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ИЗВЕСТИЯ

НАЦИОНАЛЬНОЙ АКАДЕМИИ НАУК
РЕСПУБЛИКИ КАЗАХСТАН
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NAS RK is pleased to announce that News of NAS RK. Series of geology and technical sciences scientific journal has been accepted for indexing in the Emerging Sources Citation Index, a new edition of Web of Science. Content in this index is under consideration by Clarivate Analytics to be accepted in the Science Citation Index Expanded, the Social Sciences Citation Index, and the Arts & Humanities Citation Index. The quality and depth of content Web of Science offers to researchers, authors, publishers, and institutions sets it apart from other research databases. The inclusion of News of NAS RK. Series of geology and technical sciences in the Emerging Sources Citation Index demonstrates our dedication to providing the most relevant and influential content of geology and engineering sciences to our community.

Қазақстан Республикасы Ұлттық ғылым академиясы «ҚР ҰҒА Хабарлары. Геология және техникалық ғылымдар сериясы» ғылыми журналының Web of Science-тің жаңаланған нұсқасы Emerging Sources Citation Index-те индекстелуге қабылданғанын хабарлайды. Бұл индекстелу барысында Clarivate Analytics компаниясы журналды одан әрі the Science Citation Index Expanded, the Social Sciences Citation Index және the Arts & Humanities Citation Index-ке қабылдау мәселесін қарастыруда. Webof Science зерттеушілер, авторлар, баспашылар мен мекемелерге контент тереңдігі мен сапасын ұсынады. ҚР ҰҒА Хабарлары. Геология және техникалық ғылымдар сериясы Emerging Sources Citation Index-ке енуі біздің қоғамдастық үшін ең өзекті және беделді геология және техникалық ғылымдар бойынша контентке адалдығымызды білдіреді.

НАН РК сообщает, что научный журнал «Известия НАН РК. Серия геологии и технических наук» был принят для индексирования в Emerging Sources Citation Index, обновленной версии Web of Science. Содержание в этом индексировании находится в стадии рассмотрения компанией Clarivate Analytics для дальнейшего принятия журнала в the Science Citation Index Expanded, the Social Sciences Citation Index и the Arts & Humanities Citation Index. Web of Science предлагает качество и глубину контента для исследователей, авторов, издателей и учреждений. Включение Известия НАН РК. Серия геологии и технических наук в Emerging Sources Citation Index демонстрирует нашу приверженность к наиболее актуальному и влиятельному контенту по геологии и техническим наукам для нашего сообщества.

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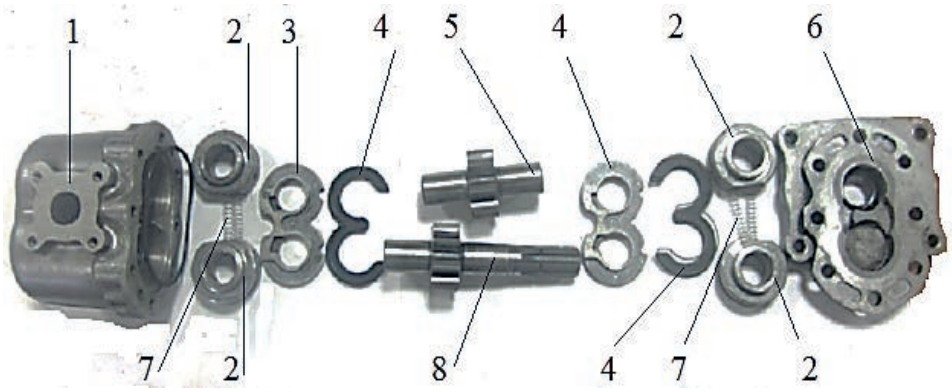
METHOD FOR SELECTING THE LOCATION OF THE CLEARANCE FIELDS OF THE LANDING SURFACES OF GEAR PUMP PARTS WITH A BIAXIAL CONNECTION

