Вестник НТУ "ХПИ". Серия: Проблемы механического привода. – Х.: НТУ "ХПИ", 2015. – №35(1144). – С.135-139. – Библиогр.: 12 назв. – ISSN 2079-0791.

В статье рассмотрено напряженно-деформированное состояние основных деталей опорно-поворотного устройства автомобильных кранов с учетом жесткостных характеристик зубчатого венца и полуобойм по методу конечных элементов. Установлены закономерности распределения контактных напряжений на торцах роликов и по их длине. Выявлено наличие двух зон с максимальными контактными напряжениями и уменьшение его величины на основной контактной линии. Установлено, что неравномерность нагрузки ролика соответствует условиям равновесия, поскольку равнодействующая сила от действия давления на обеих его сторонах будет одинакова, но в результате вращения ролика вокруг своей оси пиковые нагрузки несколько увеличиваются по отношению к таким, которые возникают на другой его стороне.

**Ключевые слова**: автокраны, опорно-поворотные устройства, контактные напряжения.

УДК 531.3+621.313.32

**Динамика двухдвигательных приводов с гидропневмобаллонными муфтами / А.В. Христенко, Б.В. Виноградов** // Вестник НТУ "ХПИ". Серия: Проблемы механического привода. – Х.: НТУ "ХПИ", 2015. – №35(1144). – С.140-145. – Библиогр.: 10 назв. – ISSN 2079-0791.

Рассмотрены двухдвигательные приводы, содержащие муфты с резинокордными оболочками, которые сообщены между собой общим трубопроводом. Приведены схемы муфт, предназначенные для передачи крутящих моментов 509кН·м и 814кН·м, а также аналитические выражения их упруговязких характеристик. В качестве примера рассмотрена динамика синхронного двухдвигательного привода, с гидропневмобаллонными муфтами. Установлено, что применение таких приводов позволяет равномерно распределить статические и динамические нагрузки между линиями передач каждого двигателя и ограничить их максимальную величину в резонансном режиме до безопасной величины.

**Ключевые слова:** двухдвигательный привод, резинокордные оболочки, упругие муфты, распределение нагрузки.

УДК 621.833.6

**Условия прочности и оценка несущей способности оптимальной по массе конструкции простого планетарного механизма типа $\overline{AI}$ / А.В. Шехов** // Вестник НТУ "ХПИ". Серия: Проблемы механического привода. – Х.: НТУ "ХПИ", 2015. – №35(1144). – С.145-157. – Библиогр.: 7 назв. – ISSN 2079-0791.

Рассмотрена методика оценки несущей способности оптимальной по массе конструкции простого планетарного механизма типа $\overline{AI}$ с учетом различных условий прочности. Методика основана на исследовании экстремальных свойств целевых функций аналога массы и коэффициента несущей способности конструкции механизма. Целевые функции задают как функции передаточного отношения механизма и параметров его конструкции. В качестве параметров конструкции механизма принимают число сателлитов, коэффициент приведения массы эпицикла, число зубьев центрального подвижного зубчатого колеса и коэффициент параметров прочности внешнего зубчатого зацепления. Аналог массы конструкции механизма определяют для трех условий прочности внешнего зубчатого зацепления – контактной, изгибной, контактной и изгибной равнопрочности.

**Ключевые слова**: простой планетарный механизм типа $\overline{AI}$, условия прочности, несущая способность, конструкция оптимальная по массе, аналог массы, контактная и изгибная равнопрочность.

## ABSTRACTS

**Memories of the outstanding Ukrainian scientist and teacher professor Zablonsky Konstantin Ivanovich / S.S. Gutyrya, B.V. Motulko, V.P. Yaglinsky** etc. // Bulletin of NTU "KhPI". Series: Problem of mechanical drive. – Kharkiv: NTU "KhPI", 2015. – №35(1144). – P.4-10. – ISSN 2079-0791.

