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Make Harmony Between Technology and Nature, and Your Mind will Fly Free as a Bird
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TESTING RIG FOR RELIABILITY CONTROL OF ROLLING BEARINGS

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Abstract: *The rig is designed to determine some functional parameters of rolling bearings based on short time tests, thus one can predict their functioning limits. Working-life tests can also be performed both for spherical roller bearings and radial cylindrical roller bearings. The main parameters which are tested: spindle speed, radial load, axial load, functioning temperature, vibration mode of rolling bearing. The rig is originally conceived (excluding other rolling bearings; testing bracket rolling bearings; easy in mounting and replacing of the tested rolling bearings etc.) and is equipped with modern measuring, recording, analysis and control devices.*

Key words: *reliability, rolling bearings, testing rig*

1. INTRODUCTION

The rig is designed mainly for the determination of some operational characteristics of ball-bearings, by short-time tests that would enable a prediction of their operational performances. On the stand, we may also perform durability tests. The constructive solution enables the testing of two types of ball-bearings (radial-self-aligning spherical roller bearings and radial cylindrical roller bearings) in the range of dimensions: d = 160 - 240 mm, D = 270 - 440 mm, B = 74 - 120 mm. The testing regimen has as limits for the main parameters the following values: maximal radial load, $F_{r\ max}$ = 300 KN; maximal axial load, $F_{a\ max}$ = 60 KN, operating speed, n = 200 - 800 r.p.m. The main measuring parameters are: the service life and the effective speed of the operational vibrations of the tested roller bearing. Also, bench durability tests can be performed for large bearings

2. CONSTRUCTIVE AND OPERATIONAL DESCRIPTION

The main constructive parts of this type of rig are (fig.1):

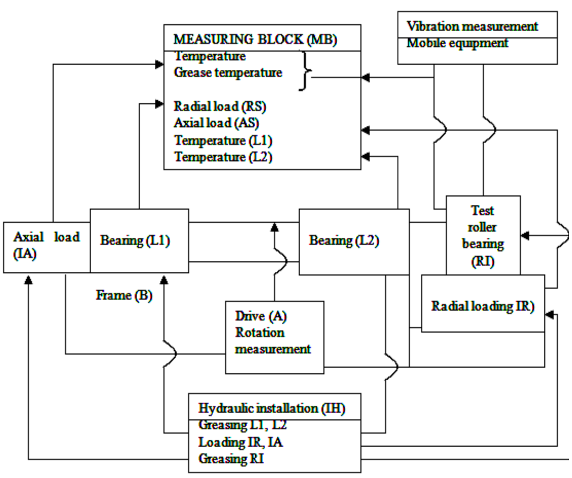

Fig. 1. The rig constructive components

- driving subset (for tested roller rotation);
- testing subset with radial load;
- testing subset with axial load;
- hydraulic installation of loading and greasing;
- measurement and control block of the work parameters;
- the measuring equipment of the operational vibrations;
- the electric control panel.

The rotation subset of the tested roller bearing has the constructive solution presented in a simplified manner in fig. 2. The tested roller bearing (8) is mounted at the conical end of the tested spindle (6) by means of a changeable bush and fixed with the outer ring in the box (10), also by means of a bush that can change depending on the tested roller bearing. The box guides in the vertical support (9) mounted on the frame plate (11), the support taking over also the axial load transmitted by the spindle. The spindle is supported in its rotational movement by the slide bearing (5) and (7) avoiding the use of the bearing on the roller bearing that would induce impairing vibration (Constantinescu, 1980).

The driving into the rotational movement is made by a transmission with 5V belts (2, 3, and 4) from a DC eledctric motor (1). The adjustment of the speed is made by an electronic variator.The subset for radial load can apply different values for load on the tested roller bearing more than 300kN (value limited by the strength and deformation condition of the spindle). The pressure chamber with rubber membrane (12) acts upon the piston (13) when it is supplied with pressure (the pressure being controlled roughly by means of the manometer).

The level system (14, 15, 16) provides a three-times amplification developed by the pressure chamber, the real force that loads the roller bearing being determined with precision by the tens metric (17) and the afferent measuring devices. After load adjustment, the pressure circuit may be closed with the cock (18).

The load sub-assembly with axial load (19, 20, 21) has construction and operation similar to the one for radial load having an independent building that does not ensure, depending on the type of the tests, the achievement or the cancelling of the axial load of the tested roller bearing (Gafitanu, 2002).

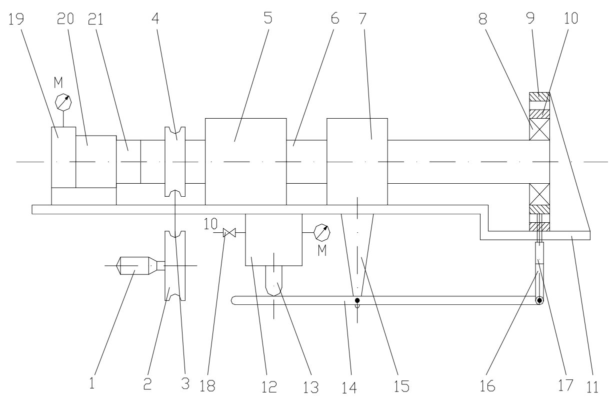

Fig. 2. The rig constructive solution

The hydraulic installation of loading and greasing performs two main functions (fig. 3):

