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EXPERIMENTAL ASSESSMENT CONCERNING THE HD RADIAL BEARINGS IN THE CASE OF DYNAMIC CHALLENGING WORKING

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Abstract*: Due to the very short time of loading radial bearings exposed to shocks and vibrations, of about 0.5-1 ms, this paper presents a few experimental assessment concerning the function of radial bearings with HD lubrication in the case of huge challenging working. It was focussed on the determination pressure distribution from the film to be lubricated in various places of the bearing's body.*
Key words *: bearing, pressure distribution, radial hydrodynamic bearing, impulse loading.*

1 INTRODUCTION

We consider the closing motion between spindle and bushing on the direction of the center line, without the rotation of the spindle (the case of the non-rotating bearing), so that the lubricant expulsion effect be prevalent in the achieving of the squeeze film.

Analytically expressed, the Reynolds equation corresponding to this study, within an isothermal approach is [8]

$$\frac{\partial}{\partial x}\left(h^3 \frac{\partial p}{\partial x}\right) + \frac{\partial}{\partial z}\left(h^3 \frac{\partial p}{\partial z}\right) = 12\eta \frac{\partial h}{\partial t} . \tag{1}$$

where η- viscosity of lubricant (Ns/m^2); p-pressure (Pa); h- fluid film thickness (m).

2. EXPERIMENTAL DEVICES AND ACQUISITION CHAINS

The assessment was made on the experimental stand of the Tribology and Manufactural Engines Lab from the North University of Baia Mare (Fig. 1), making use of the modern technology concerning the results'processing and acquisition[1].

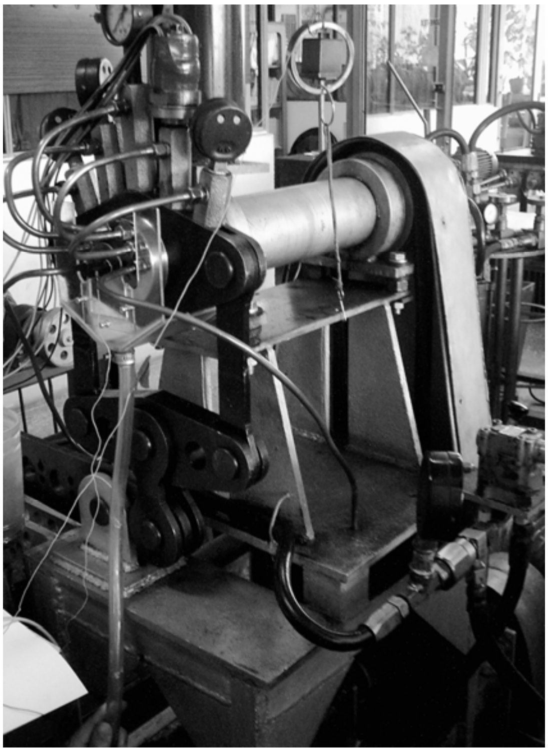

Fig. 1. The testing experimental devices

The research was made using a HD radial bearing with L/D=0,5 and the spindle's diameter d_e =59,86 mm, and the bushing diameter D_e =59,93 mm, spindle's asperity 58-62 HRC, made of 18MoCr10, bronze bushing made of 88% Sn, 8%Sb, 4%Cu.

The HD radial bearing is put into function by an electric engine with a power of 3 kW, and the entrance rotation is made due to a gear box, which assures the rotation of 960, 600 and 370 rot/min.

The dynamic loading of the bearing is made through the launcing of a weight which hits the bearing at different heights. They were made assessments for heights between 5 and 40 cm, using a weight with m=5 kg, so as for H=5 cm we have F_1=1665 N, for H=20 cm we haveF_2=2356 N, and for H=40 cm we have F_3=3332 N. The static working conditions is presented for the following value H=0 cm

All the tests were made at a 40 °C of the lubrifiant, being constant, pressure distribution p_{in} having the following values, from 0,5 bar to 10 bar[3].

