ПОД- СЕКЦИЯ 4. Инновационные технологии.

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GEARS OF HIGH ACCURACY WITH AN ELASTIC LOAD OF INCREASED DURABILITY

Application of the tooth gears as the part of the spacecraft reducers is considered to be a highly specific sphere. The main problem of these gears is nonserviceability over a long operating life (20 and more years). The word nonserviceability means no ability to ensure the specified accuracy for moving the output shaft. The open-circuit, which in its turn depends on the space between gearings, is considered to be the main factor influencing the functionality of the gear. The removal of the space for a long time period is a very hard implementing goal since the spacecrafts (shuttles as an example) cannot be maintained and no change of any of the tools is available. That is why the method for producing the reducers for spacecrafts has been suggested [1, p.23].

Wave gears with intermediate bodies (WGIB) improve the reliability and durability of gears by increasing the hardness of work surfaces (more than 60 units of Rockwell) and the decrease in tension in the deformed element. The main advantage of the gear construction with intermediate bodies is that they provide a permanent and elastic load over a very long period of time. The experience in application of these types of gears has shown that they can be used with a guarantee within the period of up to 20 years and the error of the output shaft will not exceed 2 seconds of arc.

Consider a few examples of the constructions of such gears.

Fig.1 shows a general view of the wave gear with the intermediate body of a serpentine spring. The inner ring of the flexible bearing of the generator in this gear simultaneously with its primary function performs the function of the elastic element, which creates an elastic load in the meshing of coils of the intermediate body with the teeth of a rigid gear.

To perform this two stud-pints 2 arranged diametrically towards each other which are installed in the nest slots 3 connected to the input shaft of the gear are adjusted to the inner ring 1. Tightening of stud-pints 2 towards each other by screw nuts 4 deforms the ring 1 making it oval. Meshing of the coils of the intermediate body with the teeth of the rigid gear occurs along the long axis of the oval. Regulating the size of the ring deformation 1 (screwing/unscrewing screw nuts) we change the size of the mesh arch with the central angle of 2Θ. When the central angle of the mesh region $2\Theta \geq 20^{\circ}$ the elastic load between the intermdiate bodies and the teeth of the rigid gear compensates the working surface deterioration [2, p.67].

Fig. 2 shows the wave gear with intermediate rolling bodies, where the outer ring of the bearing 1 and that of the generator 2 are made of several elements: a race 3, with radial grooves in which the elastic element 4 is installed and the outer split ring 5. The adjustment of the force of the elastic elements 4 is performed by the fitting of linings 6.

Between the elastic elements 4, and the ring 5 are placed the balls 7. In a free state the diameter of the ring 5 is equal to the calculated diameter of the generator. If there is clearance in the mesh the elastic elements 4 enlarge the ring 5 and press the intermediate bodies against the teeth of the rigid gear 8.

The clearance *a* is very small if compared to the sizes of the intermediate bodies, therefore, it does not sufficiently effect the operation of the gear. If rolls are used as intermediate rolling bodies and the ends of the split rings have the shape of that shown in Fig. 2, the clearance is not expected to affect the operation of the gear.

There are various types of such gears (some types can see below on Fig.3 and Fig.4). And they can all work for a long time without maintenance and changing the tools. Most of the companies have already implemented these programs in a variety of spacecrafts. The results of this implementation have proved to be successful.

Consider another variant of the construction of the generator for creation of elastic load (Fig. 3). The generator is made as a flexible bearing and its inner ring 1 is an elastic element, which creates an elastic load in the meshing of the rotate bodies with the profiles of central gear teeth. To perform the elastic load the ring 1 has two stud-pints 2 with thread at their ends.

Stud-pints are installed in the nest of the faceplate of the gear input shaft 3. When tightening the stud-pints 2 to the shaft 3 by the screw nuts 4 the inner ring of the flexible bearing and the outer ring 6 tighten the gear intermediate bodies to the profiles of the ring's teeth through the balls 5 (are not shown in the Figure). The ring 1 is being deformed until the desired force for the specified elastic load in meshing is formed.

In the constructions of WGIB with intermediate rolling bodies (WGIRB) where balls are used as rolling bodies the outer surface of the generator ring is made conical. It makes it possible to change the diameter of the generator surface interacting with the balls under flexible elements force orientated towards the cone top.

In the gear (Fig. 4) the flexible elements 1 are placed in the axis slot of the outer ring 2 of the generator bearing and are based on the axial bearing 3, installed in the gear body 4.

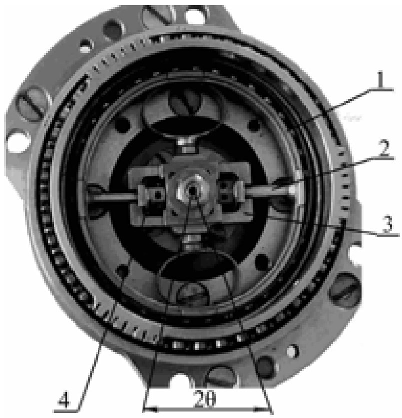

Figure 1 - Wave gears with intermediate bodies with elastic ring flexible Bearings

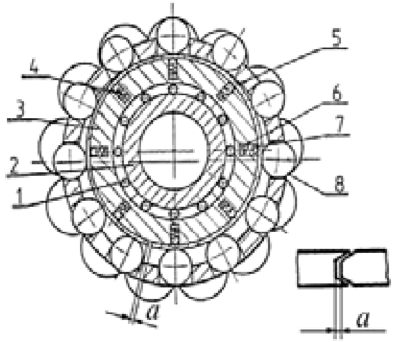

Figure 2 - Wave gear with intermediate rolling bodies

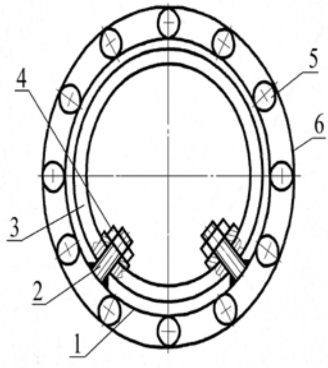

Figure 3- Generator with elastic deformed inner ring of the bearing

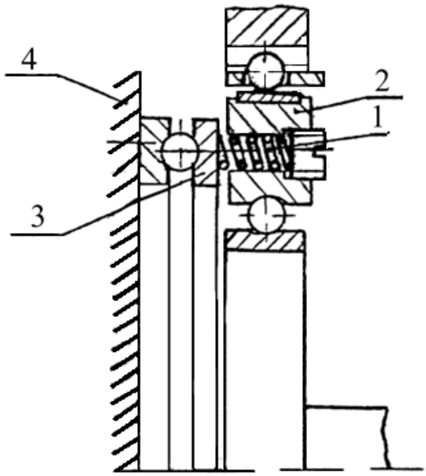

Figure 4- WGIB with flexible elements in the inner ring of the generator bearing

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