BASED ON THE DEVELOPMENT OF THE PRINCIPAL SCHEME OF THE HYDRAULIC OPERATION OF VOLUME PUMP DEVICES

Oybek Mustafaev
Ph.D., Associate Professor of the "Mining Electrical Mechanics" department, Navoi State University of Mining and Technologies

Lazizbek Murodullo ugli Husanov
4th year student of Navoi State and Mining Technology University

ABSTRACT

Nowadays, a number of machines and equipment with a hydraulic system are widely used in mining, construction and agriculture. In order to increase the stable and reliable operation of the hydraulic systems of these machines, it is important to develop their correct principle schemes, and this article presents analyzes on the justification of the development of the principle scheme of the hydraulic operation of volume pumping devices.

Keywords: pump, handling, principle scheme, hydraulics, machine, equipment, control devices, hydraulic motor, and hydraulic cylinder.

INTRODUCTION

Hydraulic drive is a set of hydraulic machines, hydraulic equipment, hydraulic lines (pipes) and auxiliary devices, and it is called a hydraulic system designed to transfer energy and convert motion through a fluid. At the same time, it is possible to regulate and reverse the speed of the output device, as well as transfer one type of movement to another at the same time [1,2].

The hydraulic machines that are part of the hydraulic system are pumps and hydraulic motors, and there can be several of them.

Hydraulic devices are devices for controlling hydraulic operation, with the help of which it is regulated, as well as means of protecting it from high and low pressures of the liquid. Hydraulic equipment includes throttles, valves for various purposes, and distribution devices for changing the direction of hydraulic fluid flow [3].

Auxiliary devices are called conditioners of the working fluid, which serve to ensure its quality and condition. These are various particle separators (filters), heat exchangers (heaters and coolers), hydraulic tanks and accumulators [4].

The hydraulic control elements are interconnected by hose hydraulic lines through which the working fluid moves.

LITERATURE REVIEW AND METHODOLOGY

Let's look at the structural scheme of the simplest piston hydraulic system in Fig. 1.

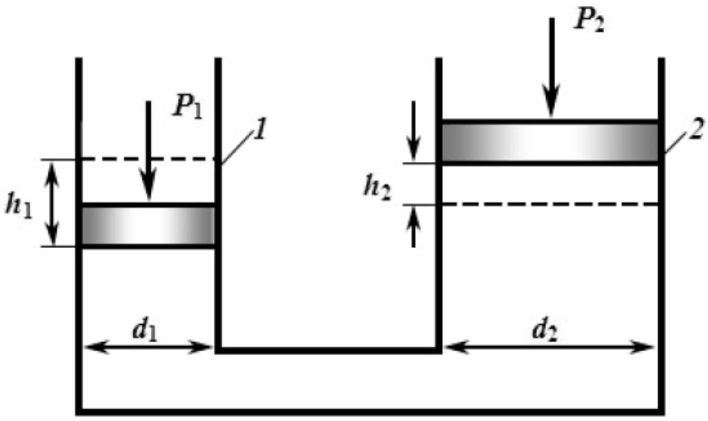

Figure-1. Structural scheme of the simplest piston hydraulic drive

Two cylinders (1 and 2) are filled with liquid and connected to each other through a straight pipe. The piston of the 1st cylinder moves down a distance h1 with the force P1 supplied from above and discharges the liquid into the 2nd cylinder. In this case, cylinder 2 moves the piston up a distance h2 and carries the load P2 up[5,6].

If we ignore pressure losses (hydraulic losses and friction losses), according to Pascal's law, the pressure created by the force P1 in cylinder 1 is equal to the entire volume of the liquid:

$$p_1 = \frac{P_1}{F_1} = \frac{P_2}{F_2} = p_2 .$$

where F_1 and F_2 are the surfaces of pistons of cylinders 1 and 2.

Then the relationship between the pressure forces acting on the pistons is as follows [7]:

$$P_2 = P_1 \left(\frac{d_2}{d_1} \right)^2 .$$

The liquid can be considered almost incompressible and the cylinders completely sealed.

$$h_1 F_1 = h_2 F_2$$

The dependence of the power spent on the movement of the piston in the 1st cylinder is determined by the following expression[8]:

$$N = P_1 \upsilon_1 = p_1 F_1 \upsilon_1 .$$

In the formula given above, the multiplication of speed and consumption gives the consumption

$$v_1 F_1 = Q.$$

Then the law of conservation and transfer of energy (in the absence of hydraulic losses and frictional forces) takes the following form[9]:

$$P_1\, v_1 = p\, Q = P_2\, v_2\,. \quad (1)$$

here, P2v2 – 2 is the power developed by the piston, that is, the indicator representing the dependence of the system on the output device given per unit of time.