Using a lubrifiant oil for bearings of LA 32 STR 5152-89 type, with the viscosity of 31,3 cSt at 40 °C, it was focussed on the determination pressure distribution from the film to be lubricated in various places of the bearing's body, with the help of pressure measuring dose with tensiometric translators put together through an amplifier placed at the acquisition plate ADuC 812.

Figure 2 presents the bushing diagram in experimental assessments having L/D=0,5.

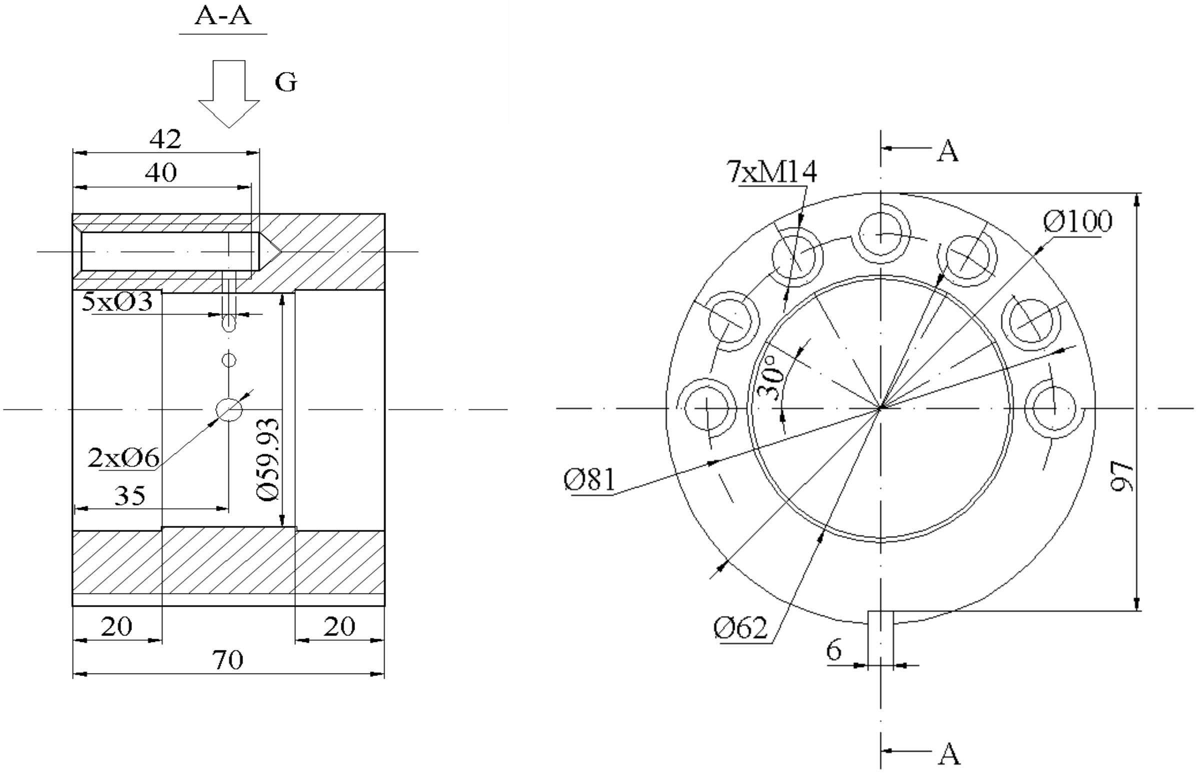

Fig.2. The bushing of the experimental radial bearing

In dynamic charging conditions, the pressure distribution was determined in the lubricated film in those 5 points on the bearing's body with the help of pressure measuring with tensometric translators.

The tensometric translators are used in large scale due the simpleness and the extanded domain for application from 7 to 700 bari [6].

The translator is a manometric capsule at which the sensible element to pressure is an enclosed tube at one end whose inner part is conected to the oil whose pressure is measured. The tube is made of steel with elastic properties on which there are 4 tensometric stamps, each of them having the electric resistivity of 129 **Ω**, two of them in axial direction, and two in perpendicular direction[2].

Those 4 tensometric stamps are conected in a tensometric bridge diagram, being related by an amplifier at the acquisition plate ADuC 812 [7].