The biographic sketch about a vital and front way, study and labor achievements of the famous Ukrainian scientist, teacher, long-term head of the well known in the scientific world Odessa's school of mechanics and details of machines, the rector of the Odessa polytechnic institute (1969-1985), the prof. K.I. Zablonsky, written by his pupils and colleagues, to the 100 anniversary since the birth of the Teacher, is presented. Professor Zablonsky is the author of known scientific works in the field of rigidity, load ability and improvement of designs of gearings, and also textbooks on such basic engineering and mechanical disciplines as "The Theory of mechanisms and machines", "Machines elements ", "Applied mechanics", "Bases of design of machines", "Design of units and mechanisms of devices". Professor Zablonsky – the author of 430 scientific works, including 11 monographs and 25 inventions. As the research supervisor and the consultant prepared 48 Doctors of Engineering and 5 Doctors of Science. The course



of life of the professor K.I. Zablonsky is a remarkable example of continuous study, persistent search of scientific knowledge, honest dedicated work in interests of the Homeland, the charged work, institute and chair, colleagues and pupils, a family and friends.

**Keywords**: machines elements, gears, rational design of machines, biographic sketch.

**The synthesis of modern involute spur gears in the course "Applied Mechanics" / D.T. Babichev, A.I. Smovzh, A.V. Krivosheya** // Bulletin of NTU "KhPI". Series: Problems of mechanical drive. – Kharkiv: NTU "KhPI", 2015. – №35(1144). – P.10-19. – Bibliog.: 9. – ISSN 2079-0791.

The technique of computer design of spur gears in the transition from single-pair to two-pair linkage is stated. While the case shaped parts, shafts and mounting surfaces remain invariable. The non-standard initial contour having parameters $h_a^*$=1.25, $c_o^*$=0.20, α=20° was used in a technique basis. Quality of the designed gears is estimated by two criteria along all line of linkage: level of contact voltages according to Hertz and intensity of abrasive damage of teeth (coefficient of specific sliding). We created two diagrams for quickly to estimate prospects of replacement of single-pair engagement by the two-pair. The first diagram concerns dependence of overlap factor $\varepsilon$ of the projected gear with $\varepsilon<2$ on numbers of teeth $z_1$ and $z_2$ of initial gear with $\varepsilon>2$. The second diagram concerns quantitative assessment of increase of rated power $P_1$ of gear upon transition from the optimized single-pair engagement to not optimized two-pair engagement (depending on a combination of numbers of teeth $z_1$ and $z_2$ in initial gear). We gave examples of synthesis of 4 transfers: having the same sizes, but different loading capacity: two to overlap factor $\varepsilon<2$ and two with $\varepsilon>2$. The article, technique of synthesis and the developed program and methodical providing are focused on ordinary engineers, technicians and students.

**Keywords:** cylindrical gear, multi-engagement.

**Research methodology the noise characteristics for spur gear / V.A. Berezhnoy, N.V. Matyushenko, A.V. Fedchenko** // Bulletin of NTU "KhPI". Series: Problem of mechanical drive. – Kharkiv: NTU "KhPI", 2015. – №35(1144). – P.19-22. – Bibliogr.: 4. – ISSN 2079-0791.

The method of experimental research of noise is examined for involute spur gears. Actuality of decision of this task is proposed. Basic concepts and standards, necessary for the lead through of experimental researches, are considered. Short-story description of different types of noises is Given depending on the type of his source. Basic noise descriptions of transmission are studied: level of voice pressure, intensity of sound and acoustic power of source. The basic base moments of experimental method are selected. Basic methods over of determination of acoustic power of machine are brought. The method of research of noise of reducing gear gets out and its substantive provisions over are brought. The terms of measuring of levels of voice pressure and sound-levels are considered in a reducing gear by sound level meter. The chart of measuring of acoustic power of source of noise is represented round a reducing gear. Conclusions over and list of literature are given.

**Keywords:** involute spur gearing, noise characteristics, experimental methodology, sound power, sound pressure, sound intensity.

**The rational design of two-stage cylindrical gear reducers taking into account level of gears tension / O.V. Bondarenko, O.V. Ustynenko, V.I. Serykov** // Bulletin of NTU "KhPI". Series: Problem of mechanical drive. – Kharkiv: NTU "KhPI", 2015. – №35(1144). – P.23-27. – Bobliogr.: 7. – ISSN 2079-0791.

