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Finite element research of rubber-cord flat coupling

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Abstract

The finite-element research of the intense deformed condition of the highly elastic flat coupling at the shaft axial offset and twisting small angles is presented in the paper.The rubber-cord disk modeling which is a working coupling element was carried out with the use of the program Ansys complex in the assumption that threads of a cord work only for stretching independently of each other. The rubber layers contribution is not considered. The comparison of the calculation results with the available experimental data has confirmed the legitimacy of the accepted simplifications.

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*Keywords:*highly elastic flat coupling; rubber-cord disk; axial offset; twisting; finite element method

1. Introduction

The couplings forming part of many aggregates and machines are the critical assemblies often defining reliability and durability of the whole machine. They are among the major devices which basic purpose is transmitting a gear rotation and the moment from one shaft to another.

In modern equipment, including petrochemical and oil and gas mechanical engineering, highly elastic couplings with rubber and rubber-cord elastic elements are widespread; one of their perspective construction is the rubber-cord flat coupling (Fig.1) developed in FSUE "SPE "Progress" and patented in the Russian Federation in common with way of rubber-cord disk assembly. Rubber-cord flat couplings (RKFC) allow to transfer big rotational moments, differ in construction simplicity, lack of the wearing surface and axial forces (at rotational moments loading), insensitivity to dust and damp, promote decrease in level of vibration and noise. RKFC keep the high compensating properties, allow considerable radial, axial and angular offsets of the connected shafts in the drives experiencing static and dynamic strains in the wide range of values.

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Fig. 1. Three-dimensional model of the rubber-cord flat coupling with two working elements

2. The simplistic approach to modeling of the rubber-cord disk

The most fully developed mathematical model of the rubber-cord disks and casing is the model based on the momentless mesh shells theory [1, 2, 3]. This model has applied significance as rubber keep significantly smaller rigidity, than cord threads. Therefore almost all loading is took up by cord threads. Rubber coating layers provide, mainly, plates and casing protection against mechanical damages, and rubber innerliner of the casing which are kept under pressureprovide their tightness. In this regard it is possible to assume that at rather small deformations of a working element cord thread coupling similar spokes between a rim and a nave of a bicycle wheel. The similar model of a rubber-cord disk is simpler, than considered in [4].We will limit research by small corners of half coupling twisting and their axial offsets to define applicability area of the accepted simplifications through comparison of calculations results with the available experimental data.

3. Finite element model of a rubber-cord disk

For creation of coupling power characteristics it is enough to consider behavior of the elastic element containing two layers of a cord threads which make with a radius equal angles of different signs (Fig. 2). The cord threads are modelled by one-dimensional object (core) of round cross section, equaling to cord thread section of diameter d = 0.7 mm. Each thread is divided into the finite elements link 180 (Fig.3).

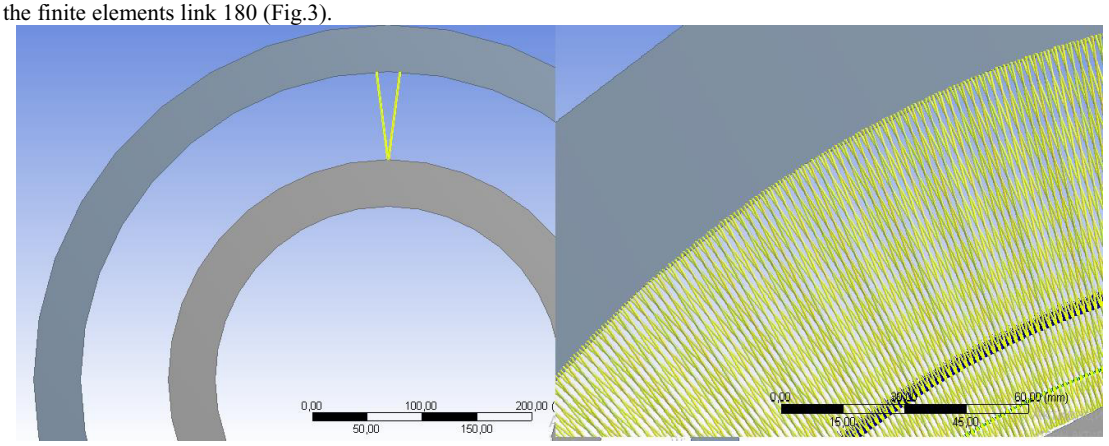

Fig. 2. Geometrical model of the coupling elastic element