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Features of the Planetary Continuously Adjustable Gear Train as Element of the Kinematic Chain

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Abstract

It is shown in the article that a planetary continuously variable transmission is the result of the development of a gear according to the criterion of gear ratio, and its features caused by the need for the formation of kinematic chains are considered.

Introduction

In our opinion, the planetary smoothly adjustable transmission is capable of satisfying the need for a continuously variable gear, which is becoming more and more clearly emerging in recent times, the operation principle of which implies radical changes in the gear design, namely, fragmentation of the central gear and satellite. For a more complete understanding of its possible role in the class of mechanical gears, it is necessary to turn to the sources of its origin.

Main Part

A continuously variable planetary gear is the result of the natural development of such a technical object as a gear known for millennia. The following reasoning confirms this thesis. Any technical object created must satisfy one of the set of development criteria, which includes the following criteria: functional, technological, economic and anthropological. In this case, the name of the technical object itself indicates that technological, economic and anthropological criteria do not participate in the creation of the selected gear development vector aimed at improving its transforming ability. This improvement would not impede the implementation of the principle of progressive development for this new generation of gears in full if the design of the gears did not change, since the improvement of the transforming ability would allow other criteria to be maintained at the achieved level. But practice shows that due to the fatal effect of conservation laws (in this case, properties, the totality of the qualities of the use value), the improvement of indicators by one criterion in this group with a change in the integrity of the structure (fragmentation) is possible only due to deterioration indicators by other criteria. For a long time, the gears had a constant gear ratio, and new types of gears were created to satisfy the need for ever-increasing gear ratios. Reality convinces of the relevance of the gradually brewing but declaring itself increasingly urgent problem of creating a continuously adjustable gear transmission. It seems that it is precisely in a planetary continuously variable transmission based on composite polysector gears that a gear ratio regulated in a certain predetermined range can be obtained. Almost the only way to improve this criterion (giving it values that gradually change over time) is also to smoothly change the geometric dimensions of the transmission elements in the process of its functioning. In gears with integral gears, only a discrete change in the gear ratio can be achieved by replacing the gears, and in gears with composite polisector gears, smooth by radial movements forming the gear rims of the central gear of the sectors and the satellite.

As a representative of the class of mechanical transmissions, a planetary continuously variable transmission possesses such functional development criteria as converting ability, load capacity, accuracy of conversion of the rotation link rotation parameters. The obvious interconnection of these parameters confirms the the-sis about the manifestation of the conservation law with respect to the transmission in question, which means that when adjusting the gear ratio, an error in the rotation of the output transmission shaft arises due to the periodic non-multiplicity of the circumferential pitch of the sectors of the central toothed ring to the circumferential pitch their teeth and the deviation of the teeth of the sectors from the nominal position. he obvious interconnection of these parameters confirms the thesis about the manifestation of the conservation law with respect to the transmission in question, which means that when adjusting the gear ratio, an error in the rotation of the out-put

transmission shaft arises due to the periodic non-multiplicity of the circumferential pitch of the sectors of the central toothed ring to the circumferential pitch their teeth and the deviation of the tooth sectors from the nominal position.

The originality of the design of a planetary continuously variable transmission makes it relevant to pose the question of its properties as an element of the kinematic chain, which is a connected system of objects. The output element of a continuously variable planetary gear, which is a kind of KHV gear, is a satellite mounted on a variable radius crank, therefore the mechanism of parallel constant radius cranks used in KHV gears for communication with the environment cannot be used in it. The resulting collision is resolved as a result of equipping a planetary continuously variable transmission with an output shaft and a device that in one way or another connects the satellite to this shaft. In a first approximation, four ways of organizing this connection can be outlined: the use of an auxiliary planetary gear; use of Schmidt coupling; installation on the output shaft of the "disinhibited" central gear and the use of an auxiliary gear to fix the gears of the satellite from rotation around its own axis; the use of a "braked" central gear wheel and Schmidt clutch for fixing the gears of the satellite (when installing a half-clutch on the output shaft with the help of the freewheel clutch, the Schmidt clutch will take part in the formation of the transforming ability of the planetary continuously variable transmission). The solution of this problem allows us to proceed to an in-depth study and solution of such problems as the selection of optimal layout and kinematic trans-mission schemes, the selection of gearing of the satellite and the central gear wheel, ensuring the relative position of their geometric axes, and improving the mechanism for changing the gear ratio transmission, selection of the type and installation location of elastic elements that ensure the quality of the transmission.

Conclusion

Regardless of the actual order of formation of the properties and design of a continuously variable planetary gear, it is far from final, but still the result of the development of a gear according to the criterion of gear ratio.

Since the inherent property of a smooth change in the gear ratio is achieved by changing the integrity of the central gear wheel, the implementation of the development criterion leads to a deterioration in its performance according to the quality criterion for converting rotation parameters, which manifests itself in an increase in the error of the angle of rotation of the output shaft with uniform rotation of the drive shaft. In addition, for communication with neighboring elements of the kinematic chain, a planetary continuously variable transmission must have a mechanism for removing rotation from the satellite and transmitting it to the driven shaft.

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