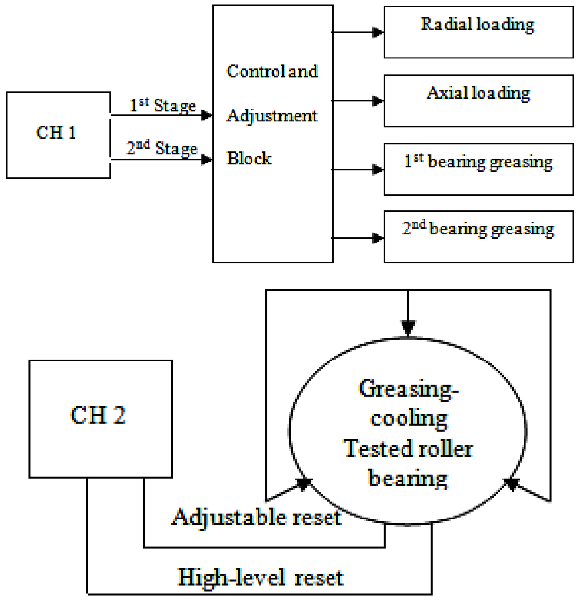

Fig. 3. Hydraulic installation

- typical hydraulic plant (CH1) with two stages, provides by the control and regulation block on the first stage the necessary flow for greasing and cooling the bearing (bearings equipped with temperature transducers and warning system for the overrun of the admitted temperature limit) and on the second stage, the necessary pressure with the chambers of the loading system.

- typical hydraulic plant (CH2) ensures the necessary flow for the greasing and the cooling of the tested roller bearing; the supply is made by 3 points, with the adjustable flow and pressure from the adjustment block in order to ensure the desired level of temperature.

Regarding the stand destination, this was equipped with machinery for:

- measuring the operational parameters;
- measuring, recording and analyzing the operational vibes of the tested roller bearing.

The measurement of the operational temperatures is performed by a device with 6 measuring channels having as traducers some miniature resistance. The measurement of (radial and axial) loads is made by means of two thermal cells and of the measure-view-storage-warning equipment. The speed of the spindle is measured by means of a photo-electrical transducer and of a tachometric computer.

To measure and analyze the operational vibes that occur with the tested roller bearing, three places for the transducers were provided (one on the up of professional microcomputer, specter analyzer, piezoelectric accelerometers, conditional amplifier and oscilloscope.

The electrical installation was designed for feeding the electro motors of the stand in a cycle of orders that would ensure the good operation and the protection against mishandling.

3. RESULTS

As one of the rig uses refers to the reliability tests, were tested on this three sets bearing type 120/240 WJ (Grigoras, 1989). Tests were accelerated type, short. In order to carry out a comparatively study, the resulted values for the reliability parameters (statistical interpreted) have been compared (table 1). The information been processed using the maximum likelyhood method (Popinceanu et al., 1985).

The correlation between service life and failure procentage *P* is represented on a Weibull probabilistic plat (fig.4). The different value of the slope parameter *e* can explain the variations of the service life, L10 and L50 (Grigoras et al., 1998).

Sets	Bearings [number]	*e*	L10 [hours]	L50 [hours]
1	20	0.916	60.88	476.9
2	20	0.692	44.33	675.1
3	20	1.222	71.19	381.4

Tab. 1. Main parameters of sets

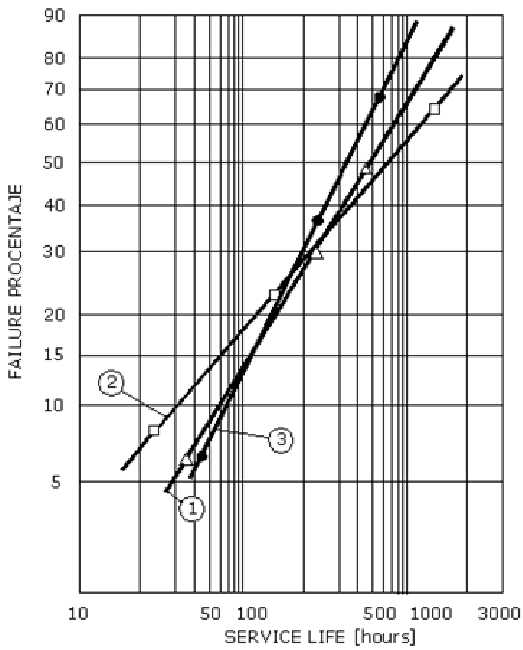

Fig. 4. Service life of the bearings sets

4. CONCLUSIONS

1) This rig has an original design concerning solutions that are not used usually with roller bearings test machinery and presents advantages such as:

- the exclusion from construction of the roller bearings;
- the placement in the console of the tested roller bearing that can be changed without performing any special dismantling;
- the testing head (tested roller bearing put on the bush) may be prepared in advance, maybe it is needed to test a wide range of roller bearings;
- it presents modern measuring, recording, analysis and control equipment.

2) Particular type of testing has led to a short time to determine the main functional parameters of rolling bearings.

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