The article is devoted to the problem of the rational design of widespread of two-stage cylindrical gear reducers taking into account level of tension gears. It deals with questions the search of an optimal rational geometric parameters that satisfy certain criteria. All the complexity of the design and the relationships between parameters, make it impossible for them without the use of mathematical optimization approaches. Using the well-known pseudo-random-up method $LP\tau$-search with the author's modification to avoid problems associated with discrete and number of parameters. To solve this problem, was shaped formulation and set the limits on the variable planning, and afterwards registered criteria and chosen approach. An objective functions and limits on the variable planning taking into account level of tension gears are written. Elaboration method and algorithm for solving the problem, taking into account the level of tension gears for "bending" and "contact". Test calculations for two-stage cylindrical gear reducer carried out. This calculations are indicate the correctness of the proposed approach.

**Keywords:** design, gear, criteria, objective function, rational parameters, algorithm, $LP\tau$-search, intensity.

**Shaping simulation and screw gear performance assessment / N.I. Velichko, P.L. Nosko, D.N. Marchenko, P.V. Fil** // Bulletin of NTU "KhPI". Series: Problem of mechanical drive. – Kharkiv: NTU "KhPI", 2015. – №35(1144). – P.28-32. – Bibliogr.: 2. – ISSN 2079-0791.

This article describes the developing of a generalized mathematical model of gears composed of cylindrical gearwheels. The mating surfaces of the wheels are described as envelopes of a rack-type tool with parametric specification of the rack tooth profile. The developed model allows to investigate the operational engagement of approximate hyperboloid gears obtained from using hard incongruity pairs of a rack tooth profile for gears and wheels. The influence of the contact localization degree on the current

status of active lines is investigated; the numerical analysis of the helical gears performance criteria with different geometry of a generating rack profile is performed; practical recommendations on the choice of the circular profile parameters are provided. Research results have confirmed the benefits of the original circular contour, optimal (from the standpoint of smoothness and load capacity) is $\rho_1=(8\ldots10)m$, the degree of localization contact $k_\rho=0{,}8\ldots0{,}9$.

**Keywords:** basic profile, machine engagement, screw gear

**Methodology of realization the exporting data, visualization and the formation of 3D-model of the mechanism in a specialized system of calculating / V.V. Vlakh** // Bulletin of NTU "KhPI". Series: Problem of mechanical drive. – Kharkiv: NTU "KhPI", 2015. – №35(1144). – P.33-37. – Bibliogr.: 7. – ISSN 2079-0791.

The article deals with the ways in which formed mechanisms visualization and data transmission is performed from specialized software environment in AutoCAD. Featured software was created in the Embarcadero Rad Studio Delphi with methods of object-oriented programming. It is largely made it possible to implement-export the kinematic scheme of mechanism and create program code AutoLISP language, describing the three-dimensional model. Functions of the program include the possibility to research mechanisms in other systems. Program provides export of data in office applications Word and Excel and in automated design system AutoCAD. Export data in Word and Excel enables you to receive standard documents and tabular data for detailed analysis mechanism. Also this program has possible to implement exporting the kinematic scheme of mechanism and create program code AutoLISP language, which describing the 3D-model.

**Keywords:** Delphi, object-oriented programming, AutoLISP, AutoCAD, 3D-model.

**Vibration condition monitoring of gearing gears in the process of running-in of gear wheels / S.A. Gavrilov, N.N. Ishin, A.M. Goman, A.S. Skorokhodov** // Bulletin of NTU "KhPI". Series: Problem of mechanical drive. – Kharkiv: NTU "KhPI", 2015. – №35(1144). – P.38-46. – Bibliogr.: 3. – ISSN 2079-0791.

The principles and features of vibration diagnostics of the motor-wheels reducers of dump trucks BELAZ to the stage of running-in. Developed basic methods of assessing the quality of manufacture and the vibration monitoring of gearboxes. The results of the methods of grading in terms of their plant running and recommendations on the assessment of the quality of manufacture. As an integral evaluation criterion assembly of the motor-wheels reducers can serve as RMS value of vibration acceleration in the frequency range 3-100Hz and amplitude of the vibrations on the back of the frequency of the torsion shaft. It is recommended to evaluate the manufacturing quality of the motor-wheels reducers as: Satisfactory – for registration on the permissible levels of amplitude characteristic frequencies and recorded a minimum decrease RMS at one pair of controllable parameters for running; Permissible – in identifying trends reduce vibration amplitudes within the prescribed period of his break-in with an additional increase of 30-45min; Unsatisfactory – in excess of the individual amplitude spectra recorded at characteristic frequencies, more than 20% compared to the reference and the absence of the tendency to reduce them, and reduce the RMS for a double period running from under.

