement in real customer use, are smaller, lighter, cheaper, more precisely controllable and far more versatile than “conventional” automatic transmissions.

The Smartmatic transmission is an elegant solution that delivers on all the features that the new generation of automatics require.

We now see a number of “automated” manual transmissions appear on the market, together with some “manualised” automatics, CVTs and even some Toroidal IVTs. These are all novel in one way or another, but they do not fill the need that is described above. They don’t go all the way.

The 1903 Leander Megy principle for automatically shifting gears in a layshaft constant mesh transmission using a clutch device in place of forks, synchroniser rings and dog clutches, offers a means of achieving those objectives. However, in those early days when sophisticated hydraulic and electronic technologies were not available, it met with very limited success. Even today, the embodiments of this principle that we have seen so far in cars such as the Mercedes Benz A Class and others, still have some significant shortcomings.

The Smartmatic transmission is however a whole new approach to applying the Leander Megy principle, an approach that circumvents the shortcomings in the above mentioned embodiments.

The Smartmatic delivers all the recognised benefits available from the Leander Megy principle with the added benefits of high precision controllability and a smaller and less power consuming hydraulic (or electric) system to operate it.

Overall, the Smartmatic offers the car maker the next generation of highly efficient, compact, light and cheap automatic transmissions with unparalleled controllability and versatility.

The State of the Art as at the beginning of the 21st century.

As stated in the background information above, we are seeing a number of attempts at alternative automatic transmission concepts appear in the market.

Some of them are automatically shifted manual transmissions where a computer module controls an electro-hydraulic substitute for the gear lever and clutch pedal. These usually have the feature of switching between automatic shift and manual shift mode, by way of buttons or paddles on the steering wheel or the like. Most of these offerings seem to be in the more “sporty” models of cars where a small lack of refinement in the automatic shift quality is more likely to be acceptable to the customer. This is not always the case however.

We are also seeing some embodiments of the basic Leander Megy principle appear on the market. The embodiments seen so far however, reflect the same approach that was patented by Ford in 1969 wherein the gears were engaged by a device made up of a spinning hydraulic actuator containing a multi-disc wet clutch pack; and they still employ a hydraulic torque converter as a launch device.

The major problems with this configuration are the high levels of parasitic power loss and the difficulty of precise control. The difficulty of sealing the spinning actuator, the resultant fluid loss and significant centrifugal pressure effects, all combine to make “timing” of the engagement and disengagement of gears quite difficult to control with any real precision.

All the offerings we have seen to date fall short of the mark in one way or another. Perhaps the most significant point is that none of them provide the versatility or the level of controllability offered by the Smartmatic concept, or the smoothness of engagement and disengagement the Smartmatic offers, even with open loop control. Smartmatic offers a fully functional automatic transmission with state of the art shift quality, unparalleled versatility, low parasitic power loss, low cost, low weight, and much lower levels of complexity.

Functional Benefits of the Smartmatic Technology.

At the heart of the Smartmatic transmission is a selector concept with some very significant features. These are a hydraulic actuator which does not rotate together with a clutch (selector) arrangement that requires much less energy to actuate, all of which can be controlled with a degree of precision which is unmatched in the prior offerings. This adds up to minimum levels of parasitic power loss and extraordinary versatility.

The non-rotating actuator eliminates centrifugal pressure effects, the sealing and fluid loss problems of a spinning actuator, and it needs much less fluid thus eliminating the variables that make precise control so difficult.

The Smartmatic therefore provides major controllability benefits. The absolute hydraulic pressure levels, the pressure rise rates and the pressure release rates can all be controlled with a level of precision not achievable with a spinning hydraulic actuator.

The higher level of control precision the Smartmatic offers is especially important in situations where the car maker wants to integrate engine and transmission control into a single module to extract the maximum benefit in terms of fuel economy, driveability and smoothness of the gear shifts for its powertrain.

The level of control precision needed to do this is fully achievable with Smartmatic. It is also a transmission that can be applied as a manual, semi-automatic or fully automatic with no changes to the gearbox itself.

Another important feature of the Smartmatic is the use of a low actuation energy selector that can be operated by the non-rotational hydraulic actuator as mentioned above, or an even less energy consuming electric actuator. The benefit is that a much smaller and less power consuming hydraulic pump or electric actuation system can be used, adding to the overall efficiency of the powertrain.

In combination with the non-rotating hydraulic (or electric) actuator, this gives Smartmatic a very efficient, compact and precisely controlled gear engagement and disengagement paradigm.

Design Versatility

The precise controllability features of the Smartmatic together with its low energy actuation requirement, make this design very versatile indeed.

The way the gear shift is initiated, the quality of the shifts, the shift speed (which can be virtually instant, or fully synchronised) and the switching between manual and automatic shift modes, are all determined by the control regime the car maker selects for any given model. There is no need to change the transmission itself.

Shift speeds ranging from 30 milliseconds to over a second can be set by the chosen control regime and can be fully integrated with an overall powertrain control system. Only the control system changes for applications in sports or luxury models.

Because the Smartmatic is based on the layshaft constant mesh gearbox configuration, the addition of ratios is quite straightforward compared to a conventional automatic transmission.

Automatic transmissions with 5, 6 or 7 speeds (or more) are readily achievable by applying the Smartmatic technology to any layshaft manual transmission platform that has the desired set of gear ratios.

DISCLOSURE: *Since first being engaged as independent consultants by Select Design Technologies Limited in the first quarter of 1999, the directors of Decson (authors of this paper) were appointed directors of Select Design Technologies Limited in July 2000. The authors of this paper can therefore no longer be regarded as independent consultants. The above statements on Decson letterhead are presented this way purely as a means of conveying to the reader the credentials of the authors to make such “expert” comment.*