From the formula (1) above, it follows that increasing the power of the hydraulic drive is more beneficial not by increasing the area of \u200b\u200bthe pistons (which leads to an increase in dimensions), but by increasing the pressure, since in this case a small increase in the volume and weight of the hydraulic drive "growth occurs due to the need to increase its strength [10,11].

RESULTS

Depending on the purpose of the hydraulic system and in accordance with the selected option of the initial data, it is necessary to make a sketch of the principle scheme of the hydraulic system, which is then tested and determined by calculations. The scheme uses all the elements of equipment necessary for its operation. Symbols of elements are adopted in accordance with normative documents [12,13,14].

Next, you need to choose the method of regulating the speed of the hydraulic drive at the output link: throttle (picture 1) or volumetric (picture 2) [15].

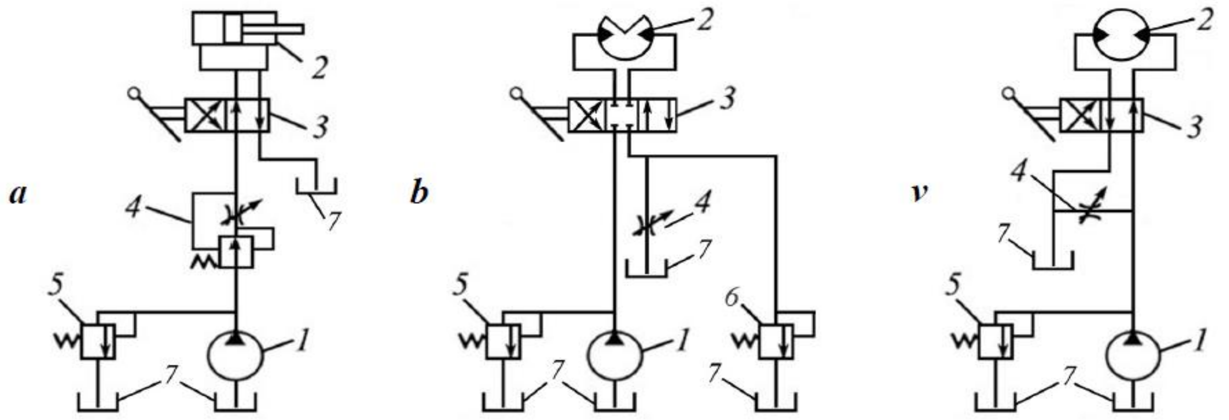

Figure 2. Throttle regulation hydraulic system:

1 – pump; 2 - hydraulic motor (a - power hydraulic cylinder; b - moment hydraulic cylinder;
v - hydromotor); 3 – distribution device (a – two-stage; b – three-stage);
4 – throttle regulator; 5 – overflow valve; 6 – safety valve;
7 – pouring tube.

A In this case, it is necessary to analyze the aspect of technical and economic efficiency. Throttle controlled hydraulic systems are relatively easy and inexpensive to operate. However, due to large energy losses, the throttle regulation method is currently used in low-power hydraulic systems (N < 15 kW) in production conditions [16,17].

By installing a throttle in the main pressure pipeline, a series throttle regulation is implemented (Fig. 1,a) and is used in cases where there is a load of one sign at the output link.

When there is a variable load or large accelerations of the output link, a regulating throttle should be installed in the main pipeline (Fig. 1, b).

The parallel throttling regulation method (Fig. 1.v) has a higher efficiency than the series throttling method, so it can be used with relatively high power requirements (from 10 to 15 kW). However, the disadvantages of such a hydraulic system are a decrease in external network characteristics, regulation accuracy and stability.

Regulation with a hydraulic driving power of more than 15 kW, despite the relatively high price of the hydraulic machine, it is necessary to adopt the volumetric regulation method (Fig. 2).