**Keywords:** gear, running-in, vibration condition monitoring, quality control.

**Forms and criterion of connectivity of fluctuations of a planetary wheel gearbox / S.S. Gutyrya, V.P. Yaglinsky, A.N. Chanchyn** // Bulletin NTU "KhPI". Series: Problems of the mechanical drive – Kharkiv: NTU "KhPI", 2015. – №35(1144). – P.47-55 – Bibliogr.: 6. – ISSN 2079-0791.

On the basis of the developed model of definition of a range of the main frequencies of the planetary wheel gearbox (PWG) forms of fluctuations are defined, elastic communications between the partial systems are investigated. Between partial systems there is a constant interrelation in the form of an exchange of kinetic energy of fluctuations. Three characteristic partial systems (sun, carrier, epicycle) are allocated and investigated, charts of coherence of fluctuations the partial systems of PWG are constructed. Decrease of the first two main frequencies at increase in number of satellites is established, and also in the presence of a crack in an epicycle. The highest frequencies practically don't change. Reduction of torsional rigidity of an epicycle owing to development of a fatigue crack leads to decrease of the first main frequency of PWG twice. Increase of rigidity of support of planets reduces criterion of connectivity of fluctuations forward the partial systems of planets with rotary that promotes weakening of elastic communication between partial systems of PWG. Similar, but considerably reduction of a corner of gearing has smaller impact. Recommendations about weakening of elastic communication between the partial systems of PWG are proved.

**Keywords:** model of oscillatory system, range of the main frequencies, partial systems, energy of fluctuations.

**Gear box vibrokinematicmetry / V.N. Zhuravlev, A.B. Yedjnovich, A.V. Papchenkov, A.V. Korneychuk** // Bulletin of "KhPI". Series: Problem of mechanical drive. – Kharkiv: NTU "KhPI", 2015. – №35(1144). – P.56-60. – Bibliogr.: 5 – ISSN 2079-0791.



The task of vibration diagnostic of gear box, particularly gas-turbine engine gear box is decided. A mathematical model the parameters of that are sensible to the size of tooth linear deformation and tooth speed in the process of flowage is worked out and approved. The mathematics model was verified by analysis of the horizon transverse vibrometr sensor data on primary gear frequency of the turboshaft engine TV3 – 117VMA – SBM1. The results of experimental researches allow to forecast adequacy of mathematical model not worse 0,9. The model calculation algorithm software processes data of the regular gearbox vibrometers. This software can supplement the next generation onboard diagnostic systems for engine operation on condition. The software that implements the algorithm for calculating the model works with regular vibration sensor signal housing GTE and may complement the on-board (or bench) automatic analysis system technical condition of gears GTE fifth and sixth generations.

**Keywords:** gear, mathematical model, vibration diagnostic.

**Analysis of ways of improving the performance of the elements of power transmission units of vehicles PJSC "AutoKrAZ" / R.O. Kaidalov, C.V. Dun, P.N. Kalinin** // Bulletin of NTU "KHPI". Series: Problems of mechanical drive. – Kharkiv: NTU "KhPI", 2015.– №35(1144). – P.61-66. – Bibliogr.: 8. – ISSN 2079-0791.

The paper presents the results of the evaluation of operating characteristics of the basic elements of drive units of vehicles. As the object of the study examined the elements of the transfer box car KrAZ-6322 (leading gear wheel leading of the shaft and the bearings of the drive shaft) when you work the box in the lower and higher modes of transmission and the eight modes of operation for the transmission. The analysis of the tensions of the investigated elements of the transfer box and the conclusions about their potential for increasing the saturation of the car and increase mileage up to the regulated deadlines. It is noted that the accuracy of the estimation of reserves depends, in part, on the accuracy of the assignment of the modes of operation of the transmission of the car. It is shown that, using the developed software package, you can conduct rapid diagnostic performance of gears, shafts and bearings of drive units of vehicles with a view to their further improvement.

