Thus facings of rockfill and blast-formed dams of rock covered with poured asphalt are simple, are easily programmed with respect to properties and design, and are easily made by commercial equipment, which opens broad opportunities for their use.

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DESIGN OF CRANES FOR OPERATING GATES

I. Kh. Kaplan

As is known, when lifting a gate its wedging in the guideways of the groove is possible, as a result of which both overloading of the hoisting device and transmission of an increased pulling force from the hoisting device to the gate, trash rack, grab, etc., being raised occur.

During lowering of the gate its jamming in the guideways of the groove is possible. In this case, the hoisting device continues to operate and unwinds the cable from the drum, i.e., slackening and sagging of the cable occur. After this a sudden spontaneous movement (drop) of the gate occurs and a dynamic load (jerk) considerably exceeding the design load often occurs.

To limit overloading of the crane during lifting and to limit slackening of the cables during lowering of a gate, load relays are installed on cranes, which should provide during lifting an overload of not more than 25% of the rated load and during lowering should provide a maximum slackening of the cables equal to the tension in the cable from half of the mass of the suspension.

At the same time, one and the same crane can operate different gates or racks. In this case, different pulling forces are required for raising each of the gates or racks. In the case of wedging of the gate or rack in the grooves, the rated pulling force of the crane plus 25% of the overload is transmitted to the restrained load (gate, rack, etc.). As a result of the large difference in the required pulling forces for operating different gates, the pulling force of the crane in the event of wedging of a restrained load can damage or destroy it.

Often in such cases there are different hoisting mechanisms on the crane carriage for different restrained loads, which leads to an increase of the overall dimensions both of the crane carriage and of the crane itself.

It is clear from the aforesaid that a crane and the restrained load which it operates are a single system and a device performing functions of protection both of the crane and of the restrained load under various necessary pulling forces is needed for such systems. In order not to install additional mechanisms of different capacity on the crane, it was necessary to create a special device which could change (or assign) the required nominal capacity of the crane and protect the crane and restrained load from overload and slackening of the cables for various capacities. Furthermore, there has long been the need to replace the unreliably operating spring and eccentric type load limiters.

The Moscow Special Design Department for Steel Hydraulic Structures (Mosgidrostal') developed a device for controlling the hoisting mechanism [1] for a gantry crane of the water intake and outlets of the Kambarata No. 2 hydroelectric station. The device for controlling

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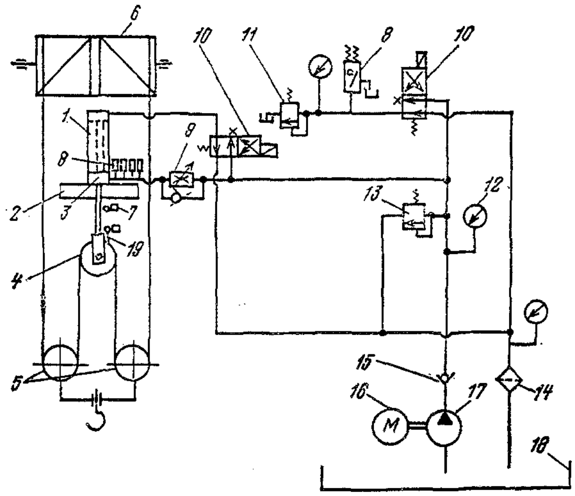

Fig. 1. Hydromechanical diagram of the device for controlling the hoisting mechanism: 1) hydraulic cylinder; 2) frame of the crane carriage; 3) rod; 4) equalizing tackle block; 5) block and tackle; 6) load-lifting drum; 7) limit switch; 8) pressure relay; 9) choke with check valve; 10) distributor; 11) supporting valve; 12) manometer; 13) safety valve; 14) filter; 15) check valve; 16) electric motor; 17) pump; 18) tank; 19) rule.

the hoisting mechanism of the crane is located on the crane carriage, which makes it possible to change (in the given case, toward a decrease) of its capacity from 100 to 30 tons and to protect the crane and restrained load from overloading and slackening of the cables for each capacity, respectively.

