

**DESIGN AND CALCULATION OF PARAMETERS OF GEAR
TRANSMISSIONS WITH VARIABLE PARAMETERS AND FLEXIBLE
ELEMENTS**

Jumaev Akbarjon Sayfullaevich

Almalyk State Technical Institute, Almalyk, Uzbekistan
Doctor of Philosophy (PhD) in Technical Sciences, Associate Professor

E-mail: akbarjumayev011@gmail.com

Rakhimova Rukhshona Bakhodir qizi

Almalyk State Technical Institute, Almalyk, Uzbekistan
Student of the 7-24 MM group, Mechanical Engineering

E-mail: ruxshonaraximova645@gmail.com

Abstract. The article discusses an analysis of theoretical and experimental studies focused on investigating the operating conditions, durability, and laws of motion of gear transmissions. It has been established that increased wear in gear transmissions caused by the deflection of the driven element leads to a reduction in transmission efficiency. One of the main drawbacks of several existing devices is the decrease in the applied influence on the teeth of the driven element during operation, as well as the generation of an additional resisting torque. To ensure stable and uniform operation of the driven shaft, the device must provide sufficient vertical mobility. While maintaining structural simplicity, the inclusion of an elastic element into the gear transmission system is proposed.

Keywords. Gear wheel, elastic element, vibration amplitude, driven shaft, transmission, device, gearbox

Annotatsiya. Maqolada tishli uzatmalarning ishlash holati, chidamliligi va harakat qonuni o'rganish bo'yicha nazariy va tajribaviy tadqiqotlar tahlili muhokama qilingan. Tishli uzatmalarda yetaklanuvchi tarmoqning egilishi hisobiga yeyilishning ortishi va uzatma FIK ning kamayishiga olib keladi. Qator qurilmalarining asosiy kamchiligiga ularning ish jarayonida tish yetaklanuvchi tarmog'iga ta'sirining kamayishi hamda qo'shimcha qarshilik momentini hosil qilish hisoblanadi. Yetaklanuvchi valning bir me'yorda saqlash uchun qurilmani yetarli darajada vertikal yo'nalishda harakatlanishi lozim bo'ladi. Konstruksiya soddaligini saqlagan holda, tishli uzatmani tarkibiga qayishqoq element qo'yishni tavsiya etildi.

Kalit so‘zlar. Tishli g‘ildirak, qayishqoq element, tebranish amplitudasi, yetalanuvchi val, uzatma, qurilma, reduktor

Аннотация. В статье рассмотрен анализ теоретических и экспериментальных исследований, посвящённых изучению рабочих состояний, долговечности и законов движения зубчатых передач. Установлено, что увеличение износа в зубчатых передачах вследствие прогиба ведомого звена приводит к снижению коэффициента полезного действия передачи. К основным недостаткам ряда существующих устройств относится уменьшение воздействия на зубья ведомого звена в процессе работы, а также возникновение дополнительного момента сопротивления. Для обеспечения равномерного режима работы ведомого вала необходимо, чтобы устройство обладало достаточной подвижностью в вертикальном направлении. При сохранении конструктивной простоты предложено включение упругого элемента в состав зубчатой передачи.

Ключевые слова. Зубчатое колесо, упругий элемент, амплитуда колебаний, ведомый вал, передача, устройство, редуктор

In the field of mechanical engineering, instead of metal raw materials, non-metallic materials with variable parameter elastic elements with high strength are used in the manufacture of most parts of machine mechanisms. This, in turn, leads to economic efficiency by reducing metal consumption.

In the conditions of a market economy, the demand for mechanical engineering is growing rapidly. One of the main issues of mechanical engineering during its development is the design and implementation of high-quality, reliable, modern, and economically efficient machines and mechanisms. The development of science and technology is closely related to the design of new machines and mechanisms. In order to provide the people and industry of the republic with abundant, affordable, and high-quality products, it is necessary to introduce advanced technologies into production and effectively use modern equipment created on the basis of the latest achievements of science and technology [1].

In order to fill the shortcomings and gaps in gear transmissions, it is now important to analyze the achievements achieved at the global level, develop new competitive energy-saving transmissions, and introduce them into all areas of mechanical engineering. During the years of independence, a number of new machines

were created by scientists of our Republic. In order to improve the working bodies of the created machines, it is important to create new, competitive designs of transmission mechanisms in all respects and conduct their kinematic and dynamic analysis.

In accordance with the resolution of the International Federation of Machines and Mechanisms (IFTOMM), the following current scientific directions have been identified in the theory of mechanisms and machines [2]: in machine dynamics - the study of the laws of motion of working parts of machines and mechanism joints; in gear transmissions - the development of new designs and calculation methods; in man-machine and robots - automation of machine movements; in automatic, pneumatic and hydraulic systems - automatic control of machine movements; in model analysis - the creation of mathematical, graphic and computer programs for machines and mechanisms; in vibration control - the creation of new methods for reducing vibration; in passive and active protection - the study of protecting objects from vibration; in random vibration - the reduction of random vibrations generated during the operation of machines and mechanisms; in noise in equipment - the study of the laws of damping noise generated during operation.

