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POSITION CONTROL ALGORITHM OF HYDRAULIC DRIVE OF WORKING MACHINE

1. Introduction

In the positioning working machines the move speed is a basic state variable. If we need to set precisisly machine to required position with demanding time, we have to control the moving speed with a high accuracy. In the modern working machines driven by hydraulic power systems, motors and actuators are supplied with oil through proportional or servo valves.

The speed of motor or actuator movement is nearly directly proportional to value of their liquid flow.

The quantity of oil passing valves is controllable with an electrical signal.

When the servo valve is used the liquid flow is controlled by itself. To keep the constant speed the valve steering signal changes have to correct leakage following changes of work condition. When proportional valve is used changes of steering signal must compensate speed variation resulted also by changes of load torque and supply pressure.

High dynamic of hydraulic drive machines following high extra driving torque immediately available from a supply system (specially during motion at low speed), results in a short lasting transition state. It enables building the quite simple hydraulic drive controlled by electronics devices which realises uncomplicated algorithm.

The price which we have to pay is the cost of building high quality speed and position feed-back.

It is very convenient to use one position sensor and calculate the speed basing on position increase in knowing time period.

The high dynamic of hydraulic drive demands using an appropriate speed and position sensor which can provide real discriminatable position values in short period time.

So the position must be measured with appropriate resolution connected with: drive time-constant, load torque distortion, speed accuracy .

The algorithm shown below was used in the working machine which works with speed stabilisation in range of 0,3°/s up to 36°/s, with accuracy 0,15°/s position adjustment and with precision better than 0,2°.

2. Scheme of Controlling Working Machine Movement.

On the basis of many analyses the idea of simple hydraulic drive was worked out. The scheme of steering controlling and driving system is shown in Fig.1 and Fig.2, where the following elements are: 1 - low speed hydraulic motor with brake, 2 -subplate, 3 - subplate, 4 -directional, 5 - subplate, 6 -sandwich mounting for valves, 7 - direct relief valve, 8 - direct relief valve, 9 - non return valve, 10 - non return valve, 11 - control valve, 12 - stage directional servo valve with mechanical, 13- hydraulic accumulator.

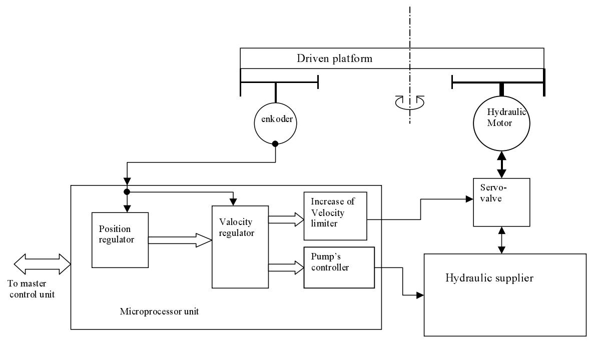

Fig. 1. Functional model of driving system

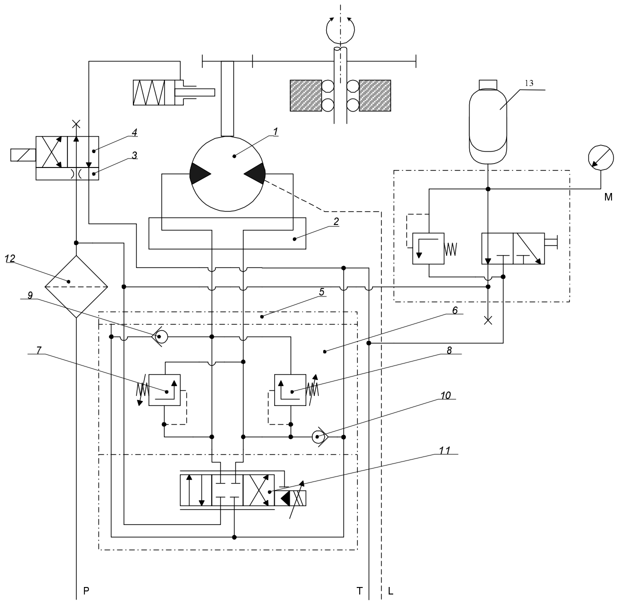

Fig. 2. Simplified hydraulic diagram of driving system of platform turn

The realised position and speed control algorithm is shown in Fig.3 and Fig. 4.

