Proceedings of the International Conference on Manufacturing Systems – ICMaS
Vol. 4, 2009, ISSN 1842-3183
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Bucharest, Romania

STAND FOR TESTING OF THE HYDRAULIC SYSTEMS FOR RECOVERING THE KINETIC ENERGY FROM ROAD MOTOR VEHICLES

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Abstract: *The paper presents several issues on the need to promote hybrid propulsion system of road vehicles, which follow the recovery of kinetic energy in braking phase, in order of energy efficiency and reduce emissions. In this sense, it is said mechatronic system for the recovery of energy that has been achieved in one CEEX project. In the article is presented a testing stand which was, especially designed for testing the hydraulic system for recovery the kinetic energy. The testing stand is based on simulation the braking and starting regimes of the road motor vehicles, by electro hydraulic means. The stand was made, also in the CEEX research project and is one of the physical results of it.*

Key words: *testing stand, hydraulic systems, hybrid systems, road vehicles, energy recovery system.*

1. INTRODUCTION

As is known, development of road transport has a strong impact on the environment, global warming of the planet and the resources of fossil fuels. From this reasons it considered that it is necessary to make urgently something to reduce the fuel consumption and to decrease the gaze emission quantity.

In order to reduce these effects, manufacturers of motor vehicles considers that a radical solution to improve the situation is changing the propulsion of vehicles by promoting hybrid propulsion systems, considered as a future solution for a substantial reduction in fuel consumption and pollutant emissions.

In the braking phase, the kinetic energy of the motor vehicle accumulated in the accelerating phase is converted in the thermal energy which is normally and irremediable wasted in atmosphere. To reduce fuel consumption and limit the emission of motor vehicle manufacturers have developed less polluting vehicles and reduced consumption of fuel in this category are also vehicles with hybrid propulsion systems. Propulsion systems that have in their composition, in addition to a conventional internal combustion engine [1], at least one capable of providing torque to the wheels traction car and recover some of the kinetic energy are known as hybrid Regenerative systems. There are many kind of regenerative system, but the most known are the electrics and hydraulics, where, nearly the existing thermal engine, it exists an electric or hydraulic one motor.

The Research Institute for Hydraulic and pneumatic INOE IHP-2000, together with its partners: the University Polytechnic from Bucharest, INCDMF, INMA and ROMFLUID were involved in the development of a research project, conducted under the Program of Research Excellence CEEX-funded and NASR, which aims to recover kinetic energy during braking road vehicles by developing a hybrid thermal-hydraulic system to be use recovered energy during braking in the starting phases of motor vehicles, in order to reduce fuel consumption and pollutant emissions.

This new propulsion technology aims to creating the means to recovering and saving, storing and reusing the kinetic energy, wasted through the braking process, in order to accelerate the vehicle.

2. THE PREZENTATION OF THE ENERGY RECOVERY SYSTEM

The main physical product, resulting from the finalization of the research project was the mechatronic system to recover energy from braking for medium and heavy vehicles. The aim of the mechatronics system is the recovering the kinetic energy of the medium and heavy motor vehicle in the braking phase, Fig. 1. The technical problem which the mechatronics system solves, is the capturing and storing the lost braking energy, using a mechanic, hydraulic and pneumatic module, end use it in the accelerating phases.

In the following, is presented the Romanian technical solution for the energy recovery system, based on a hybrid system compound by a mechanical and hydraulic module and an existing thermo-mechanical transmission, designed as a mechatronics system [2].

2.1. The recovery system conceptual model

The kinetic energy recovering system was designed to be implemented on one Romanian motor vehicle, well-known as ARO 243, which has a 4 × 4 driving system.

The conceptual model of the kinetic energy recovering mechatronics system, Fig. 1, distinguishes the Diesel engine MD, the gearbox CV and the gear transmission to the front wheels, through one torque and transducer (TMR) and one Cardan axle. Also, the Fig. 1 distinguishes the mechanical transmission to the hydraulic machine/unity UH, the low pressure thanks LT and the height pressure stored system compounds of the two hydraulic and pneumatic accumulators AC1 and AC2. The hydraulic power driving is transmitted, to the breech