**Keywords:** gear, bearing, car, transmission, transfer case, stress, strength, fatigue.

**Methods improve the wear resistance and contact fatigue of gear wheels / P.V. Kaplun** // Bulletin of NTU "KhPI". Series: Problem of mechanical drive. – Kharkiv: NTU "KhPI", 2015. – №35(1144). – P.67-75. – Bibliogr.: 12. – ISSN 2079-0791.

The article lays out the results of experimental research of wear resistance and contact endurance of various steel specimens after hardening with heat treatment methods and ion nitriding in hydrogen and hydrogen-free media at combined rolling and sliding friction. The article distinguishes the importance of the influence of properties gradient of received compositions on the performance of the materials operating in rolling and combined rolling and sliding friction conditions. The article points to the need to achieve a minimum reduction of properties gradient in coating depth. The article emphasizes the role of residual compressive stress occurring in the coatings after ion nitriding. Research data on ion nitriding in hydrogen bearing and hydrogen-free media were provided. The analysis of the influence of aggressive media at friction pairs operation was performed. Data on comparative research of steels with different alloy degree were provided. The article offers the ways of increasing the contact endurance and durability of gear wheels.

**Keywords:** wear, contact fatigue, rolling friction, slippage.

**Influence estimation of engagement parameters of bevel gears with biconvex-concave teeth on their resource / A. Kuznetsova, A. Gnitko, V. Onishchenko** // Bulletin of NTU "KhPI". Series: Problem of mechanical drive. – Kharkiv: NTU "KhPI", 2015. – №35(1144). – P.75-79. – Bibliogr.: 7. – ISSN 2079-0791.

Influence estimation of engagement parameters of bevel gears with biconvex-concave teeth on their resource was carried out in this article. Resource prognostication method of bevel gears with biconvex-concave teeth is developed. Resource prognostication is carried out by selecting gear rational parameters based on the modeling of teeth wear. The method is based on the two mathematical models: the model of teeth engagement and the numerical model simulation of teeth wear. The fact that the change of profile shape of biconvex-concave teeth work surfaces has effect on the value of geometric, kinematic and loading parameters was taken into account during wear modeling, which improves the accuracy of wear calculations. The software was developed for wear and resource prognostication of bevel gears with biconvex-concave teeth taking into account initial profile curvature of the teeth working surface after each cycle of stress changes.

**Keywords:** biconvex-concave teeth, wear, resource, bevel gear, module, number of teeth, contact stresses.

**Qualimetric approach to assessing the factors that affect the operation of cogwheels of ship reducers / V.V. Kuryljak, G.I. Himicheva** // Bulletin of NTU "KhPI". Series: Problem of mechanical drive. – Kharkiv: NTU "KhPI", 2015. – №35(1144). – P.80-87. – Bibliogr.: 15. – ISSN 2079-0791.

In the article qualimetric approach to the study of factors that influence the life of ship reducers, components and assemblies was considered. The task of systematization and analysis of defects discovered during repair of ship reducers was set. Technical reasons that lead to the appearance of the characteristic defects with aim of determining rational effective use of various types of tonics were analyzed in the article. The most common reasons that lead to reduction of reducers working life, namely their gear transmissions were mentioned. Also the technique of removing condensate from the area of gear by means of technical silica gel was proposed. The desire to increase the mechanized gear durability court-MIB by further increasing demands for precision geometric were little affective combination of parts, as well as leads to substantial growth of technological difficulties and costs of production. Application of new but high-strength materials for the manufacture of critical parts for judicial mechanisms though it promotes growth static strength, but at the same time accompanied by a significant increase of the cost of technological products.

**Keywords:** durability, resource, gears, defects, analysis, condensate, drainage, silica gel.

**Cylindrical involute gear with arched-spiral teeth / R.A. Matsey, A.V. Kovra** // Bulletin of NTU "KhPI". Series: Problem of mechanical drive. – Kharkiv: NTU "KhPI", 2015. – №35(1144). – P.88-95. – Bibliogr.: 7. – ISSN 2079-0791.