Abstract. One of the types of volumetric pumps is a gear pump designed for pumping oil and petroleum products that have a lubricating ability, without mechanical impurities and do not cause corrosion of the pump's working bodies, as well as for pumping light-duty liquids and diesel fuel. The authors have developed a new design of a gear pump with a two-axis connection. The new connection, which the authors called biaxial, consists of two parts with landing surfaces, one of which has a surface consisting of two cylinders with two axes, respectively. The use of a two-axis connection in the design of a gear pump allows ensuring the accuracy of the location of parts in the connection and the greatest alignment of the axes of holes and shafts, i.e. maximum alignment of the hole axes with the shaft axis or the axis of rotation, as well as the greatest contact between the shaft and hole surfaces, and ensuring that the shaft and hole axes are parallel. As a result of the study of the designs and technological requirements of gear pumps, a new type of "shaft-hole" connection was proposed in the designs of fixed joints, in particular the shaft-gear of the gear pumps. The use of a two-axis connection allowed us to offer a new design of the gear pumps with a two-axis connection confirmed by innovative patents of the Republic of Kazakhstan. The research was carried out within the framework of the grant №AP09562459.

A method has been developed for selecting the location of the clearance fields of the landing surfaces of the two-axis connection in relation to gear pumps.

Key words. Gear pump, biaxial connection, clearance fields, landing surface, shaft-hole connections.

Introduction. Currently, a large number of hydraulic machines are used, which work is related to the mutual conversion of mechanical energy and liquid energy, with the transportation of liquid, with the transfer of forces using the liquid inside the machine [1,2,3]. Hydraulic machines include pumps, hydraulic motors, and hydraulic cylinders. Pumps are machines for creating a fluid flow. They are one of the most common types of hydraulic machines, used for a variety of purposes [3,4,5,6]. In dynamic pumps, the fluid is moved by force in a chamber that constantly connects with the pump inlet and outlet. In volumetric pumps, the liquid is moved by periodically changing the volume of the chamber it occupies, which alternately connects with the pump inlet and outlet [7,8,9,10]. One of the types of volumetric pumps is a gear pump designed for pumping oil and petroleum products that have a lubricating capacity, without mechanical impurities and do not cause corrosion of the pump's working bodies, as well as for pumping light-fast liquids and diesel fuel [11,12,13]. The authors have developed a new design of a gear pump with a two-axis connection [14,15], which allows providing: accuracy of the location of parts in the connection, the greatest alignment of the axes of holes and shafts, i.e. the maximum alignment of the axes of holes with the axis of the shaft or the axis of rotation, maximum contact of the shaft and hole surfaces and ensuring that the axes of the shafts and holes are parallel. The increase in the above indicators dictates the improvement of manufacturing technologies for gear pump parts, which consists in the use of advanced technologies for machining and assembling gear pump parts with a two-axis connection [16]. Figure 1 shows the main components and components of the gear pump with a biaxial connection.



1-housing; 2-bushings; 3-bearings; 4-seals; 5-driven shaft-gear; 6-housing cover;
7-spring; 8-drive shaft-gear

Figure 1-Main components and components of the gear pump with a biaxial connection

The new connection, which is called biaxial, consists of two parts with landing surfaces, one of which has a surface consisting of two cylinders with two axes, respectively [17, 18, 19]. For example, the surface of the biaxial shaft, on which the connection is made, has a landing and free diameter. The landing surface is located on an arc of a circle with a Central angle of φ<180°. The landing surface of the shaft contacts the surface of the hole due to the forces of force interaction. The second free cylindrical surface of the shaft has a radius that provides a gap in the "shaft-hole" connection. The connection can also consist of a cylindrical shaft and a biaxial hole.

Materials and methods. The layout of the clearance fields [16, 20, 21, 22] recommended for biaxial connections is shown in figure 2. Analysis of the layout of the clearance fields shows that in the end section, in cases where the clearance fields shown in figure 2, b and 2,c are located, the contact of the landing surfaces will differ from the contacts possible when the clearance fields shown in figure 2, a are located.

