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STRESS AND STRAIN STATE OF SINGLE – STAGE CYCLOIDAL SPEED REDUCER

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Abstract: This paper deals with analysis of stress-strain state for some elements of single-stage cycloidal speed-reducer when machining tolerances exist. Due to existence of machining tolerances, teeth of cycloid disc are not all at simultaneous contact with appropriate rollers of the central stationary gear and do not carry load. In order to efficiently do analysis, one single-stage cycloidal speed-reducer has been designed.

Analysis of cycloid disc stress-strain state is realised using FEMAP software package. Cycloid disc is considered to be elastic deformable body. The cases when one, two or three pairs of teeth are in contact simultaneously have been analysed. Problem has been considered as being planar.

Analysis of the stress and strain that occur in the contact of the stationary central gear and the pins on which rollers are positioned and which conjugate with cycloid disc teeth is realised. Analysis has been done using CATIA software package, with appropriate 3-dimensional numerical models made for this purpose. Numerical analysis of stress and strain state for eccentric was realised, too.

Based on analysis of obtained results, conclusion can be made that from aspect of stress distribution, the most unfavourable case is the theoretical case when one pair of teeth is in contact, what was expected. Even in a case of the most unfavourable single meshing, maximum stress and strain values are within the limits that provide reliable work of cycloid disc during the foreseen working life, what is extremely good recommendation for even more extensive use of cycloidal speed reducer.

Key words: cycloidal speed reducer, cycloid disc, stress state

1. INTRODUCTION

Cycloidal speed reducers belong the group of planetary gears. Their inventor is German engineer Lorenz Braren (1931). Because of very wide area of application, production of cycloidal speed reducer has growing character. Their main characteristics are: big transmission ratio, low losses, compact design, reliable work,... Model of the cycloidal speed reducer is shown in Figure 1.

The most important element of the cycloidal speed reducer is cycloid disc which teeth profile is equidistant of the shortened epitrochoid. In theoretical case, when machining tolerances are not considered, half of cycloid disc teeth participate at the load transmission process.

The basic information about cycloidal gearing are presented by Kudrijavcev [1] and by Lehmann [2]. Litvin and Feng [3] developed parametric equations for equidistant of trochoid. Calculation of forces which acting on cycloidal speed reducer elements, when machining tolerances don't exist, is defined in papers [4, 5, 6]. Dynamic loads are dominant at cycloidal speed reducer. Their dynamic behaviour is presented in papers [7, 8]. Chmurawa and Lixing [9, 10] described the distribution of loads at cycloid disc with modified tooth profile.

Experimental analysis of cycloidal speed reducer is presented in paper [11].

This paper deals with analysis of stress and strain state of cycloidal speed reducer elements when machining tolerances exist.

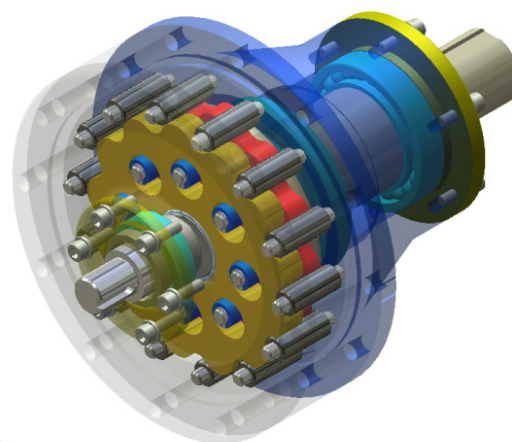


Fig.1: Model of cycloidal speed reducer