It was considered in this article the increasing of the loading ability of the cylindrical involute hooking with the arched points due to the optimization of the geometrical-kinematic characteristics. The assigned aim is achieved due to the fact that along the width of the wheel's crown the arched part of the tooth, locating in the middle of the wheel's crown, attends with helical-half chevrons, that allow to increase the axial contact ratio of the gear drive and the teeth thickness on butt ends towards the action of the distributed contact load. In that connection, that wheels cut with the involute end mill, the shape's and sizes' optimization of the heel pattern achieve due to modification arched teeth, that decrease contact's stress concentration and vibroactivity gearing under the influence of the external load, that essentially influence on the increase transmission's resources. The authenticity has been confirmed by theoretical studies on the technology and the experimental phase of the research project.

**Keywords**: geometrical-kinematic characteristics.

**SE GTRPC "Zorya"-"Mashproekt" Gear Boxes Improvement / A.I. Mironenko, V.E. Spitsyn, E.A. Gamza, D.V. Matveevskyi, S.A. Dzyatko** // Bulletin of NTU "KhPI". Series: Problem of mechanical drive. – Kharkiv: NTU "KhPI", 2015. – №35(1144). – P.95-100. – Bibliogr.: 7. – ISSN 2079-0791.

The article presents the new directions in the design, manufacture and testing of gearing production "Zorya"-"Mashproekt." Constructive features of gears and other elements of gear. In order to reduce weight and size and improve the performance gears and bearings designers created a series of original, multi-threaded cylindrical and bevel gears, schematics which are protected by patents of the USSR and Ukraine. It is shown that the modernization of the production of high-precision equipment gear. For example, the manufacture of cylindrical gears with the help of German machine Gleason-PFAUTER really reached the fourth degree of accuracy. Noting the existence of modern test stands: made conical and cylindrical gears up to 10...12MW are being tested at the stands with closed loop circulating load using hydraulic and mechanical loading devices of its own production. Gear production capabilities and qualifications of its staff allow to establish production of gears for all industries of Ukraine, as well as to carry out large volumes of overseas orders.

**Keywords:** gear box, gear wheels, gear tooth grinding machines, test benches.

**Research of the accelerations level of influence on exercise machine-hexapod / A.S. Obaydi** // Bulletin of NTU "KhPI". Series: Problem of mechanical drive. – Kharkiv: NTU "KhPI", 2015. – №35(1144). – P.101-106. – Bibliogr.: 9. – ISSN 2079-0791.

Mathematical models of management of the exercise machine-hexapod of kinematics parameters on the mobile basis having eight degrees of freedom are developed. Expansion of a working zone of the exercise machine- hexapod is received by application of the offered design with highly forced reloading ability of engines that promotes imitation of the movement of mobile machine with a difficult relief by land at working off of standard conditions of maneuvering. Control of fighting mobile vehicles is very difficult and dangerous operation demanding adoption of fast decisions on deduction of a course and instant reactions on movement change by impact on governing bodies. Therefore imitation of process of management of mobile machine and actuating units of movements of a cabin of the exercise machine is an actual problem. The levels of accelerations load of crew arising at the movement by land with a difficult relief with maneuver implementation are determined. Results of researches testify that levels of impacts on crew corresponds to the level of possible influences (to 60dB) at implementation of standard maneuvers of mobile machine and promote acquisition of skills of driving in extreme conditions.

**Keywords**: dynamic platform, model, imitation, maneuver.



**Non-linear contact problem conformably to straight tooth system / A.P. Popov, L.A. Popova, A.M. Medvedovskiy, O.I. Savenkov** // Bulletin of NTU "KhPI". Series: Problem of mechanical drive. – Kharkiv: NTU "KhPI", 2015. – №35(1144). – P.107-112. – Bibliogr.: 4. – ISSN 2079-0791.