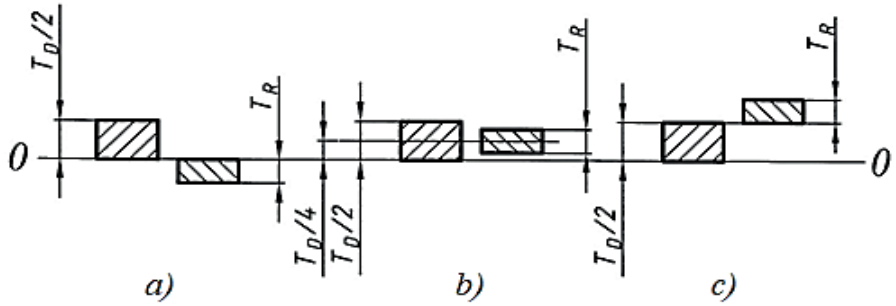


Figure-2-Layout of clearance fields for shaft-hole biaxial connections in the hole system

When placing the clearance fields shown in the diagram (figure 2, a), a condition occurs

$$R \leq D/2. \qquad (1)$$

If condition (1) is met, the contact of the landing surfaces is made along the cylinder-forming surface or, if R≤ D/2, along the cylindrical surface. [20,23] shows the values of the eccentricities of the hole axis relative to the shaft axis when the clearance fields are located according to the scheme in figure 2,and for sizes ranging from 10 to 250 mm. Figure 2 shows three special cases of schemes for the location of clearance fields of two-axis shaft-hole connections in the hole system.

When the clearance fields shown in figure 2, b, and 2,c are located, the condition (1) is not met. The value of the radius R may exceed the value of half the diameter of the hole D / 2. That is, both the condition R≤D / 2 and the condition R>D/2 can be maintained. Under the second condition, the contact of the landing surfaces of the shaft and the hole will occur along two forming cylinders located at a distance of the Central angle φ In this contact, a gap is formed between the landing surfaces due to the mismatch of the landing surfaces along the cylinder-forming surface with the maximum value in the middle of the landing surface in the end section between the shaft and the hole. Figure 3 shows a diagram of a biaxial connection under the condition R>D / 2.

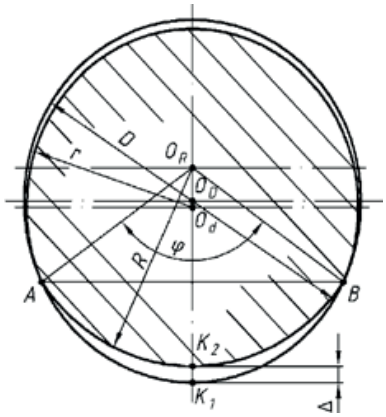


Figure 3-Diagram of the biaxial connection "shaft-hole» provided R>D/2

Results. From figure 3 it is seen that in the connection due to inequalities of the arc landing master cylinder AK_2B and arc mounting surface hole AK_1B form a gap K_1K_2. The value of the gap K_1K_2 will affect the amount of displacement of the hole axis relative to the axis of the landing diameter of the shaft and, consequently, affect the amount of radial runout of the sleeve on the biaxial shaft.

The value of the segment K_1K_2 is determined in the following sequence:

$$K_1K_2 = O_RK_1 - O_RK_2, \quad (2)$$

or

$$K_1K_2 = \frac{D}{2} + O_RO_D - R$$

From triangles $\Delta O_R A O_D$,, considering the known angle φ , we get

(3)

Solving equation (3) with respect to the value of O_R O_D and substituting in (2), we determine the gap K1K2 for different values of D, R, and φ using the formula

(4)

The choice of the layout of the biaxial connection clearance fields and the values of the Central angles φ must be carried out depending on the tasks to be solved when using biaxial connections. When using the biaxial connection with the location of the clearance fields shown in figures 2, b and 2, c, it is necessary to take into account the effect of the mismatch of the landing surfaces on the value of the eccentricities. In [20,23], the values of mismatch of the landing surfaces of biaxial joints in the opening system for landing transition sizes ranging from 10 to 250 mm and with Central angles of 60°, 90°, 120°are given. In [23], the values of mismatch of the landing surfaces of biaxial joints in the hole system for the landing dimensions of shafts that exceed the size of the hole, in the range from 10 to 120 mm and with Central angles of 60°, 90°, 120°are given.

