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TO REDUCE THE WEAR OF THE TEETH OF GEAR OIL PUMPS

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Annotation: *The article presents the history of hydraulic drives, types, areas of application, advantages, disadvantages and prospects for development. The main unit of the operation - the issue of prolonging the service life of the oil pump was considered and it was proposed to reduce the wear of the teeth by reversing it, and it was shown that the service life can be doubled*

Keywords. *Hydraulic drive, oil pump, condenser, safety valve, fittings.*

Volumetric hydraulic drive is used in mining and road construction machines. Currently, more than 50% of the total fleet of road construction machinery (bulldozers, excavators, motor graders, etc.) is hydrated. This is significantly different from the situation in the 1930s and 1940s, when mostly mechanical transmissions were used.

Hydraulic drive is widely used in the engineering industry, but in this field it is highly competitive with other types of drives [1].

Hydraulic propulsion is widespread in aviation. The saturation of modern aircraft with hydraulic propulsion systems means that the total length of modern passenger liner pipes can reach several kilometers. Recently, there has been a trend in aviation to switch to electronic control systems for hydraulic drives, replacing hydraulic logic circuits with electrons.

In the automotive industry, the power steering of the steering wheel is widely used, which significantly increases the ease of driving the car. These devices are a type of tracking hydraulic actuators. Hydraulic boosters are also used in many other areas of technology (aviation, tractors, industrial equipment, etc.).

Some tanks, such as Japan’s Type 10 tank, use a hydrostatic transmission, which is actually a volumetric hydraulic drive system. The same type of transmission is installed in some modern bulldozers.

In general, the limits of the scope of application of hydraulic drive are determined by its advantages and disadvantages.

The main advantages of hydraulic drive are:

the ability to universally change the mechanical properties of the drive motor in accordance with the requirements of the load;

ease of management and automation;

ease of overload protection of the drive motor and machine executive bodies; for example, if the force on the hydraulic cylinder rod is too large (when the bucket connected to the working body encounters an obstacle), then the pressure in the hydraulic system reaches high values. Then the safety system in the hydraulic system is activated and after that the fluid passes into the tank drain and the pressure drops;

operational reliability;

a wide range of step-by-step regulation of the speed of the output link; for example, the speed control range of a hydraulic motor can be from 2500 rpm to 30-40 rpm and in some cases, up to 1-4 rpm for special purpose hydraulic motors, which is difficult to implement for electric motors;

the magnitude of the power transmitted per unit mass of the drive, in particular, the mass of hydraulic machines is about 10-20 times less than the mass of electric machines of the same capacity;

self-lubrication of friction surfaces when using mineral and synthetic oils as a working fluid; it should be noted that during maintenance, for example on road construction machines, lubrication takes up to 50% of the total maintenance time of the machine, so self-lubrication of the hydraulic drive is a serious advantage;

the ability to transmit large forces and capacities with the small size and weight of the transmission mechanism;

ease of performing various types of movements - forward, turn, turn;

the possibility of frequent and rapid switching during direct and reverse movements of reciprocity and rotation;

the ability to evenly distribute the forces transmitted to several devices at the same time;

the simplicity of the location of the main components of the hydraulic drive in machines and units compared to other types of drives.

Disadvantages of hydraulic drive include:

requires high precision in the manufacture of pump parts, leakage of working fluid at high pressures in the system, especially through seals and holes;

heating of the liquid during operation, which leads to a decrease in the viscosity of the working fluid and an increase in leakage, so in some cases it is necessary to use special cooling devices and thermal protection devices;

lower efficiency than comparable mechanical transmissions;

the need to ensure the cleanliness of the working fluid during operation, as the presence of large amounts of abrasive particles in the working fluid leads to rapid wear of parts of hydraulic equipment, widening of cracks and consequently increased leakage, resulting in reduced volumetric efficiency;

the need to protect the hydraulic system from air ingress, the presence of which leads to unstable operation of the hydraulic drive, large hydraulic losses and overheating of the working fluid;

fire hazards when using flammable working fluids, such as restrictions on the use of hydraulic drives in hot workplaces;

the viscosity of the working fluid and therefore the operating parameters of the hydraulic drive, the dependence on the ambient temperature or the high cost of the base oils;

compared to pneumatic and electric drives - the impossibility of efficient transmission of hydraulic energy over long distances due to large pressure losses in hydraulic networks per unit length.

The development prospects of hydraulic drive are mainly related to the development of electronics. Thus, the improvement of electronic systems allows to simplify the control of the movement of the output links of the hydraulic drive. In particular, in the last 10-15 years, bulldozers have begun to appear, the management of which is regulated by the joystick principle.

Advances in the field of hydraulic drive diagnostics are associated with the development of electronics and computing devices. The diagnostic process of some modern machines can be described as follows. The expert connects the laptop to a special connector on the machine. Through this connector, the computer receives information about the values of diagnostic parameters from various sensors installed in the hydraulic system. The program or specialist analyzes the data obtained and draws a conclusion about the technical condition of the machine, the presence or absence of faults and their localization. Diagnostics under this scheme are performed, for example, for some modern bucket loaders. The development of computing tools will improve the process of hydraulic drive and machine diagnostics in general.

It can play an important role in the development of hydraulic drive by creating and introducing new constructive materials. In particular, the development of nanotechnology increases the strength of materials, which reduces the weight of the hydraulic equipment and its geometric dimensions, increases reliability. On the other hand, the creation of durable and at the same time elastic materials, for example, allows to reduce the shortcomings of many hydraulic machines, in particular, to increase the pressure of diaphragm pumps.

