**New Technology Synchronous Motion Control of Slide Gates – Upper Headof a Navigation Lock**

PPT Inzenjering has carried out a specific design solution for a navigation lock at the Volga-Don Canal in Russian Federation frequency regulation is used to control the synchronous motion of the slide gate. For gate lifting, a standard approach is implemented: by changing the number of revolutions of the axial-piston pump of with constant oil flow, the motion of the cylinder is accelerated or decelerated. For gate lowering, the standard approach with pump working in the motor regime and deceleration being achieved by the electro-motor with frequency regulation of the number of revolutions, is not implemented. The main disadvantages of this standard approach are heat losses when electro-motor is slowing down and a specific construction design of the axial-piston pump which has to work in the motor regime, too.

The new design solution is based on the slowing down technology during gate lowering which is carried out in a serial down connection of slowing down through constant oil flow and impulse oil flow of opposite direction generated by frequency regulator of the electro-motor and the constant oil flow defined by the proportional throttle valve. The particularity of the solution lies in the fact that the previously described configuration can achieve the accuracy of the synchronous motion of up to +/- 3 mm with the gate length of 20 m, gate weight of 105 t and hydraulic cylinders Ø360/200x8540 mm. This accuracy can't be achieved by a proportional throttle cartridge valve. Nominal oil flow during lowering is 450 l/min. If the expected accuracy of such a throttle valve is 1%, the error of the synchronous motion is within the range of +/- 20 mm. Combining two proportional throttle valves in parallel connection with the oil flow difference between the two is of the order of 1000 l/min against 100 l/min allows for a more accurate synchronous motion control to a certain degree. The radical improvement of the synchronous motion accuracy is provided by a design solution in which throttling (slowing down) is achieved when the oil flow generated by the pump collides with the oil flow from the lower cylinder chamber in a serial connection before the proportional throttle valve, as shown in Fig.1. This solution gives the possibility for higher adaptability to the ambient conditions by the change of a single parameter – gain coefficient of the correction oil flow impulse. Fig.2 shows the hydraulic unit which provides the previously described synchronous motion control technology.

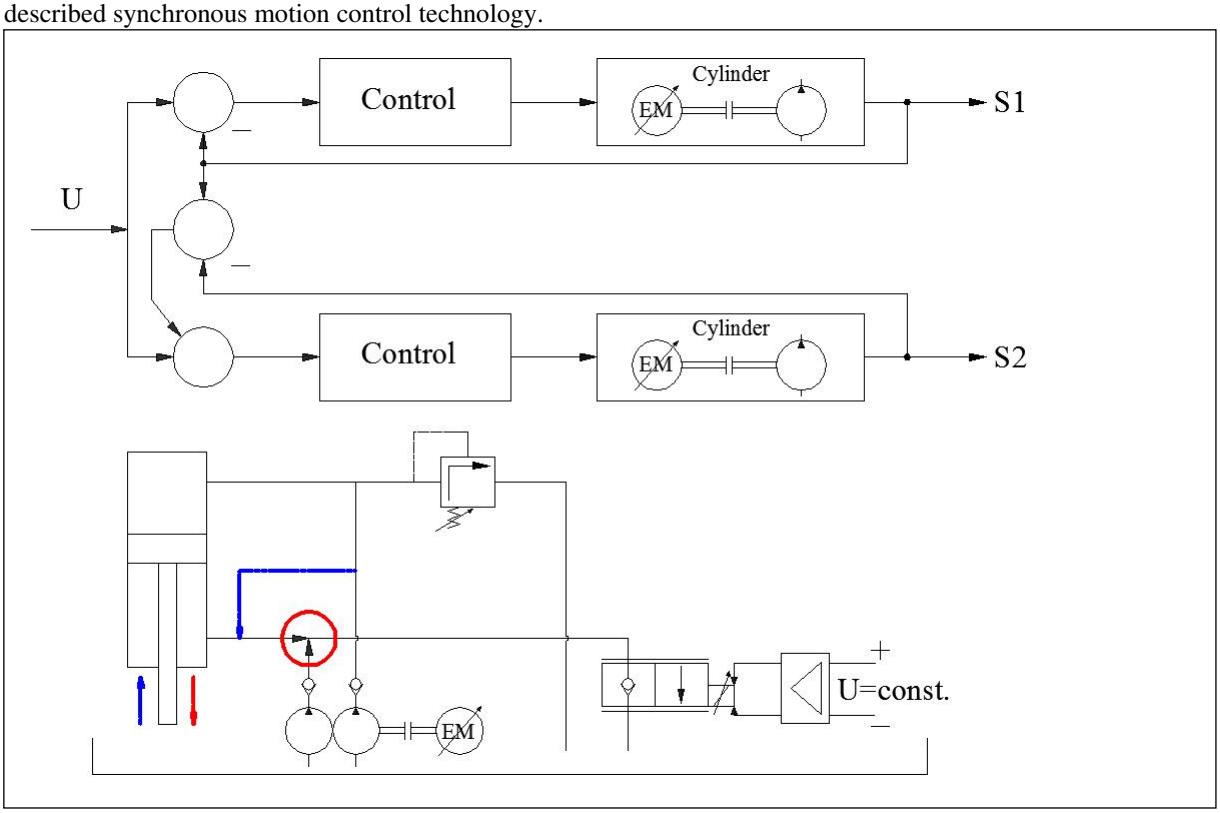


**Fig.1 – General and Hydraulic Schematic**

The spot where oil flows from the pump and from the cylinder lower chamber meet and slowing down of the cylinder occurs during gate lowering by the impulse change of the controlled oil flow from the pump. Depending on the velocity (5,5 m/min or 0.6 m/min), there is a continuous slowing down flow (indirect throttling) and controlled flow impulses in direct proportion with actual error value (above the threshold).

Working and spare proportional throttle cartridge valve: control signal changes only when nominal gate velocities change during lowering (acceleration at the beginning and deceleration at the end of manipulation).

The outlook of the configuration of the electro-hydraulic drive on one side of the navigation lock (two identical units)

SCADA touch screen for local control of the gate at the navigation lock

Electro-hydraulic drive is envisaged to allow 40 vessel transfers in 24 hours and is almost 100% redundant, so that it doesn't lose its working capability in case of any component failure.

**Fig.2 – Electro-hydraulic drive – general outlook**