The location of the clearance fields for two-axis connections can be selected using one of the schemes shown in figure 2, i.e. non-system clearances and fitments. However, you can select clearances and fitments for standard systems. Selecting and assigning clearances and fitments for biaxial connections for standard systems is more convenient for designers and technologists in many ways. For example, the out-of-system layout of clearance fields shown in figure 2, b can be represented by a system for positioning the clearance fields of transient landings that meet existing standards. When choosing the layout of the clearance fields, three schemes (see Fig. 2) are proposed. To select the layout of the clearance fields that provide small values of eccentricities, the scheme in figure 2, b was proposed. In this scheme, the middle of the shaft clearance field is equal to the middle of the hole scattering field. This scheme makes it possible to solve the problem of ensuring minimum values of eccentricities in a simplified form. According to this scheme, with some approximation, we can assume that

$$e_{max} = 0{,}25(T_D + T_d). \quad (5)$$

However, a deeper analysis of the diagram in figure 2, b does not make it difficult to guess that the value of the eccentricity calculated by the formula (5) will differ from the actual possible value, since at values R>D/2, a certain gap between the landing surfaces is formed. This gap, although insignificantly, changes the minimum possible eccentricity value. The diagram in figure 2, b shows that for values R≤D/2, the Emax values are calculated using the formula (5). At values of R>D/2

$$e_{\max} \neq 0{,}25(T_D + T_d) \quad (6)$$

Determining the optimal position of the middle of the hole clearance field relative to the shaft clearance field, where the values of *e* are equal for both R≤D/2 and R>D/2.

The gap value Δ is determined by the formula (4). Therefore, for values R>D/2

$$e_{\max} = 0{,}25(T_D + T_d) + \Delta. \quad (7)$$

To align the $e_{\max}$ values determined by (5) and (7), shift the position of the middle of the shaft clearance field relative to the middle of the hole clearance field by the value $\Delta_1/2$ formed when $D_{average} = d_{average}$. Figure 4 shows the layout of the shaft and hole clearance fields, taking into account the offset by the value $\Delta_1/2$ in the hole system.

When the clearance fields are arranged according to the diagram in figure 4, the $e_{\max}$ value is as it follows. For values $R \leq D/2$, $e_{\max}$ values will be calculated using the formula

$$e_{\max} = 0{,}25(T_D + T_d) + 0{,}5\Delta. \quad (8)$$

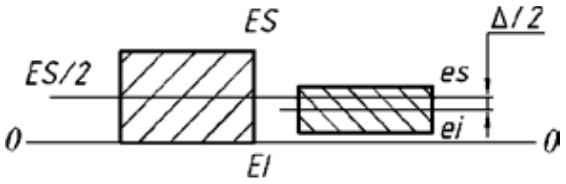


Figure 4 - Diagram describing the location of the shaft clearance field, taking into account the value of Δ

For values R>D/2, the eccentricity *e* will be equal to

$$e_{\max} = 0{,}25(T_D + T_d) - 0{,}5\Delta_1 + \Delta_2, \quad (9)$$

where Δ_2 is the new gap value for values R>D / 2.

If the $e_{\max}$ values determined by the formulas (8) and (9) are not equal, we shift the middle of the scattering field by the value $\Delta_2/2$.. And then we get

$$e_{\max} = 0{,}25(T_D + T_d) + 0{,}5(\Delta_1 + \Delta_2);$$

when R≤D / 2

$$e_{\max} = 0{,}25(T_D + T_d) - 0{,}5(\Delta_1 + \Delta_2) + \Delta_3, \quad (10)$$

where Δ_3 is the new value of the gap at R>D/2.

Discussion. By repeating such calculations and approximating the values of eccentricities at R≤D / 2 and at R>D/2, it is possible to determine the relative position of the tolerance fields of the shaft and the hole with a second-order margin of error, at which the minimum value of the eccentricity of the hole axis relative to the shaft axis will be provided by the values of the clearance fields. In [23,24,25,26], the question of determining the optimal position of the hole scattering field relative to the shaft scattering field is not considered. We can only say that when the hole and shaft sizes are dispersed according to the Gauss law, the greatest probability of matching the sizes R and D/2 must be expected when the clearance fields are arranged according to the scheme shown in figure 2, b. When considering the actual dimensions of holes and landing shafts that have a certain size dispersion distribution law [24, 27, 28], the described method will be adjusted within the batch of parts based on the probability theory.

Conclusion. 1. As a result of the study of the designs and technological requirements of gear pumps, a new type of "shaft-hole" connection was proposed in the designs of fixed joints, in particular the shaft-gear of the gear pump. The use of a biaxial connection allowed us to offer a new design of the gear pumps with a biaxial connection confirmed by innovative patents of the Republic of Kazakhstan.