Under the pressure variation influence, the thin wall of the dose is changing its shape, the stamps are changing its resistance [5].

Figure 3 presents the pressure measuring dose with tensometric translators made of steel 18 MC10 [9].

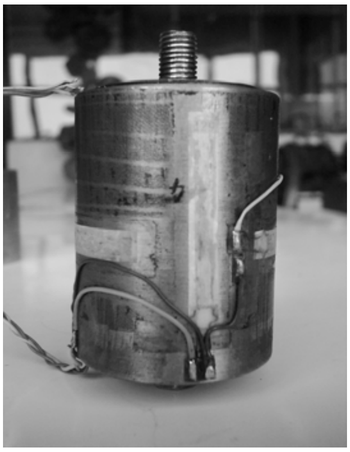

Fig.3. The dose with tensometric translators

Figure 4 presents the pressure measuring chain in the lubrifiant film.

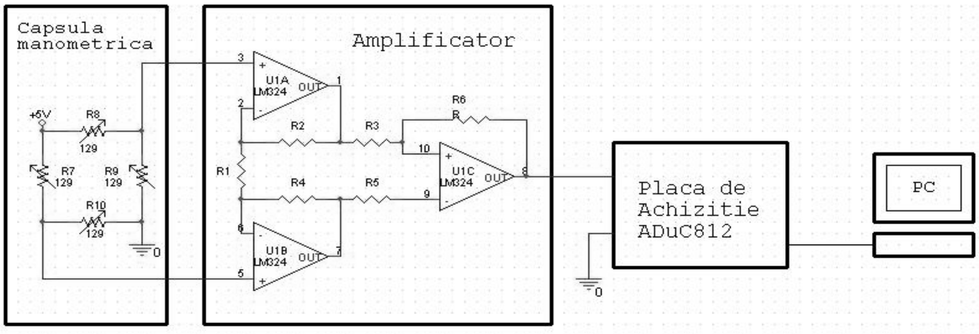

Fig 4. The pressure measuring chain in the lubrifiant film

The exhibition of the pressure measuring dose was made in the case of dynamic charging, on the manometer's exibition stand, using the above chain, focussing on the variation exit sign and registering amplifier and the acquisition plate ADuC 812. The pressure increase was made bar by bar, the dose distortion being liniar with the pressure[4]. It was established the dependency relation between the pressure and the tension in the exit point in mV (2,3 mV = 1bar Δp).

3. EXPERIMENTAL RESULTS

The pressure distribution on the peripheric side of the bushing, depending on the available supply pressure, the static and dynamic charging conditions at different spindle's rotations are presented in figure 5 for n=370 rot/min, p_{in} =0,5 bar; figure 6 for n=600 rot/min, p_{in} =1,5 bar and figure 7 for n=960 rot/min, p_{in} =10 bar.

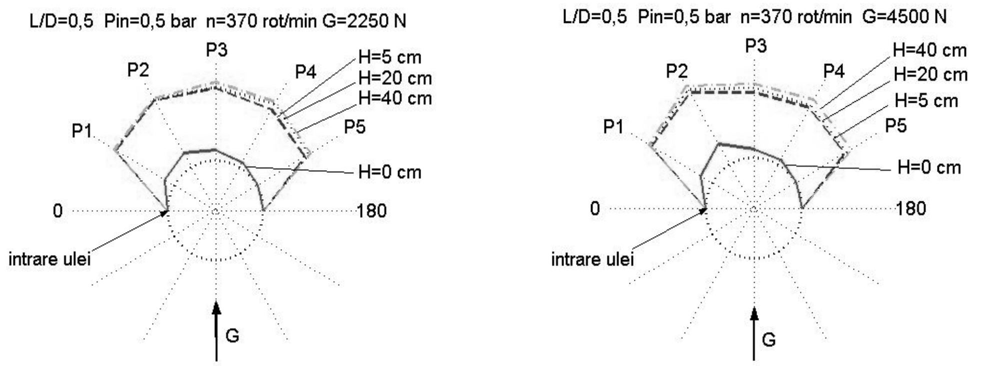

Fig 5. The dynamic pressure distribution on the peripheric side of the bushing depending on the static and dynamic charging conditions of the bearing (n=370 rot/min, p_{in} =0,5 bar)