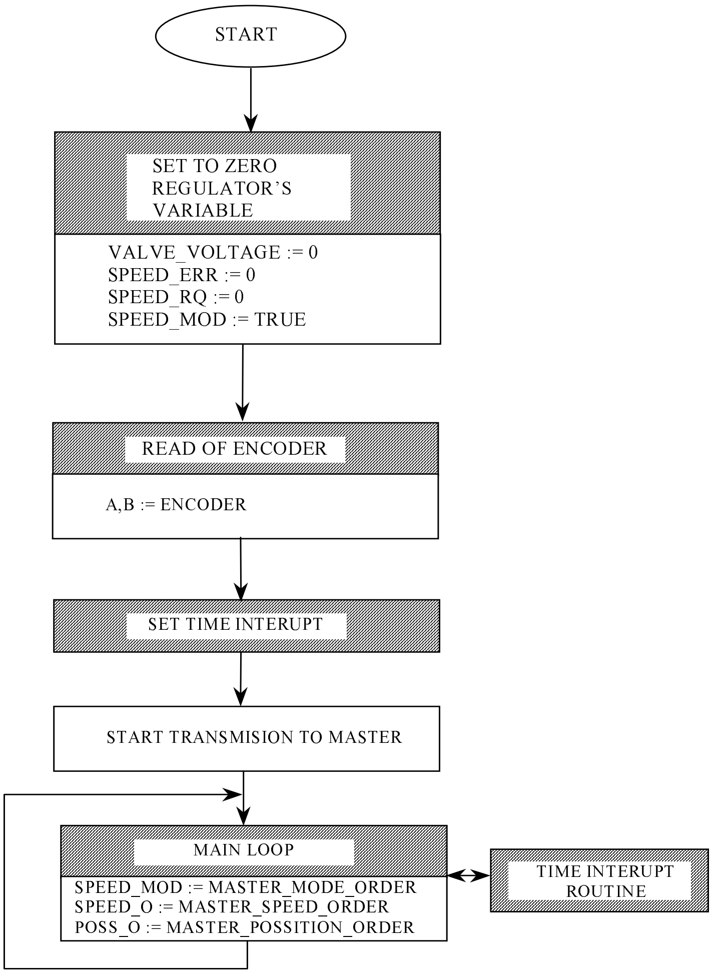

Fig. 3. Block diagram of steering algorithm - main circle

This algorithm runs rather simple function of proportional-integrating regulator.

As the analyses shown it would be enough to fulfil taken requirements with lowest speed equal 0,2°/s.

Those analyses shown that the use of more complicated regulator algorithms would not improve significantly properties of the considered machine.

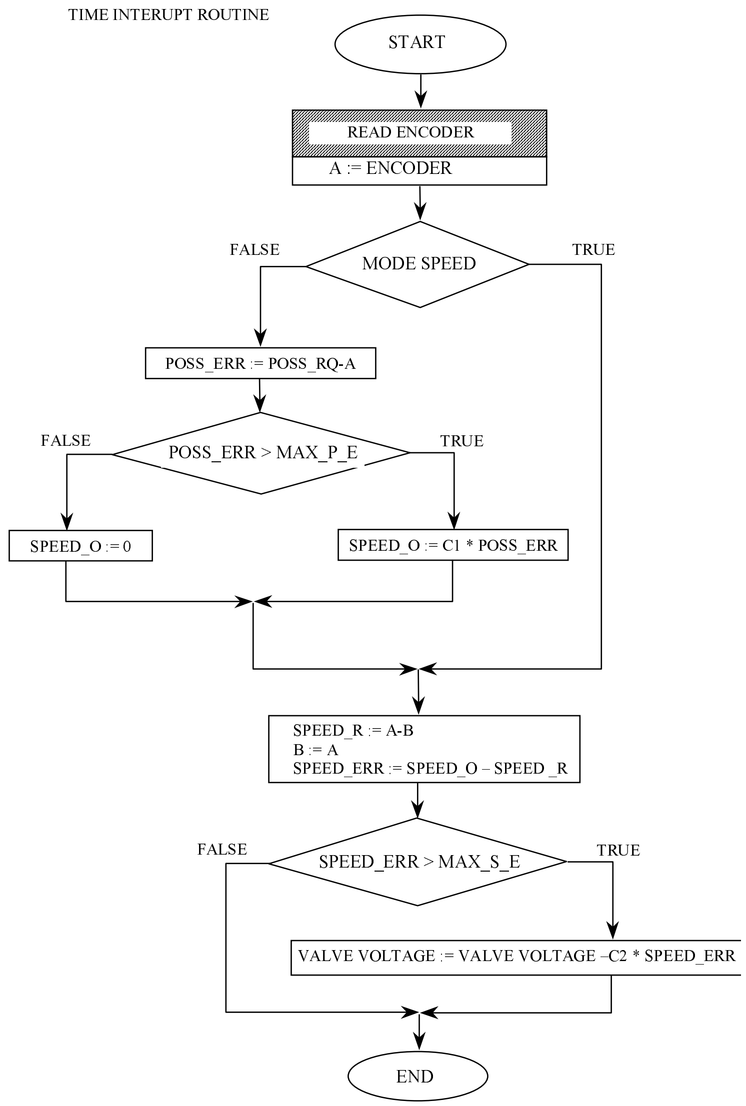

Fig. 4. Algorithm of maintenance time interrupting, which realize function of position and velocity regulator