The developed design of the device for controlling the hoisting mechanism has as the main actuators of hydraulic cylinder, hydraulic apparatus, and electrical apparatus, which make it possible to easily determine the extent of overloading of the crane or the value of slckening of the cables, as well as to back-up the control system (pressure relays and limit switches). Furthermore, it became possible to select (assign) the capacity of the crane, and it is accomplished by the crane operator directly from the operating cabin. The device (Fig. 1) consists of:

a hydraulic piston cylinder, on the rod of which is fastened an equalizing tackle block. The hydraulic cylinder is made in the body of a crossbeam installed in rolling contact bearings, which makes it possible to arrange the hydraulic cylinder at the required angle and thereby to eliminate the transmission to the rod of the horizontal forces occurring from tension of the cables at an angle to the equalizing block;

an oil-pressure system for delivering the working fluid under pressure to the hydraulic cylinder in order to create the necessary force. The oil-pressure system consists of a welded tank, pumping plant with a gear pump submerged in oil, pipelines, panel with hydraulic apparatus, electric heaters heating the system at negative temperatures, thermal relay checking the temperature of the oil in the tank;

housing with a jacket for heat-insulating and waterproofing the system.

The device can be adjusted for a capacity of 100 and 30 tons (other capacities were not required). During raising or lowering of the restrained load (gate, racks), the crane operator sets the switch of the capacity to the position corresponding to a capacity of 30 or 100 tons. The oil-pressure system is turned on and the oil goes to the lower cavity of the hydraulic cylinder under pressure; the piston moves upward, moving the equalizing block with the rule. The rule closes the limit switch. The piston continues to move up to the stop in the cover, the pressure increases in the hydraulic system and operates the pressure relay. The load hoisting mechanism is turned on. When an overload occurs on the crane suspension the piston tries to descend, in which case the pressure begins to increase in the lower cavity. As soon as the increase of pressure becomes equivalent to the prescribed overload of the mechanism, the pressure relay operates and the hoisting mechanism and electric motor of the pump are turned off. During lowering of the restrained load the oil-pressure system is also turned on and the oil goes from the pump into the upper cavity of the hydraulic cylinder. The piston with the equalizing block and rule descend. The rule closes the contacts of the limit switch. The direction of the oil flow changes. The oil begins to enter the lower cavity of the hydraulic cylinder. The pressure in the lower cavity begins to increase, the pressure relay operates, and the hoisting mechanism is turned on for lowering the load. A rise of the piston does not occur, since the oil under a pressure equivalent to the force on the rod, equal to 0.5 of the mass of the suspension, drains through the supporting valve into the tank. When the load on the rod decreases (owing to the fact that slackening of the cable occurs), the piston begins to rise and the pressure in the system falls. Opening of the contacts of the pressure relay and then of the limit switch occurs. The crane hoisting mechanism and electric motor of the pump are switched off. Heating of the oil in the tank is provided for in the device. At an air temperature below 5°C, heating of the device is turned on. The electric heaters begin to heat the oil and upon reaching an air temperature of 5°C under the housing, heating is turned off. The temperature regime of the oil in the tank is regulated by a thermal relay. To check the performance of the device, Mosgidrostal' developed and manufactured a device for controlling the hoisting mechanism. The device is made on the basis of hydraulic and electrical apparatus being produced by industry and in design is analogous to the prototype. Tests confirmed the performance of the device and the results were published for adjusting and regulating the device after its insulation on the crane for the Kambarata No. 2 hydrostation.

The technical and economic indices of the device are:

the possibility of changing (assigning) the capacity of the hoisting mechanism makes it possible to reduce the number of hoisting mechanisms on the crane, which in turn made it possible to reduce the size and weight of the crane carriage and crane itself;

the accuracy of limiting overloading of the crane increases, i.e., overloading of the crane decreases due to using electrical and hydraulic apparatus instead of mechanical components used in the spring or eccentric type load limiters;

operating safety on the crane increases, since the control apparatus is backed up in the device; the possibility of changing the capacity makes it possible to protect the trash racks, gates, grabs, etc., from damage as a result of wedging. Thus the operating reliability of the mechanical equipment increases and the probability of failures decreases;

if necessary, the device can be made as an independent drive of increased capacity with a small stroke for lifting the gate from the sill and with a reduced load lifting or lowering speed.

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