Gear transmission has the ability to transmit greater power than belt mechanisms, has proven its advantages in terms of durability and accuracy in transmitting the law of motion. In gear transmissions, wear increases due to the bending of the driven network and leads to a decrease in the FIK of the transmission [3]. The main disadvantage of belt devices is their reduced impact on the driven network during operation and the creation of an additional resistance moment. To keep the driven shaft in one position, the device must move in a sufficiently vertical direction. We recommended, while maintaining the simplicity of the design, to include a flexible element in the gear transmission (Fig. 1).

During operation, the flexible bushing deforms, which somewhat reduces the loads on the tooth vibration. The degree of this normalization mainly depends on the coefficient of elasticity of the flexible bushing. However, an increase in the deformation of the flexible bushing leads to failure of the supports, increases the friction between the tooth elements and the flexible bushing, which leads to a decrease in the durability of the transmission.

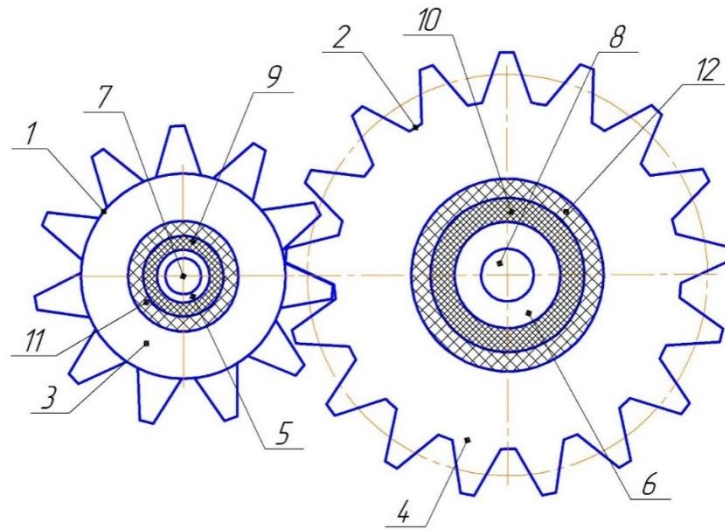


Figure 1. Gear transmission with variable parameters and a flexible element

The experiments were carried out at different power outputs. The purpose of the experimental research is to determine the torques, rotation frequencies and noise on the driven and driven shafts of the C2U-160 reducer, which is recommended for experimental research [4].

A prototype of the C2U-160 reducer design was prepared and existing methods for conducting experimental research were used (Fig. 2).

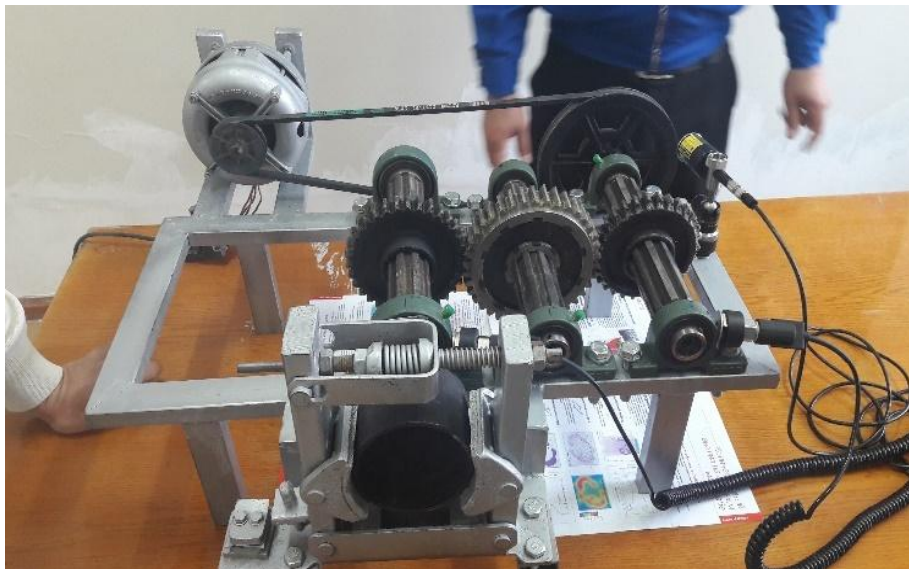


Figure 2. Experimental copy of the proposed C2U-160 reducer design

During the test, the mechanism was started using an electric motor. Measuring instruments were mounted on the outside of the bearing box of the mechanism using

magnetic transducers. As a result, the angular velocities, accelerations, and vibration amplitudes of the shafts were sequentially determined.

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