6th INTERNATIONAL MULTIDISCIPLINARIY CONFERENCE

THE REPLACING MATERIAL FOR AXIAL BUSH ON THE PLANETARY REDUCTION GEARS FOR ACTUATORS

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Abstract

This paper normally reflects on the research regarding the preoccupations and results of the research activities and the production experience which the authors have been working in, in the area of series production of the planetary reduction gears. This paper meets the optimization necessities of the mechanic transmissions and first of all of making products of superior performances and a technical and consumption of materials and energy. In this direction we aimed, at a great change of a hint in their construction axial bush which plays a great functional part linked to tribological aspects.

Keywords: *The planetary transmissions, bush sector, efficancy, fiability*

Notation:

- P_f - *the consonant friction power,*
- *W- the adimensional weigh/burden,*
- *Q- the flow necessary lubricant,*
- *L- the width of the bearing,*
- *B- the width of the bush sector,*
- p_a *the allowable pressure.*

1. INTRODUCTION

The planetary transmissions are high technical products which have special cinematic and dynamic advantage, the best in certain area of parameter. The simple transmissions (fig. 1) which from a cinematic point of view offer the maximum of advantages, from the efficancy point of view, it represents a maximum of disadvantage. Consequently, when designing these, taking, into account the two criteria (the cinematic and the energetic we choose compromise solutions).

We know many papers on the tribological aspects which affect the efficancy planetary transmissions. In general when designing planetary reduction gears we use bearing with rolling bearing, but there are after functional hints which play a part in reducing the frictions, such as the axial bush of the roll type which are found within the frontal surfaces of the dented wheels of satellite type and support of satellite carrier. These take over the axial forces that result from the gear with bent dents working as axial bush. Their importance is great conversing the functionality and the energetic consumption as well as the weight done with the purpose of optimizing this type of axial bush in designing the planetary reduction gears is necessary due to the large series of production as well as their effects on the efficiency and the fiability. The behavior under loading of different synthesis materials proves the decrease of the portent capacity at more reduced values than the initial one in time at the mould of portent capacity and oiled classical bushes increases (fig. 2) [6]

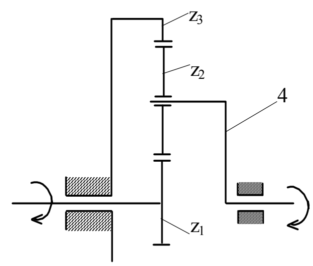

Fig.1. Planetary train gear

This paper is structured on 3 parts, the introduction, the 2nd part –the methodological principles of designing the axial bush and the third part –the experimental research. We took into consideration the bearing on planetary reduction gears made series at SC Angred SA.

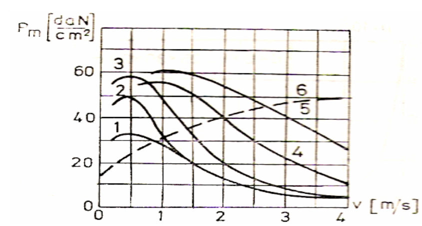

Fig.2. The portent capacity [6]

2. THE DIMENSIONING OF THE AXIAL BEARING

The dimensioning of the axial bearing at the planetary reduction gears, the construction of the axial bush planetary mechanism according to the figure 1 is shown is figure 2, to 3 satellite wheels which contains two axial bush each so, in all, on a reduction gear, there are 6 hints called rolls. These are made of an antifriction material, non ironed mixture and has a circular shape which ensures the reduction of the frictions between the mobile parts of the mechanism. The pattern of calculation regarding the dimensioning for such a type of bush taken into account contains

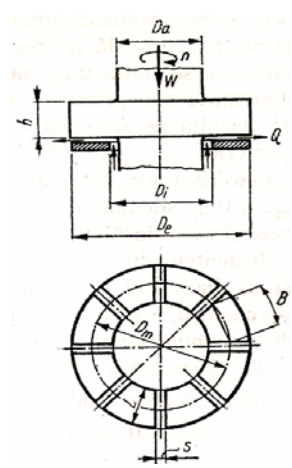

Fig.3. Axial bearing

the following determining the external diameter D_e because of the contract pressure) checking the heating and establishing the conditions of lubrication. We consider the following conditions with possible limited friction on a planetary transmission. The geometric elements of such a type of axial bush are represented in figure 4.

