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THE EXPERIMENTAL STAND FOR DETERMINING THE CHARACTERISTICS OF THE HYDRAULIC DRIVE CONTROL SYSTEM WITH THE MULTIFUNCTIONAL COUNTERBALANCE VALVE

During the design of the new hydraulic equipment, the theoretical researches of the mathematical models are conducted. It enables the calculating of the static and dynamic characteristics [1–3]. The proof of the mathematical models adequacy is performed with the help of the experimental studies.

Figure 1 shows the scheme of the experimental stand for determining the static and dynamic characteristics of the hydraulic control system with the multifunctional counterbalance valve (MCBV). The scheme of the experimental stand consists of the following basic systems: an experimental sample of the multifunctional counterbalance valve, a powering system, a loading system, a measuring and a recording system.

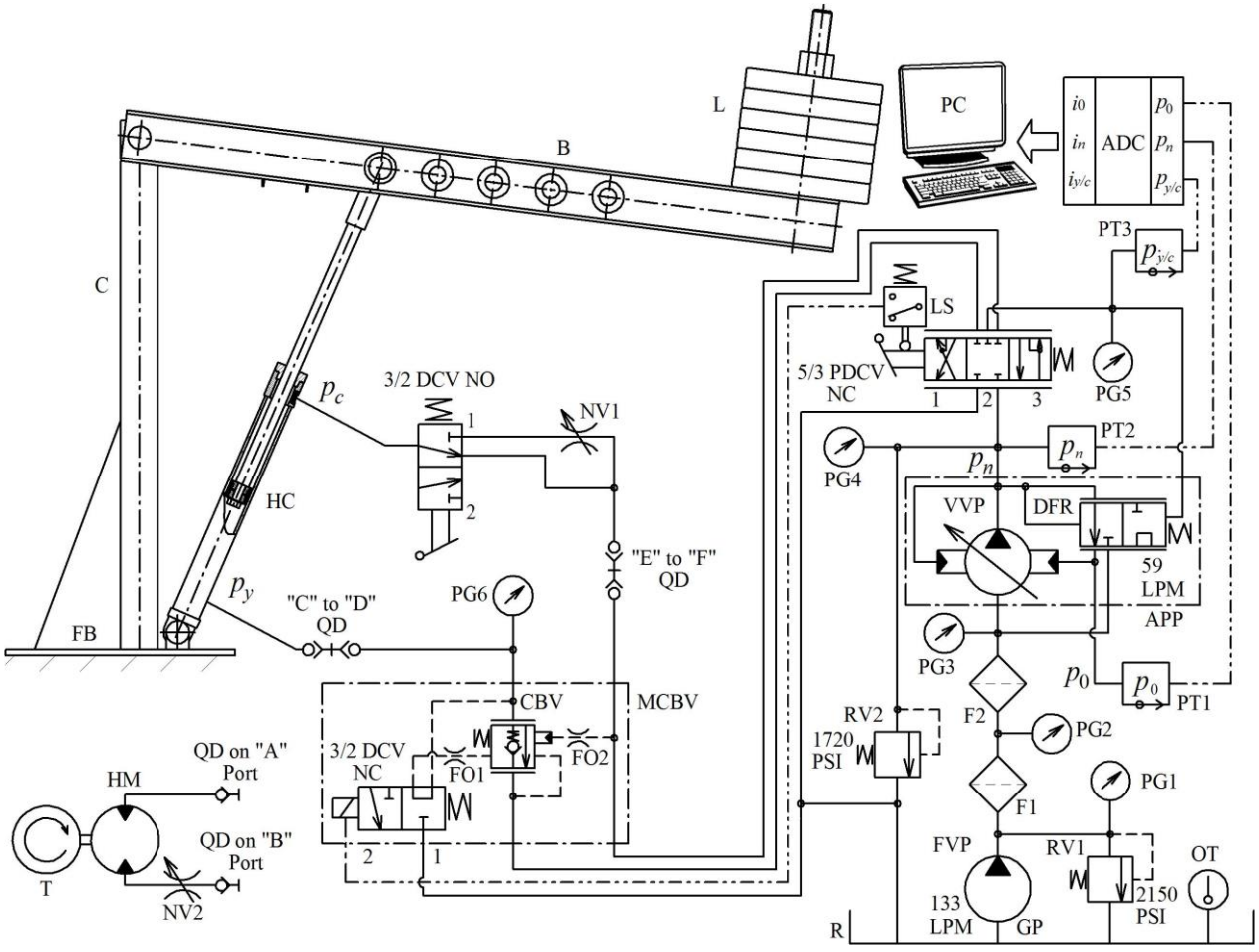

Figure 1 – The scheme of the experimental stand

The multifunctional counterbalance valve consists of a counterbalance valve CBV, two fixed orifices FO1, FO2 and an electromagnetic directional control valve 3/2 DCV NC. The peculiarity of the multifunctional counterbalance valve is the ability to perform pilot operated check valve functions (reliable leakproofness and load fixation, proportionality of speed control with counter load) at positions 1, 2 of a proportional directional control valve 5/3 PDCV NC, and counterbalance valve functions (the prevention of working hydraulic line cavitation, energy saving by load lowering almost under its own weight, proportional speed control with obiter load, stopping of uncontrolled cargo drop in emergency situations) at position 3 with the help of a limit switch LS and the electromagnetic directional control valve 3/2 DCV NC. The fixed orifices FO1, FO2 provide gradual opening of the counterbalance valve CBV.

The powering system includes: a reservoir R, an unregulated FVP gear pump GP (flow up to 133LPM), an adjustable VVP axial-piston pump APP with a flow regulator DFR (flow up to 59LMP), relief valves RV1, RV2 (adjusted for pressure 2150 and 1720PSI accordingly), pressure filters F1, F2 (nominal filtration fineness up to 25mkm) and a proportional directional control valve 5/3 PDCV NC with the limit switch LS. The energy carrier in the hydraulic control system is an industrial oil I-30A (a density 890kh/m3, a kinematic viscosity 41−51sSt at 40°C).