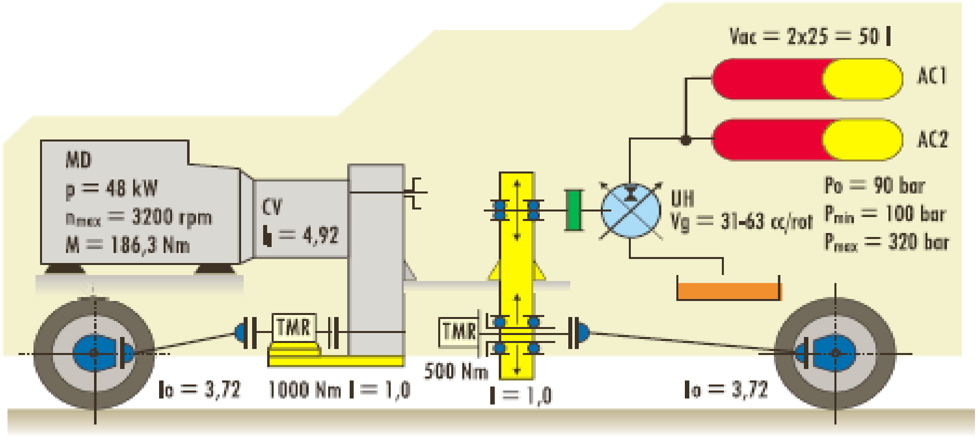

Fig. 1. The conceptual model of the kinetic energy recovery system.

wheels, through the one torque and rotation transducer (TMR) and one Cardan axle. The hydraulic machine can be connected, in parallel, anywhere in the driveline, but, generally, it is mounted in the driveshaft, between gearbox and differential mechanism.

The systems running need a lot of sensors and transducers in order to monitoring and controlling the evolution of parameters [3].

2.2. The mechatronic system block diagram

The kinetic energy recovering system was developed in a mechatronics conception, which is considerate as being the unique capable technology to manage, in very short time, the transient working regimes, in the braking and accelerating phases, in order to integrate the interaction of the all components involved, Fig. 2. The integration of the some mechatronics ensembles, into the hydropneumatic equipments, allows, through the informational systems, the measurement and control for all system parameters.

The mechatronics system, Fig. 2, through the three basic subsystems, assures the control and monitoring

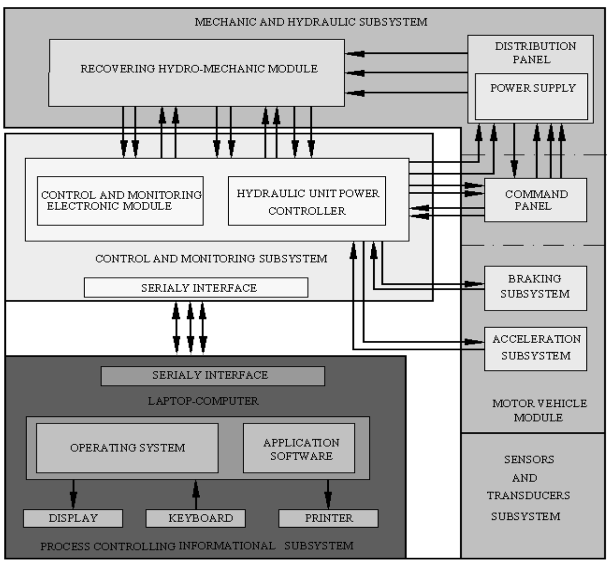

Fig. 2. The block diagram of the mechatronic system for recovering kinetic energy.

mechanics and hydraulics parameters, allows data acquisition from the moment/couple, temperature, flow and pressure transducers; the data from the transducers are scaled and transmitted within the serial communication line. The electronic module is equipped with a console which allows visualization and modification of the functional parameters and the visualization of the measured parameters.

Mechatronics system contains: mechanical subsystem, hydraulic subsystem, command and control electronic subsystem and the data management informatics subsystem.

The interface of the first two subsystems is the subsystem of sensors and transducers, which provide information on the evolution of the main parameters of the kinetic energy recovery mechatronics system.

This component defines the mechatronics basis for the system design and development. The mechatronics system is working on the basis of dedicated software, which allows monitoring and recording the evolution of output and control parameters of the system.

The sensors and transducers subsystem allows data acquisition from the moment, temperature, flow and pressure transducers [3]. The data from the transducers are scaled and transmitted within the serial communication line to the process computer. The electronic module calculates the hydraulic power at the hydraulic machine, as a product between pressure and flow, and transfers it through a serial communication line to the system [4, 5].

The system is equipped with a Lap Top or PC computer, which use one application dedicated soft, which allows visualization and modification of the impute functional parameters and the visualization of the output measured parameters.

The main command size is swivel angle of the hydraulic machine pistons block, which determines the variation of the flow and, the other hand, the pump or motor running regime, in function of the braking or accelerating regime.