The external diameter,

$$D_e = \sqrt{\frac{4W}{k \cdot \pi \left(1-\beta^2\right) \cdot p_a}}, \qquad [\text{mm}], \tag{1}$$

where

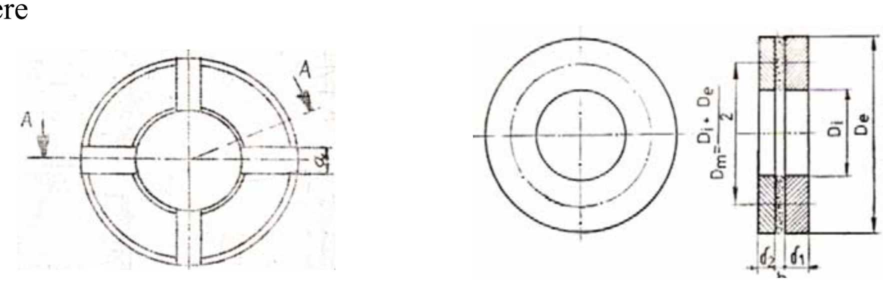

Fig.4. Axial bush

k is a coefficient for increasing the surface owing to the presence of the lubrication channels, k = 0,80…0,95.

β- adimensional coefficient, $\beta = D_e / D_i$, the usual, β = 0,4..0,6.

p_a the allowable pressure which, in the case of the couple of material cast iron on bronze on copper is 90 daN/cm^2.

Checking the heating.

These are done calculating the medium temperature of the bearing by the energetic consumption or the calculation the characteristic result $p_m \cdot v_m$ and comparing it to the allowable values. The value of the diameter of the axial bush is imposed by the construction, the interior one by the axis of the satellite wheels and the exterior one should not overpass the bottom diameter of these wheels

Checking the parameters of these lubrication

In certain conditions of these bearing use can ensure an almost fluid lubrication by the effect of thermical distortions of thermical breakdown. We indicate the following calculation;

The recommended maximum weight

$$F = k_1\left(D_e^2 - D_i^2\right) \; [\text{N}]. \tag{2}$$

The dissipated power by frictions

$$P_f = k_2 \cdot n \cdot D_m \cdot F \ \ [\text{w}] \ , \tag{3}$$

where:

n –rotation speed

D- the medium diameter

F- the maximum weight

The necessary lubricant to limit the increase temperature over 20^0 C

$$Q = k_3 \cdot P_f \ \ [\text{m}^3/\text{s}], \tag{4}$$

in which: $k_1 = 0,3$; $k_2 = 7.10^{-5}$; $k_3 = 3.10^{-8}$

The object of the optimization to increase the performances of bearing is to establish the couple of material and of the values of adimensional parameters D / D; L / B., of the number of sectors n_s separated from the channels of lubrication and of the coefficient of designing the circular surface, defined by the expression, usual φ = 0,8…0,9

$$\varphi = \frac{B \cdot n_s}{\pi \cdot D_m} \ . \tag{5}$$

This coefficient is useful to be taking into consideration and at this of bearing because it has a special effect on the use and the thermical balance.

The planetary reduction gears functions in this direction with two types of lubricants and that is it by insertion, by sinking it or oiling under high precision where the thermic regime is overpassed. By experimental research we can find the best area of this parameter φ on the couple of material.

3. THE EXPERIMENTAL RESEARCH

These researches have focused mainly on establishing the best material for the axial bush and of the parameters φ, of the way the circular surfaces function. Compared to the size and the character of the evolution of the weight as well as according to other functional conditions which reflects directly on the quality of the material of bearing, this should be closing to ensure an exploitation with maximum of fiability we especially have to take into consideration aspects such as resistance to tiredness and the propriety of antifriction, the used lubricants, the behavior at friction and the thermic regime of working, and the fabrication cost.

