

CONSTRUCTIVE SOLUTION TO THE VEHICLE DRIVE AXLE WITH WORM FACE GEARS

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ABSTRACT

This paper addresses the idea of replacing a hypoid gear type gear of the same type of lift that is, worm face gear. Constructive and functional advantages of worm face gears require their use as alternatives to hypoid gears known. Reference is made to a real situation involving the differential mechanism of Dacia 1307 car for which a new alternative with a worm face gear made of nitrated steel is proposed. This study is the initial stage of an experiment that will continue for a longer period.

Keywords: drive axle, hypoid gears, worm face gear, differential vehicle, spiroid gear

1. Introduction

Although the worm face gears are gears with skew axis, due to their specific geometry they have special functional properties regarding: very high ratios, severe torque load, multiple tooth contact, axial positioning and backlash control, great shock strength, low noise level [6,7,24,28].

Due to the extremely favorable position of the direction of sliding velocity to the line of contact, good conditions are created for a hydrodynamic lubrication between flanks of toots of the worm and those of the wheel, a fact that allows the use of material combination steel on steel. This has major effects as regards the load capacity and implicitly the application area is expanded spectacularly. This allows the inclusion of these gears in the application domain of the hypoid gears. [1,2,3,4,5,6,7,8,12,13,17,19,21,22,23,24,25,26,27,28, 29,30,31]

Constructive solutions worm face gears operating qualities are found in the fields of aerospace, military, machine tools and other more

complex situations where cost is a secondary factor compared with the functional safety and operating parameters to share higher levels. Russian scientists have tried using worm face gear drive axle and construction of motor vehicles [14,16,18,20]. Also there is a U.S. patent that refers to such a solution. [9,10,11]

At present research indicates experimental realization of a differential drive axle for motor vehicles. Experimental result by replacing the differential hypoid gear worm gear spiroid existing with nearby sensitive features (dimensional and port)..

In agreement with the literature, we chose to replace hypoid gears with cylindrical worm face gear. Worm face gear is an intermediate gear between the worm gear and hypoid gears and by their ability to transmit effort can substitute hypoid gears. As with normal hypoid gear the angle between the axes is 90 degrees.

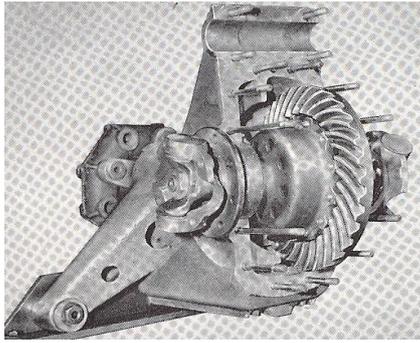


Fig.1. Hypoid gear differential [15]

Table 1 The areas of application covered by hypoid gears.

Size	Cars	Trucks
Gear Ratio	3...5	5...18
Speed (rot / min)	0...8000 (20000)	0...3500
Power kW	20...380	100...600 (1000)
Torque daN. m	70...500	400...2500

Currently, the automotive industry widely uses hypoid gear differential.(Fig.1), but over time proved to be in every way most suitable to achieve the drive axle.

2. Own research

Works Dacia Pitesti utilities built in 1307 with the composition engine axle hypoid gear differential (Fig 2). These differentials are designed and manufactured in Pitesti plant. Initially the bridge for this type of car engine was borrowed from ARO off-road vehicles 10. Was subsequently designed and used the current version. Differences between the two versions are crankcases gear ratios and bridges.

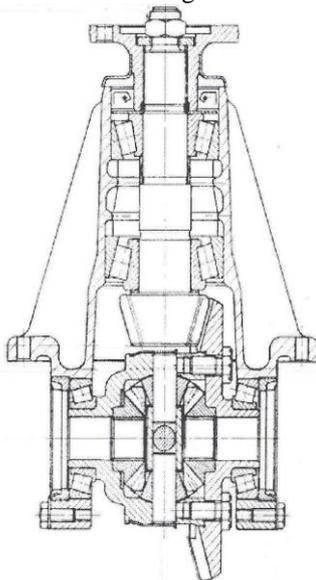


Fig.2. Dacia 1307's differential

The material of the cone is executed 17MoCr11 wheel. The wheel is hardened layer and the total thickness of 0.9 to 1.2 mm is hardened. Surface hardness is HV10 = 746-920 and core hardness:340-430 is HB100. As conical wheel protection is phosphate. The wheel diameter is 169.97 mm, number of teeth is 41 and the axial distance (offset hypoid) 25 mm.(Fig.3)

The material of the pinion is executed 19MoCr11. Sprocket is hardened, the total thickness of hardened layer is 0.9 to 1.2 mm, the surface hardness is HV10 = 745-920. Number of teeth is 9.

After execution of pinion and crown, they are run together on a special stand and wheels are marked to be used only together.

Experimental application, following the calculations led to the replacement pair of pinion-crown attack from the differential pair used in Dacia 1307 worm face gear.(Fig.4, Fig.5).

Technical characteristics replacement gear are presented in Table 2.



Fig.3. Hypoid pinion gear-wheel conical

Table 2 Characteristics of worm face gear

Features	Worm spiroid	Worm wheel spiroid
Material	alloy steel	alloy steel
Module	2.5	2.5
No teeth	1	47
Heat treatment	nitriding	nitriding
axial distance	55	55
Method of processing	turning	milling



Fig.4. Worm face gear differential-view frontal



Fig. 5. Worm face gear differential

After calculation, design and realization worm gear face differential can find some of its features and qualities that recommend him in building bridges to vehicle engines. In this context, states the following features of worm face gear.

3. Conclusions

Both bibliographic study and experiment made that the main transmission vehicles are possibly achievable in several variants, each with specific recommendations, but more common is the variant that uses hypoid gear type. Justification for this option due to high bearing capacity as a result of higher value coverage which provides superior durability compared to the other clutch.

The idea of replacing the hypoid gear with the worm face gear is required to be analyzed and studied due to its economic nature. Research conducted so far have been confined to the performance of construction and experimental sounding factory-Russia Ijevsk traction. Illinois Tool Works company also Inc in Chicago made worm face gear with applications in areas adjacent, complementary vehicles.

Constructive and functional advantages of worm face gears use require their use as alternatives to hypoid gears known.

It remains a problem for future study is how to wear a worm face gear, compared with the hypoid gear. The empirical data lead us to the idea of both

wear behaviors and at the request of teeth, the worm face gear is better than hypoid gear.

A final conclusion will be accepted when we have conclusive experimental data.

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