Contact strength of teeth is one of the main criteria working capacity of gears. Calculation of gearing on the contact strength is carried out by a well-known formula of Hertz in relation to the model of contact between two elastic compression cylinders with radii and $\rho_1$ $\rho_2$ at the pitch and involves determining the maximum contact stress. For the first time the results of theoretical analysis's of contact strength of traditional gearings with the straight teeth taking into account non-linear correlation between elastic displacements (deformations) of teeth and arising stresses have been presented. By that the dependences of the maximum contact stresses $\sigma_H$ and the semi width $b_0$ of the right-angled contact area have been determined. His shown that the value of stresses $\sigma_H$ in this case slightly exceeds the value taking place in the absence of non-linearity. In accordance with stated above $b_0$ on the contrary slightly exceeds the analogous width which is typical for the cases of absence of the abovementioned non-linearity.

**Keywords:** gearing, teeth, contact, stresses, load capacity.

**Size-functional analysis of the power three-wave gearings / A.G. Priymakov, M.V. Margulis, I.A. Kirichenko, A.V. Ustinenko, A.A. Grjazev** // Bulletin of NTU "KhPI". Series: Problem of mechanical drive. – Kharkiv: NTU "KhPI", 2015. – №35(1144). – P.113-120. – Bibliogr.: 8. – ISSN 2079-0791.

The current trend in the Ukrainian and wordwide engineering – the use of three-wave power gears with metal-polymer flexible wheels. In the article on the basis of analysis of specific of functioning of the wave gearings the initial (locking) link of aggregate of basic links is on-loading exposed in plane wave hooking (a generator is the wave hooking). For the developed wave transmissions with the intermediate bodies of wobbling it is expedient to execute a size-functional analysis taking into account the specific of their functioning. The methodical going is resulted near the exposure of initial (locking) link at the size-functional analysis of the power wave gearings. Calculation dependences are got for determination of maximum values and admittance of initial (locking) link of aggregate of basic links of the wave gearings, determining necessary exactness and labour intensiveness of their making. The radial sinking of polymeric layer of metal-polymer flexible wheels is certain on-loading.

**Keywords:** the wave gearing, wave hooking, size-functional analysis, sidelash is in hooking, calculation of sidelash, sinking of polymeric layer.

**Optimization of dynamic processes in electromechanical machines drives by dynamicity coefficient / H.S. Samidov, A.F. Gasymov** // Bulletin of NTU "KhPI". Series: Problem of mechanical drive. – Kharkiv: NTU "KhPI", 2015. – №35(1144). – P.120-124. – Bibliogr.: 8. – ISSN 2079-0791.

The work is dedicated to the optimization of parameters of the dynamic system of technological machines. Mathematical model for three-mass dynamic model of electromechanical system designed. Based on the methods of optimization of dynamic factor, a technique of optimization of dynamic processes of technological machines are designed and implemented. The developed techniques to optimize the dynamic processes of the machine allows: using simple analytical expressions to establish a link between design, performance and dynamic characteristics of the machine designed to predict the expected level of vibration of the machine to carry out the synthesis of specified dynamic characteristics and create a machine with the least dynamic factor. Case studies of optimization of dynamic processes in machines made. As a result of optimization of electromechanical parameters of pipe milling machines had been significantly reduced in the elastic systems values of dynamicity coefficients.

**Keywords:** optimal design, dynamic processes, technological machines, vibration.

**Arch gears of mixed meshing compare with the traditional one by geometry and kinematic indicators / P.N. Tkach, O.A. Revyakina, E.Yu. Chalaya** // Bulletin of NTU "KhPI". Series: Problem of mechanical drive. – Kharkiv: NTU "KhPI", 2015. – №35(1144). – P.125-134. – Bibliogr.: 7. – ISSN 2079-0791.

The article presents the initial contour's profile of arch gear of mixed meshing. The addendum of pinion's tooth and dedendum of gear's tooth are formed by a line segment, i.e. it creates a traditional quasi-involute meshing. The addendum of gear's tooth and dedendum of pinion's tooth are formed by curve which obtained by the synthesis of the given reduced curvature. The method of synthesis is presented; the geometric and kinematic indicators of working capacity are defined. The comparative evaluation of such transmissions' indicators with the tradition quasi-involute ones is presented. It showed that at the boundaries of the pressure line the most of mixed meshing's indicators values are higher than the uncorrected traditional in 1,14...6,23 times. The numbers of the pinion's and gear's teeth is 18 and 90. The maximum effect of the mixed meshing's application occurs at the base of the pinion's tooth. This is due to the fact that the number of teeth is close to the minimum conditions for the absence of undercutting. Therefore, the greatest effect of the mixed engagement is expected in the gears with a minimum number of teeth.