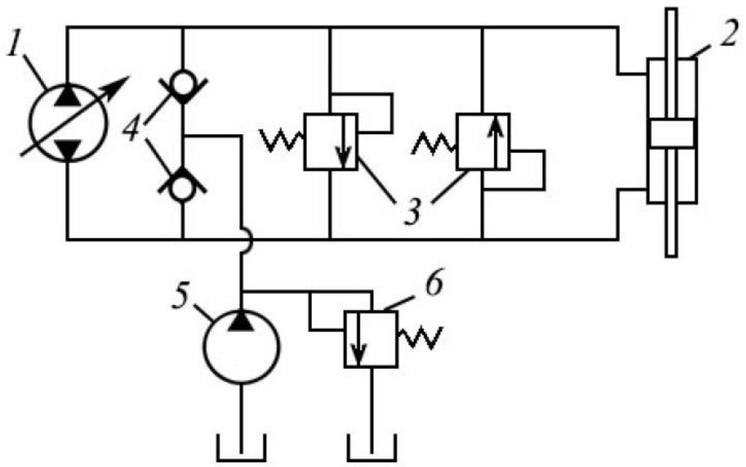

Figure 3. Volume regulation hydraulic system:
1 – regulating pump; 2 – power hydraulic cylinder; 3 – safety valve;
4 – reverse valve; 5 – auxiliary pump device for supplying the system;
6 - overflow valve.

DISCUSSION

- The choice of the regulation method can be made by the output power of the hydraulic system in the following cases:
- in hydraulic motors and torque hydraulic cylinders:

$$N = M_{st} w$$

- in power hydraulic cylinders:

$$N = R_{st} v$$

The value of the magnitude of the angular velocity:

- for the hydraulic motor shaft:

$$w = \frac{2\pi n}{60} \ (1/sek)$$

- for hydraulic cylinder torque

$$w = \frac{\varphi}{t}\frac{2\pi}{60} \ (1/sek)$$

Movement speed of the hydraulic cylinder shaft:

$$v = \frac{s}{t}$$

CONCLUSION

Based on the above analysis and results, the general load applied to the hydraulic system during the development of the principle scheme consists of static and inertia and is determined as follows:

• for hydraulic motors and torque hydraulic cylinders:

$$M = M_{st} + M_{in} \ ;$$

: • for power hydraulic cylinders:

$$R = Rst + Rin \ .$$

$$M_{in} = J \varepsilon \ ,$$

where, J is the moment of inertia of the moving parts on the output shaft;
e is the angular acceleration of the shaft.

The angular acceleration of the shaft is determined as follows:

$$\varepsilon = \frac{\omega}{t`}$$

where, t' is the mode entry time, which is assumed to be equal to one-tenth of the duty cycle (0.1 t), but not exceeding 1 s.

The magnitude of the inertial force is determined by the following formula:

$$R_{in} = m\,a\ ,$$

We can see that the volume pumping devices of the hydraulic system depend on a number of indicators, which are necessary to justify the development of the principle scheme of the hydraulic system. On the basis of the above results, the principle scheme of volumetric hydraulic treatment will be built, and through this principle scheme, it will be possible to ensure the operation of hydraulic treatment at optimal efficiency.

REFERENCES

1. Turdiyev , S. A., & Akhmedov , S. T. (2023). FUNDAMENTALS OF EXTERNAL NETWORK CHARACTERISTICS OF HYDRAULIC SYSTEM. *Educational Research in Universal Sciences*, *2*(1 SPECIAL), 87–93.

2. *Turdiyev, S. A. (2023). GIDRAVLIK YURITMANING TASHQI TARMOQ TAVSIFINI HISOBLASHNI ASOSLASH. Innovative Development in Educational Activities, 2(5), 327–333.*

3. Azamatovich, A. N., Shavkatovich, Z. A., Abdumuminovich, T. S., & Xusniddinovich, A. S. (2005). Simulation of the Motion of Dusted Air Flows Inside the Air Filter of a Hydraulic System of a Quarry Excavator. International Journal of Grid and Distributed Computing (IJGDC), ISSN, 4262, 11-18.

4. Turdiyev, S. A., and Jurayev A. Sh. "Study of the effect of excavator bucket tooth abrasion on digging resistance." Academic Research in Education Sciences 3.3 (2022): 105-110.

5. Абдуазизов, Набижон Азаматович. "Турдиев Сардоржон Абдумуминович Жураев Акбар Шавкатович. Разработка математическая модель тепловых процессов в регулирующем контуре гидрообъемной силовой установки карьерного комбайна (44-47)." Евразийский Союз Ученых. Технические науки 62.1 (2019): 44-47.