2. A method has been developed for selecting the location of the clearance fields of the landing surfaces of the biaxial connection in relation to gear pumps.

3. Using the new type of shaft-hole connection, you can solve the following problems:

- ensuring the greatest alignment of the axes of holes and shafts, i.e. the maximum alignment of the axes of holes with the axis of the shaft or the axis of rotation.

- ensuring the greatest contact between the shaft and hole surfaces and ensuring that the axes of the shafts and holes are parallel.

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ЕКІ ОСЬТІ ҚОСЫЛЫСЫ БАР ТІСТЕГЕРШІКТІ СОРҒЫ БӨЛШЕКТЕРІНІҢ ОТЫРҒЫЗУ БЕТТЕРІНІҢ ШАҚТАМА ӨРІСТЕРІНІҢ ОРНАЛАСУЫН ТАҢДАУ ӘДІСТЕМЕСІ

Аннотация. Қазіргі уақытта жұмысы механикалық энергия мен сұйық энергияны өзара түрлендірумен, сұйықтықты тасымалдаумен, машина ішіндегі сұйықтықпен күшті берумен байланысты гидравликалық машиналардың көптеген түрлері қолданылады. Көлемді сорғылардың бірі сорғының жұмыс органдарының коррозияға ұшырауын болдырмайтын және механикалық қоспаларсыз майлау қабілеті бар мұнай мен мұнай өнімдерін айдауға, сондай-ақ, оңай ағатын сұйықтықтар мен дизель отынын айдауға арналған тістегершікті сорғы болып табылады.

Авторлар екі осьті қосылысы бар тістегершікті сорғының жаңа конструкциясын жасады. Авторлар екі осьті деп атаған жаңа қосылыс түрі отырғызу беттері бар екі бөлшектен тұрады, олардың біреуі, тиісінше, екі осі бар екі цилиндрден тұрады. Беріліс сорғысының конструкциясында екі осьті қосылысты қолдану қосылыстағы бөлшектердің дәлдігін және тесіктер мен біліктердің осьтерінің ең үлкен үйлесімділігін, яғни тесіктердің осьтерін білік осімен немесе айналу осімен максималды біріктіру, сондай-ақ, білік пен тесік беттерінің ең үлкен байланысын және біліктер мен тесіктердің осьтерінің параллельдігін қамтамасыз етуге мүмкіндік береді. Өлшемдердің таралуының белгілі бір заңы бар тесіктер мен отырғызу біліктерінің нақты өлшемдерін қарастыру кезінде бөлшектер партиясының ішінде сипатталған әдіс ықтималдық теориясы негізінде түзетілетін болады. ТС сорғыларының конструкциялары мен технологиялық талаптарын зерттеу нәтижесінде жылжымайтын қосылыстардың конструкцияларындағы жаңа түрдегі «білік-тесік» қосылысы ұсынылды. Екі осьті қосылысты қолдану ҚР инновациялық патенттерімен расталған екі осьті қосылысы бар ТС жаңа конструкциясын ұсынуға мүмкіндік берді. Тістегершікті сорғыларда қолданылатын екі осьті қосылыстың отырғызу беттерінің шек өрістерінің орналасуын таңдау әдістемесі жасалды.

Түйінді сөздер: тістегеріш сорғы, екі осьті қосылым, рұқсат өрісі, отырғызу беті, «вал-тесік» қосылымдары.

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МЕТОДИКА ВЫБОРА РАСПОЛОЖЕНИЯ ПОЛЕЙ ДОПУСКОВ ПОСАДОЧНЫХ ПОВЕРХНОСТЕЙ ДЕТАЛЕЙ НАСОСА ШЕСТЕРЕННОГО С ДВУХОСНЫМ СОЕДИНЕНИЕМ

Аннотация. В настоящее время используется большое количество гидравлических машин, работа которых связана с взаимным преобразованием механической энергии и энергии жидкости, с транспортировкой жидкости, с передачей усилий с помощью жидкости внутри машины. Одной из разновидностей объемных насосов является шестеренный насос, предназначенный для перекачки нефти и нефтепродуктов, обладающих смазывающей способностью, без механических примесей и не вызывающих коррозии рабочих органов насоса, а также для перекачки легкозастывающих жидкостей и дизельного топлива.