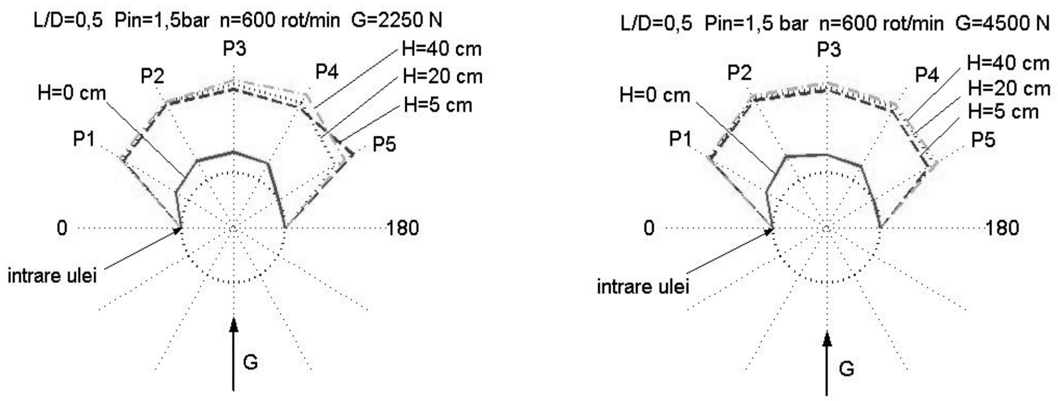

Fig 6. The dynamic pressure distribution on the peripheric side of the bushing depending on the static and dynamic charging conditions of the bearing (n=600 rot/min, p_{in} =1,5 bar)

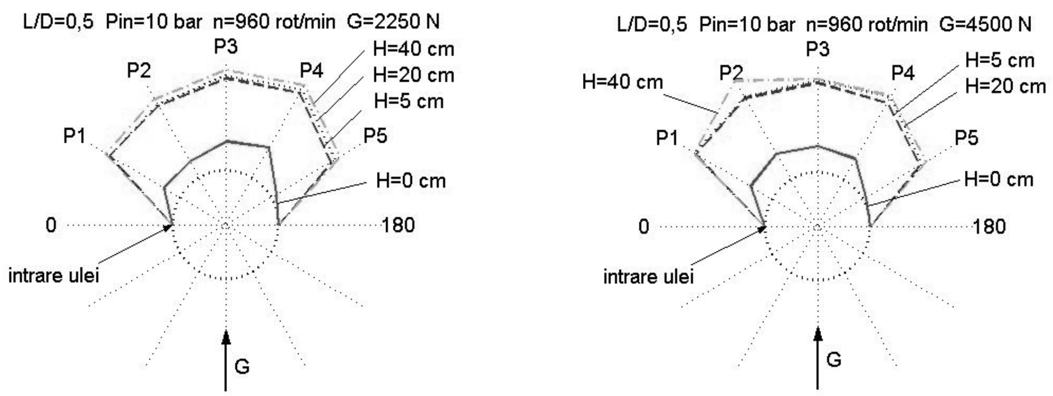

Fig 7. The dynamic pressure distribution on the peripheric side of the bushing depending on the static and dynamic charging conditions of the bearing (n=960 rot/min, p_{in} =10 bar)

4. CONCLUSIONS

The following conclusions may be taken into consideration:

- the dynamic pressure from the moment of shock is increased when increasing the dynamic charging conditions; this incresing process refers to the all portant zone, the dynamic pressure having values from 3,37 to 118 static pressure, depending on the studied position of the peripheric zone of the bushing;
- the static charging conditions of the bearing does not have an important influence regarding the changing in the pressure's values, as the static charging conditions gets bigger, so as the dynamic pressure is bigger;
- the draught's pressure in dynamic conditions has a slightly shifting to the entrance zone of the lubrifiant when static charging conditions are increasing;
- in all these situations the following fact is to bare in mind: the short time for pressure variation in dynamic charging (under 0,5 ms).

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