6. Djuraev, R. U., and S. A. Turdiyev. "Mathematical modeling of the wear of cutting elements on quarry excavators." International journal of advanced research in science, engineering and technology (IJARSET)–India 9.3 (2022): 19074-19080.

7. Мустафаев О.Б., Турдиев С.А. ДИНАМИЧЕСКОЕ ВОЗДЕЙСТВИЕ РЕЗЦОВ ИНСТРУМЕНТАМИ РЕЖУЩЕ-СКАЛЫВАЮЩЕГО ДЕЙСТВИЯ.

8. Azamatovich, A. N., Shavkatovich, Z. A., Abdumuminovich, T., & Khusniddinovich, A. (2005). Modeling the movement of dusty air flows inside the air filter of the hydraulic system of a mining excavator. International Journal of Grid and Distributed Computing (IJGDC), ISSN, 4262, 11-18.

9. Abdumuminovich T. S., Tojiboyevich A. S. ANALYSIS OF EFFICIENCY OF CONTROL METHODS OF HYDRAULIC DRIVE

MOTORS //RESEARCH AND EDUCATION. – 2023. – Т. 2. – №. 2. – С. 109-115.

10. Abduazizov N. A. et al. Gidroekskavatorning gidrobakdagi havo filtrining ichida changlangan havo oqimlari harakatini modellashtirish //Academic research in educational sciences. – 2021. – Т. 2. – №. 3. – С. 294-304.

11. Abdumuminovich T. S., Tojiboyevich A. S. GIDRAVLIK YURITMALARNI TARTIBGA SOLISH USULLARI SAMARADORLIGINI OSHIRISH //Journal of Integrated Education and Research. – 2023. – Т. 2. – №. 2. – С. 8-14.

12. Raykhanova G. Y., Djuraev R. U., Turdiyev S. A. DEVELOPMENT AND EXPERIMENTAL RESULTS OF A NEW CONSTRUCTION OF THE ELEMENT OF PROTECTION OF THE BASE OF THE JAVE PART OF QUARRY EXCAVATORS //The American Journal of Engineering and Technology. – 2022. – Т. 4. – №. 04. – С. 58-67.

13. Turdiyev S. A., Djuraev R. U. Experimental results on the effectiveness of an improved excavator bucket tooth design //The American Journal of Engineering and Technology. – 2022. – Т. 4. – №. 03. – С. 1-13.

14. Turdiyev S. A. et al. Experimental and test study of the effectiveness of the improved design of the excavator bucket jaw plate //Central Asian Research Journal for Interdisciplinary Studies (CARJIS). – 2022. – Т. 2. – №. 3. – С. 214-223.

15. Кахаров С. К., Турдиев С. А., Аблакулов С. Б. Увеличение ресурса бурового оборудования, за счет применение структурно-функциональной схемы ремонта взаимосвязанных элементов //Современные научные исследования и разработки. – 2018. – Т. 1. – №. 5. – С. 329-332.

16. Xalilov S., Raxmatova Z., Raxmatova F. GIDRAVLIK EKSKAVATORNING EKSPLUATATSION XARAJATLARINI TAHLILI //Zamonaviy dunyoda pedagogika va psixologiya: Nazariy va amaliy izlanishlar. – 2022. – Т. 1. – №. 26. – С. 34-39.

17. Abdullayev, S. H. ., Turdiyev, S. A. ., Raxmatova , Z., & Raxmatova , F. . (2022). KON MASHINALARI GIDRAVLIK TIZIMINING HAVO FILTRINI TAKOMILLASHTIRISH. Journal of Integrated Education and Research, 1(4), 417–423.

18. Raykhanova G. Y., Djuraev R. U., Turdiyev S. A. DEVELOPMENT AND EXPERIMENTAL RESULTS OF A NEW CONSTRUCTION OF THE ELEMENT OF PROTECTION OF THE BASE OF THE JAVE PART OF QUARRY EXCAVATORS //The American Journal of Engineering and Technology. – 2022. – Т. 4. – №. 04. – С. 58-67.

19. Raykhanova G. Y., Dzhuraev R. U., Turdiyev S. A. STUDY OF THE LOADS ON BUCKETS AND CUTTING ELEMENTS OF QUARRY EXCAVATORS DURING DIGGING AND CUTTING //Academic research in educational sciences. – 2022. – Т. 3. – №. 4. – С. 1123-1132.