**Keywords:** arch gear, mixed meshing, quasi-involute transmission, indicators of working capacity, reduced curvature.

**The analysis of stress-strain state of automobile crane supporting-turning device with taking into account inflexibility of supports / V.V. Fedyk, V.O. Malashenko, O.V. Lanets** // Bulletin of NTU "KhPI". Series: Problem of mechanical drive. – Kharkiv: NTU "KhPI", 2015. – №35(1144). – P.135-139. – Bibliogr.: 12. – ISSN 2079-0791.

In the article the stress-strain state of the main parts of the supporting rotary crane trucks considering stiffness characteristics of ring gear by finite element method. Analysis of stress-strain state for rollers taking into account of real parameters for basic elements executed, such as rigidity of the Rings and geometry of location rollers on treadmills. The regularities of distribution of contact stresses at the ends of rollers and their length. Revealed the presence of two zones of maximum contact stresses and reduce its size in the main contact line. Established that the uneven load roller meets the conditions of equilibrium because of the resultant force of pressure on both of its sides is the same, but the rotation of the roller about its axis peak slightly increased relative to those arising in another of his side. The obtained results in the paper can be the main base for further research supporting-turning devices crane trucks, excavator s and other handling machines.

**Keywords:** cranes, supporting-turning device, contact stress.

**The dynamic of dual pinion drive system with Flexible rubber-cord shell couplings / A. Khristenko, B. Vinogradov** // Bulletin of NTU "KhPI". Series: Problem of mechanical drive. – Kharkiv: NTU "KhPI", 2015. – №35(1144). – P.140-145. – Bibliogr.: 7. – ISSN 2079-0791.

In present article the dual pinion drive system with flexible rubber-cord shell couplings is considered. Considered couplings are interconnected by hose. The flexible couplings sketches, which are designed for torsion torque transmission 509kN·m to 814kN·m, and their visco-elastic characteristic formula are adduced. It is shown, that in mechanical systems of ball mill dual pinion drives the forced oscillations can excite. The forced oscillations caused by the accumulated error in the teeth pitch. As an example, the dynamics of the ball mill dual pinion drive with flexible rubber-cord shell couplings is shown. The equivalent dynamic diagram and forced oscillation equations of a synchronous dual pinion drives consists of rubber-cord shell couplings are adduced. The amplitude-frequency characteristics of the motors and couplings moment of elasticity are adduced. It is shown that the application of considered couplings enables to distribute the static and dynamic load between transmissions of each motors uniformly. It also enables to reduce the dynamic impact and resonant load.

**Keywords:** dual pinion drive, rubber-cord shell, flexible couplings, load sharing.

**Terms of strength and estimation of the loading ability of optimal on mass construction of simple planetary mechanism of type $\overline{\mathbf{AI}}$ / A.V. Shehov** // Bulletin of NTU "KhPI". Series: Problem of mechanical drive. – Kharkiv: NTU "KhPI", 2015. – №35(1144). – P.145-157. – Bibliogr.: 7. – ISSN 2079-0791.

The method of finding of the loading ability of the mass optimal construction of simple planetary mechanism of type $\overline{\mathbf{AI}}$ from conditions of different strength is considered. A method is based on research of extreme properties of objective functions of analogue of mass and coefficient of the loading ability of construction of mechanism. Objective functions set as functions of transmission relation of mechanism and parameters of his construction. As parameters of construction of mechanism accept the number of satellites, coefficient of bringing mass over of epicycle, number of teeth of central mobile gear-wheel and coefficient of parameters of strength of the external gearing. The analogue of mass of construction of mechanism is determined for three terms of strength of the external gearing – contact, flexural, contact and flexural strength balances.

**Keywords:** simple planetary mechanism of type $\overline{\mathbf{AI}}$, conditions of strength, loading ability, optimal construction of the mass, analog of the mass, contact and flexural strength balances.