To test functionality of the mechatronic system to recover energy from braking, was designed and developed physical, a test stand, this will be presented in the following.

3. THE PREZENTATION OF THE TESTING STAND OF THE ENERGY RECOVERY SYSTEM

The technique adopted for the design and implementation the testing stand of the system mechatronics recovery of energy from braking, was that of simulation, in laboratory conditions, the transitional regimes for braking and starting phases of
the motor vehicle, using the operation and command equipments only with an electro hydraulic actuators.

The project stands tailored for testing system is presented in Fig. 3 and the physical realization of the testing stand is presented in Fig. 4.

The main technical characteristics are:

– maximum working pressure...................... 250bar;
– the size of the hydraulic machine...0.45 cmc / rev;
– the size of the task pump.................. 63cmc / rev;
– the size of the hydraulic gear motor..45 cmc / rev;
– the size of the commands pump ......8.2 cmc / rev;
– the working fluid .... Hydraulic oil;
– voltage control / food 24 Volt DC / 220/380 Vca.

Coreponding with Fig. 3, the stand is composed of the following main parts:

1 – the group of tank and hydraulic command apparatus, with storage and conditioning fluid work subsystems, presented in Fig. 5;

2 – the electro pump with variable displacement;

3 – the acceleration subsystem, which consists of an hydraulic motor, a couple and rotation transducer and a pump with electric driving, Fig. 6;

4 – the testing module, consisting of a loading device, hydraulic machine and the couple and rotation transmitter, Fig. 7;

5 – the electronic and automation equipment of the stand, composed of electrical subsystem and command and control the operation of the tests, Fig. 8;

6 – the hydro-mechanical module, which consists from a hydraulic machine with variable displacement and a mechanical transmission with a couple and rotation transmitter, Fig. 9;

7 – the accumulating subsystem of the fluid under pressure, composed of two batteries hydro pneumatic and pressure transducers, Fig. 10.

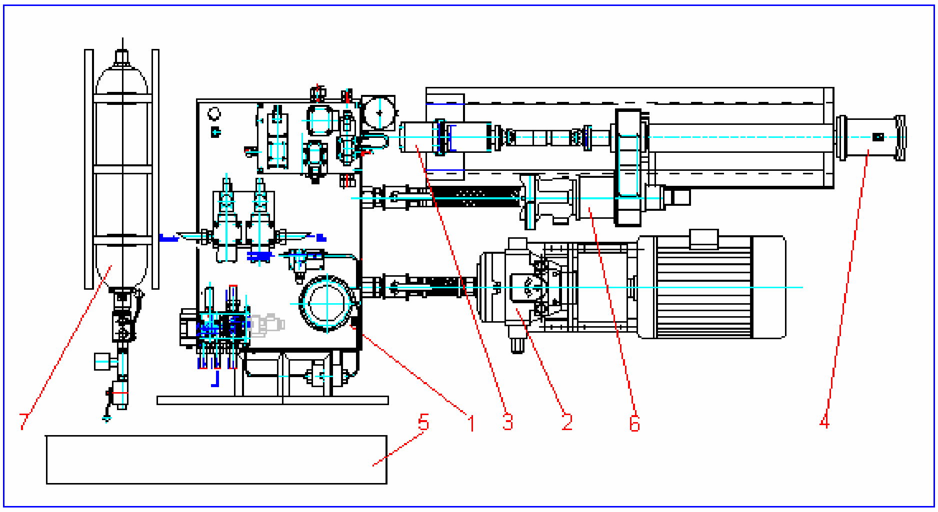

Fig. 3. The project stands tailored for testing system.

Fig. 4. The stand adapted for testing system.

Fig. 5. The group of hydraulic tank.

Fig. 6. The acceleration subsystem.

Fig. 7. The testing module.

Fig. 8. The electric and electronic equipment.

Fig. 9. The hydro-mechanical module.

Fig. 10. The accumulating subsystem.

4. CONCLUSIONS

In the first part, the paper made a brief presentation for one Romanian recovery hydraulic system, which transform the motor vehicle, where will be implemented, in one with hybrid propulsion.

In the second part is presented a testing stand which was especially designed for testing the hydraulic system for recovery the kinetic energy.

The hydraulic and electric components are available on the market and allow the realization, in good condition, systems for the recovery of kinetic energy during vehicle braking

The paper demonstrates the possibility to testing and mounting on medium and heavy vehicles a system to recover energy from braking phases.

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