In recent years, significant progress has been made in the production of compaction devices. The new material provides complete sealing, low friction coefficient and high reliability at pressures up to 80 MPa [1].

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Figure 1 shows diagrams of possible changes to the pump. One way to do this is to use a 4/2 distributor that is exchanged from the speed control relay via a pulse generator. This circuit is not completely reliable because when used in mechanisms, a large amount of electronic pulses can be "lost" and then shielding is required.

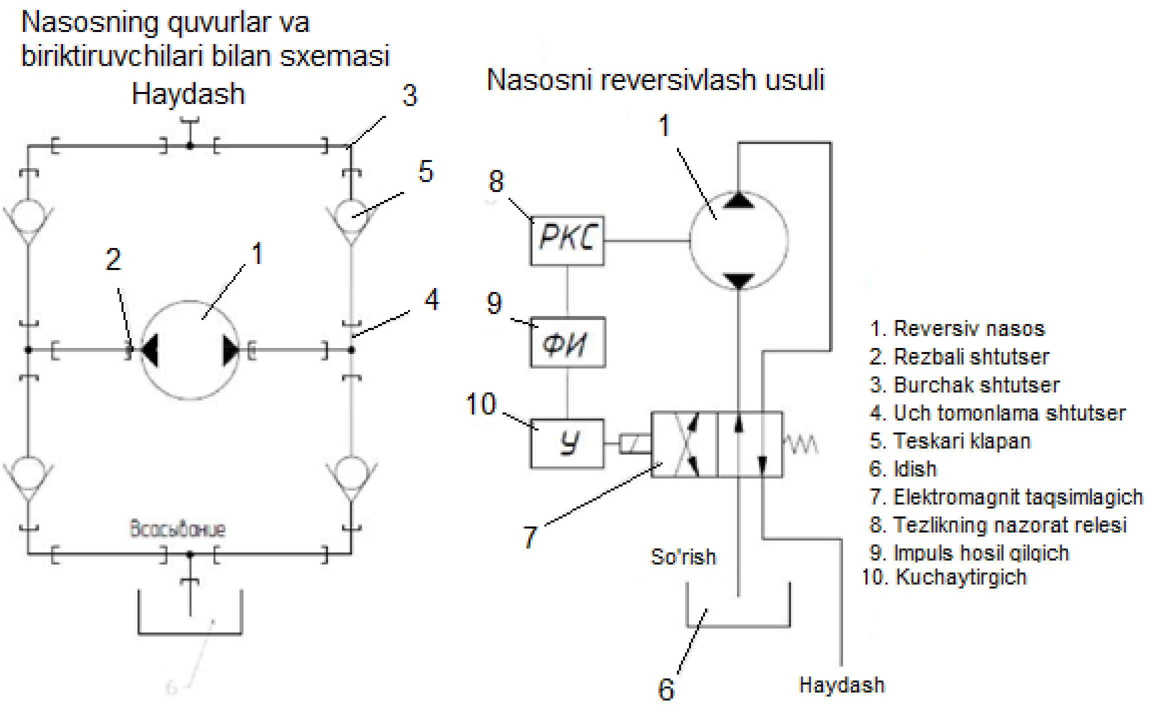

Figure 1. Methods of reversing the pump

The second method is to use storage control valves, which are more reliable than the first, with channels around the pump and four control valves. When the pump rotates, say, counterclockwise, the fluid from the pressure channel passes through the lower right level and is directed to the connection zone of the pump, the outlet, continues to move along the channel and goes down through the upper left level. When the pump is reversed, the direction of fluid flow changes, it passes through the lower left and upper right valves, and also exits the discharge cavity. Accordingly, no matter which direction the pump shaft rotates, the fluid always enters one channel (suction) and exits the other (driving).

This reversal method is the most optimal in terms of reliability and stability, as the minimum number of moving parts and the ability to quickly adjust the control valve springs make this pump easy to operate and maintain. And by placing all of this in a separate box, we practically eliminate leakage and reduce resistance so as not to use connecting fittings and conductors.

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Taking advantage of all the advantages of a gear pump, a pump was developed to lubricate the rotating gearboxes of the mining excavator and the lifting track, the feature of which was not to change the drive and suction channels when the drive reversed. The features of this pump can be applied in many fields of machinery, this work considers the use of a gear pump in heavy mining excavators.

Indicates the direction of fluid movement when the pump shafts rotate in one direction. In the return mode, the drive and suction channels do not change, but the fluid flows through the pipeline through the other two control valves.

The task in designing the pump was to place the valve and piping system and the gear pump itself in a single small housing, as 10 fittings had to be installed when using a flexible pipeline. The disadvantage of this system is that the fittings are prone to leakage, so parts of the pipes must be changed regularly to ensure full operation of the pump.

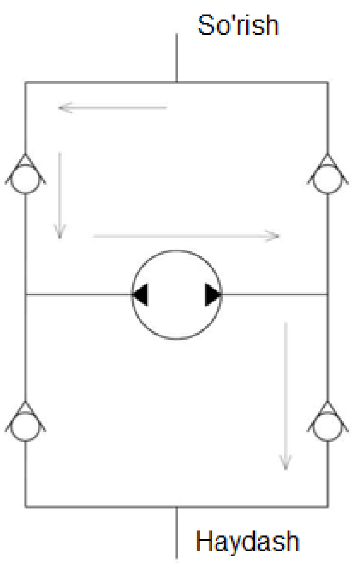

Figure 32. The principle of operation of the pump

Requirements for pumps for hydraulic transmission systems are aimed at ensuring the specified pressure and performance at minimum weights and dimensions, maximum efficiency, minimum production labor, ease of maintenance, reliable operation under operating conditions and long service life.

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