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A Special CVT for a New Power Train Concept

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American Gear Manufacturers Association



TECHNICAL PAPER

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[The statements and opinions contained herein are those of the author and should not be construed as an official action or opinion of the American Gear Manufacturers Association.]

ABSTRACT:

The Autark Hybrid is the power train for a universal vehicle that is able to drive in inner city areas with zero emission and is also suited to long distance driving. The combination of two power sources – hybrid transmission with internal combustion engine (IC engine) and small electric engine – enables significant reductions of fuel consumption at constant power as well as at the U.S. city cycle. The fuel saving is accomplished by avoiding the partial load operation areas with high specific fuel consumption and by reducing the engine speed to an optimum value for long distance driving.

This concept requires a new power transmission with wide ratio range and continuously variable ratio. The requirements, the principle function and the progress in development of this so-called i^2 -CVT is described in this paper as well as the application in the hybrid power train.

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1 INTRODUCTION

A steady increase of ic engine driven vehicles can be noticed in all industrial countries. A big part of the air pollution and fuel consumption is caused thereby. Therefore, the reduction of primary energy consumption and pollutant emission of ic engine driven vehicles is nowadays an important issue. A suitable approach for a solution is a system orientated improvement of the entire power train which is tasked to lower the fuel consumption significantly. Due to the increasing traffic density the demand for zero emission is increasing i.e. electrically driven vehicles in urban areas and inner cities (noise, smog).

A power train concept, that on the one hand enables fuel saving while using the ic engine and on the other hand enables short distance driving with electric engine (working as motor) would be perfect.

The Autark Hybrid aims to meet this requirements. A combination of optimized components of the power train (ic engine, gearbox, electric engine, etc.) leads to an optimum configuration. The ic engine (conventional design, low in fuel consumption and emission) is only used in driving modes where it runs with low specific fuel consumption and low pollutant emission and simultaneously provides the

electric components with energy when needed (current circuit, charging of the battery).

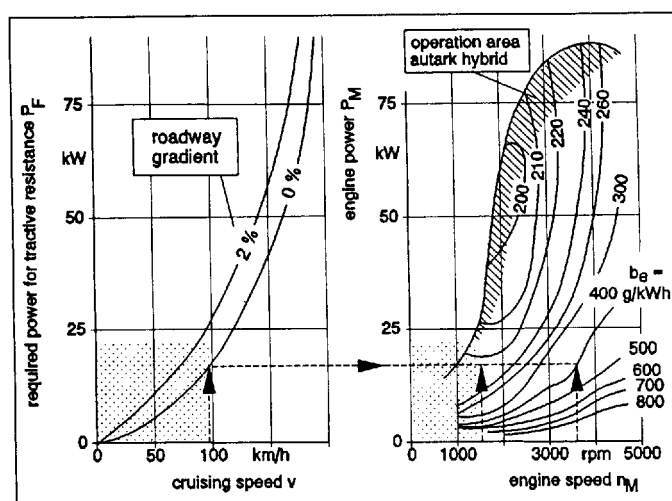


Figure 1 – Tractive resistance line of a vehicle and power characteristic of a turbo diesel engine with direct injection [12]

The right part of fig. 1 shows the power characteristic of a turbo diesel engine with direct injection and on the left side the required power to overcome tractive resistance of an automobile as a function of cruising speed (without acceleration). The lowest specific fuel consumption of $b_e = 200 \text{ g/kWh}$ occurs at an engine power of $P_M = 40 \dots 65 \text{ kW}$ and an engine speed of $n_M = 2000 \text{ min}^{-1}$. The low c_w -factor of the vehicles and the powerful engines means