The loading system allows to use two executive bodies: a manipulator system for the dynamic characteristics research and a motor system for the static characteristics research, which are connected with the experimental stand by using quick-disconnects QD. The manipulator system includes a manipulator (a fixed basis FB, a column C, a boom B, a load L and a hydraulic cylinder HC), a directional control valve 3/2 DCV NO and a needle valve NV1. Transition process is created with the directional control valve 3/2 DCV NO by means of the drain flow direction of the working fluid through the needle valve NV1. Therefore, the pressure of the head flow is increasing, which has pulse character changes. The motor system includes a hydraulic motor HM and a needle valve NV2. The flow through the hydraulic motor HM can be changed using the needle valve NV2.

The measuring and recording system includes: pressure gauges PG1...PG6 (measuring range 0…2500 PSI, accuracy 0,3 PSI), a thermometer OT (measuring range 0…150°C, accuracy 0,5°C), pressure transducers RT1...RT3 (measuring range 50…2500 PSI, accuracy ±1,6%), a tachometer T (measuring range 0…1000 RPM, accuracy ±1%), an analog-to-digital converter ADC and a personal computer PC.

The experimental stand allows to reproduce physical processes in the hydraulic control system at a wide range of the load change as well as to fix measuring equipment performance. The usage of the pressure gauges PG1...PG6 allows to monitor the pressure in the hydraulic lines of the hydraulic control system and to determine the static characteristics. The usage of the pressure transducer RT1...RT3, the analog-to-digital converter ADC and the personal computer PC allows to record pressure transients p_n, p_0, p_y or p_c and to calculate the dynamic characteristics. The thermometer OT is used to determine the temperature of the industrial oil. Rotation frequency of the hydraulic motor HM is measured by using the tachometer T.

Reference

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