Авторами разработана новая конструкция насоса шестеренного с двухосным соединением. Новое соединение, названное авторами двухосным, состоит из двух деталей с посадочными поверхностями, у одной из которых поверхность состоит из двух цилиндров соответственно с двумя осями. Использование двухосного соединения в конструкции насоса шестеренного позволяет обеспечение точности расположения деталей в соединении и наибольшей сносности осей отверстий и валов, т.е. максимальное совмещение осей отверстий с осью вала либо осью вращения, а также наибольшего контакта поверхностей вала и отверстия и обеспечение параллельности осей валов и отверстий. При рассмотрении действительных размеров отверстий и посадочных валов, имеющих определённый закон распределения рассеивания размеров, в пределах партии деталей описанная методика будет корректироваться на основе теории вероятностей. В результате исследования конструкций и технологических требований насосов НШ было предложено соединение «вал-отверстие» нового вида в конструкциях неподвижных соединений, в частности вал-шестерня НШ. Использование двухосного соединения позволило предложить новую конструкцию НШ с двухосным соединением подтвержденного инновационными патентами РК. Разработана методика выбора расположения полей допусков посадочных поверхностей двухосного соединения применительно к шестеренчатым насосам.

Ключевые слова: насос шестеренный, двухосное соединение, поля допуска, посадочный поверхность, соединения «вал-отверстие».

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REFERENCES:

[1] Lepeshkin A.V., Mikhailin A.A., Sheipak A.A. Hydraulics and hydropneumatic drive: textbook: Hydraulic machines and hydropneumatic drive. / edited by A. A. Sheipak. - Moscow: MGIU, 2003. - Part 2. – 352p. (In Russian).

[2] Bashta T.M., Rudnev S.S., Nekrasov B.B. and others. Hydraulics, hydraulic machines and hydraulic drives: textbook for engineering universities. - 2nd ed., processing. - M.: mechanical engineering, 1982. – 423p. (In Russian).

[3] Syritsin T.A. Operation and reliability of hydro-and pneumatic drives.- Moscow: Mashinostroenie, 1990. - 315 p. (In Russian).

[4] Lezin P.P. Fundamentals of reliability of agricultural machinery. - Saransk: mu Publishing house, 1997. - 223 p. (In Russian).

[5] Zhabo V.V., Uvarov V.V. Hydraulics and pumps: textbook for technical schools. - 2nd ed., processing. - M.: Energoatomizdat, 1984. – 328p. (In Russian).

[6] Bashta T.M. Volumetric pumps and hydraulic motors of hydraulic systems-Moscow: Mashinostroenie, 1974. - 606 p. (In Russian).

[7] Osipov A.F. Volumetric hydraulic machines. - Moscow: Engineering, 1966. - 160 p. (In Russian).

[8] Kadyrov A., Zhunusbekova Zh., Ganyukov A., Kadyrova I., Kukesheva A. General Characteristics for Loading the Working Elements of Drilling and Milling Machines when Moving in the Clay Solution // Communications - Scientific Letters of the University of Zilina. - 2021. - Vol. 23, no. 2. - P. B97-B105. DOI: *https://doi.org/10.26552/com.C.2021.2.B97-B105* (in Eng.).

[9] Abramov E.I., Kolesnichenko K.A., Maslov V.T. Hydraulic drive Elements: reference Book-Kiev: Technika, 1977. - 320 p. (In Russian).

[10] Kogaev V.P., Drozdov Yu.N. Strength and wear resistance of machine parts. - Moscow: Higher school, 1991. - 319 p. (In Russian).

[11] Yudin E.M. Gear pumps. - M.: Mechanical Engineering, 1964.- 232p. (In Russian).

[12 *Togizbayeva B.B.*, *Sazambayeva B.T.*, *Karazhanov A.A.*, *Kenesbek A.B.*, *Cocoşilă M.* (2020) Simulation of operation of neural network with purpose of utilisation of hydraulic actuators in complicated technical conditions / *International Journal of Agricultural and Biological Engineeringthis link is disabled*, 2020, 13(1), стр. 11–19. (in Eng.).

[13] Stesin S.P. Hydraulics, hydraulic machines and hydraulic pneumatic drive. - Moscow: Publishing House: Academy, 2005. – 336 p.