The structure of the axial bush of roll type is presented in the following figure achieved in the existent phase by refining the non ironed composition Bz10T mould for replacement and experimental research was made of synthesis material on iron symbol FU-E10-64, the same as the mixture. The proprieties of the synthesis material are the following: Composition: Cu-Sn sau Cu Al 10 Fe 3; Density 6,4 -6,8 gr. /cm^3; Static loading < 1200 daN/ cm^2; Maximum linear sped 6 m /s; Allowable loading p.v = max 18; Turation of regime n<30 000 rot/min; Temperature working – 20^o ..+80^o C ; the oiled structure.

The research consisted of endurance evidence (of duration) on the basis of a research program which consisted of loading on the stand two sizes of bush (25 x 12 x3 ; 30 x 20 x 3,5) when functioning under loading. The measured parameters are represented in the table 1.

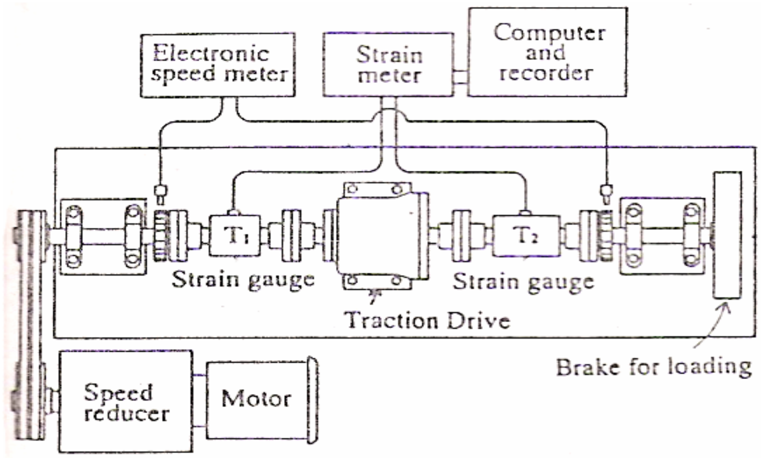

Fig. 5. The pattern of the trial stand with brake for loading

The measured parameters Table 1.

No crt.	The name of the parameters	Measured values			Obs.
		UM	1-3-1	2-3-1	
1	The medium absorbed power	kW	4,9.	7,6	
2	The turation of entrance	rot/min	1460	1460	
3	The moment of braking.	daN m	10	24	
4	The medium temperature,	^{o}C	46,72 ^{o}C	40^{o}C	
5	The duration of the evidence: - when empty	hour	2	2	*
	-when loaded.	h	81	181	
6	Level of medium noise	< C_z 70	< C_z 70	< C_z 70	

* Observations: An hour clockwise and an hour counterclockwise

The pattern of the measurement stand is presented in figure 5. The stand is of the open a open type and contains batteries, an electric engine , the reduction gear to bi tried on aid a brake a with metallic powder. The size of the used material was determined by measuring the thickness of the bush noting small values of these after the endurance evidence, such as we have shown in the table 2, for a series of 6 pieces fixed on a reduction gear.

The size of the used material. Table 2.

Measured values			
Before the evidence		After the evidence	
3.01	2,96	3,53	3,51
3,02	2,95	3,56	3,53
3,06	3,03	3,55	3,50
3,04	3,00	3,54	3,51
3.05	3,01	3,55	3,50
3,03	2,98	3,52	3,49

The curves of portent capacity are presented in figure 6

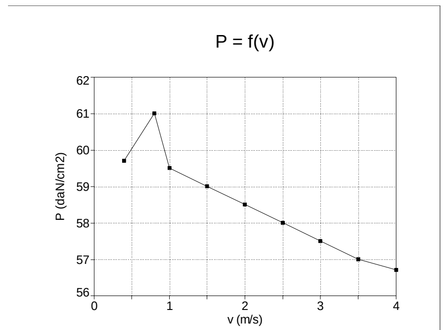

Fig. 6. Portent capacity

4. CONCLUSIONS

The experimental research done on the proposed material as replacements prove their efficancy under aspects that ensures a successful replacement and the introduction of a series fabrication for the whole productions. The experimental research on the behavior manifesting only little decrease on the conditions of ensuring an appropriate oiling of the reduction gear (fig. 6).

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