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Research of Automated Positional Hydrodrive with Hydraulic Control Circuit

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Abstract

This paper explores the process of positioning of the hydraulic drive with the original hydromechanical control subsystem. Using direct numerical simulation in Matlab Simulink software environment, the effect of parameters of the hydraulic control circuit is investigated: the control pressure and the conduction of hydro-mechanical valve-positioner on positional cycle accuracy and the speed of operation. The modeling is done taking into account the nonstationary processes in the flowing part of the control device, preset by experiment. The analysis and comparison of the dependencies obtained as the result of multifactorial computing and full-scale experiments confirm the adequacy of the developed mathematical model of the hydraulic drive and are necessary for further optimization of its control devices parameters. The research results allowed for the recommendations to be made that increase the efficiency of hydraulic control circuit for realization of the rational motion control position cycle of technical objects.

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Keywords: position cycle; mathematical modeling; dynamic analysis; accurac; speed; hydro-mechanical control devices.

1. Introduction

Possessing known advantages, the hydromechanical positioning systems [1], allowing organizing optimal trajectories of movement of technical objects and providing their highest performance at the given positional accuracy with the most accessible means, have gained a widespread application.

The analysis of a condition and researches in this technical field has allowed pointing out systems of drives with the hydraulic communication lines, representing a control subsystem [2], they possess considerable advantage and

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are capable to provide high speed of operation and stable work [3], however they are not investigated enough. In accordance with the abovementioned, the purpose of work is to come to synthesis of a positional hydrodrive with a hydraulic circuit of motion control and to research its influence on speed of operation and accuracy of a position cycle.

2. The main points

The hydraulic calculated scheme of an offered drive explaining structure and an interconnection of elements of its subsystems is represented on fig. 1 and consists of energy-power and operating circuits. The power circuit contains: delivery and drain hydraulic lines L, the hydraulic motor HM, kinematically connected with crane distributor RD with rotaryand location bush with flow through windows, self-contained setter of motion (SSM), hydrocontrolled brake HCB operated by the directional valve DV2 with electromagnetic management and a tankT [4].

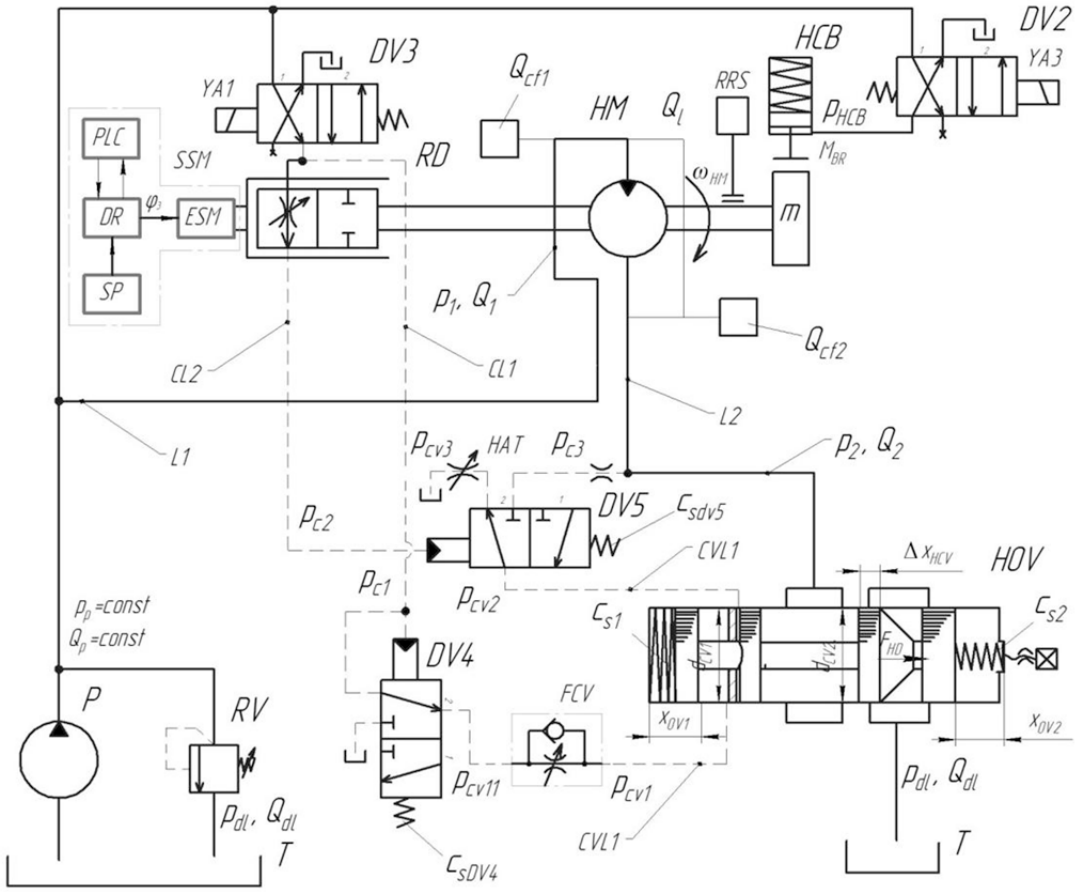

Fig.1. The hydraulic scheme of the automated positional hydrodrive.

The operating circuit forms: multifunctional controlling device – hydraulically operated valve HOV, directional valve DV4 and DV5, an adjustable throttle with inverted valve HAT and hydraulic communication lines CL [5]. Position of a slide-valve of distributor DV4 is defined by control signal Pc1 from distributor DV3, and DV5 - at matching of working windows of bushes of rotary distributor RD [6].

The research of the presented automated positional hydrodrive functionality largely depends on the competent mathematical description of its dynamic system, a choice of boundary conditions and assumptions. Upon that it is