[14] Sherov A.K., Alikulov D.E., Smirnov Yu.M., Sherov K.T. Gear Pump / Innovative patent No. 27941 of the Republic of Kazakhstan. publ. 15.12.2013 year. Bul. No. 12. (In Russian).

[15] Aistov I.P. Development of methods for increasing the resource of gear pumps of hydro-fuel systems: ... dis. doctor. Techn.sciences'. - Omsk, - 2009. – 284p. (In Russian).

[16] Sherov A.K., Sherov K.T., Sikhimbayev M.R., Absadykov B.N., Kuanov I.S. (2021). Research of qualitative indicators of a gear pump with two-shaft connection for pumping petroleum products // News of the National Academy of Sciences of the Republic of Kazakhstan. Series of geology and technical sciences. 2021, Volume 4, Number 448 (2021), 108-116 *https://doi.org/10.32014/2021.2518-170X.88* (in Eng.).

[17] Sherov A.K., Myrzakhmet B., Sikhimbayev M.R., Absadykov B.N. Gear pump quality improving by changing the design and size of the support bushings / News of the National Academy of Sciences of the Republic of Kazakhstan. Series of geology and technical sciences. 2021, Vol.6, Nu. 450 (2021), 155-162. *https://doi.org/10.32014/2021.2518-170X.132* (in Eng.).

[18] Sherov A.K., Alikulov D.E., Smirnov Yu.M., Sherov K.T., Rakishev A.K., Mussayev M.M., Mazdubay A.V. Research of the internal leakage process of a liquid in the design of a gear pump with a two-axial connection / News of the National Academy of Sciences of the Republic of Kazakhstan. Series of geology and technical sciences. 2021, Volume 2, Number 446 (2021), P.198-204. *https://doi.org/10.32014/2021.2518-170X.53* (in Eng.).

[19] Sherov K.T., Alikulov D.E. Control ruler for angles between planes of V-shaped guides / *Measurement Techniques*. July 2012, Volume 55, *Issue 4*, pp 397–399. *https://doi.org/10.1007/s11018-012-9971-5*. (in Eng.).

[20] Alikulov D.E. two-Axis connection "shaft-holes".- Tashkent: Publishing House "Malia".- 2007.- 131c. (In Russian).

[21] Matveev V.V., Tverskoy M.M., Boikov F.I., and others. Dimensional analysis of technological processes-M.: mechanical engineering, 1982. - 264 p. (In Russian).

[22] *Balgabekov T.K.*, *Issin D.K.*, *Kimanov B.M.*,.*Akashev A.Z.*, *Issin B.D.* Studying and improving blast furnace cast iron quality / *Metalurgija*, 2014, 53(4), стр. 556–558. (in Eng.).

[23] Parkhomenko V.I., Shamgunov S.M. Fundamentals of repair and operation of tractors: a textbook. - Pavlodar, 2008. - 130 p. (In Russian).

[24] Myagkov V.D., Paley M.A., Romanov A.B., Braginsky V.A. Admissions and landings. Reference: in 2 hours-L.: Engeneering., 1982.- Part 1.- 543s.; Part 2.-447 pp. (In Russian).

[25] Zhunusbekova Zh.Zh, Kadyrov A.S. (2016) Study of digging machine flat element loading in clay solution / Journal "Naukovyi Visnyk Natsionalnoho Hirnychoho Universytetu" Volume №2 (152), P.30-33. (in Eng.).

[26] Dudak N., Taskarina A., Kasenov A., Itybaeva G., Mussina Z., Abishev K., Mukanov R. (2017) Hole Machining Based on Using an Incisive Built-Up Reamer // International Journal of Precision Engineering and Manufacturing, Volume 18, Issue 10, Pages 1425-1432. *https://doi.org/10.1007/s12541-017-0170-9* (in Eng.).

[27] Ganyukov A.A., Kadyrov A.S., Balabekova K.G., Kurmasheva B.K. (2018) Tests and calculations of structural elements of temporary bridges / Roads and Bridges - Drogi i Mosty 17 215 - 226 DOI: 10.7409/rabdim.018.014 (in Eng.).

[28] Anukhin V.I. Tolerances and landings. Textbook. - 4th ed. - SPb.: Peter, 2008. – 207p.

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