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RESEARCH OF REVOLVING ACCURACY OF A ROTOR WITH HYDRODYNAMIC BEARINGS

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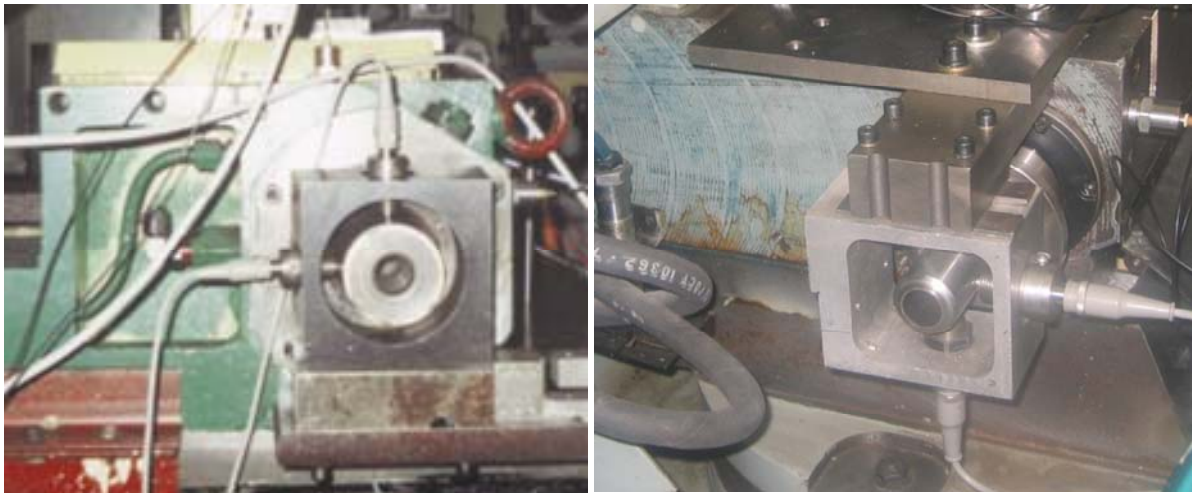
ABSTRACT
Accuracy of rotary machines with hydrodynamic sliding bearings of rotors rotation is analyzed in this work, being different frequencies of rotors rotation. Experimental rotary systems with bushing and segmental bearings of sliding friction are described. Principal schemes of searching bearings and photos of stand are given. Experimental measurements and analysis of getting results are done.
Primary experimental results of measurement are gotten; its analysis is done and necessary formats of data are got for further analysis. Internecine dependences of experimental results of searching rotary systems with different bearings are ascertained.
Discussion of research results is done and primary conclusions are formulated.
Keywords: rotor, rotors machines, tilting-pad journal bearing, sleeve liquid-friction bearing, orbits

1. INTRODUCTION
Sliding bearings are one of the main elements of rotary machines constructions of high power. They are kept rotor and they are pervaded widely in turbines of vapour of high power, in compressors, in pumps, in internal-combustion motors, in generators and similarly [1, 2].
For instability of rotor and bearing and nocoxial and for other factors are happened mechanic problems in these rotary machines. Those problems are varied changing frequency of rotor rotation, the major frequencies of rotor rotation the more major these problems [2, 3]. Problems are increased more, when frequency of rotor rotation is become resonant [4].
Trying these problems to decrease, hydrodynamic bearings of sliding friction of different constructions are used in rotary systems [5].
The better results are gotten using adaptive segmental bearings of sliding friction instead of simple bushing sliding frequency bearings [6, 7]. Adaptive segmental bearings of sliding frequency have its defects too, that is inaccuracies of measurement, irregular repartition of workloads on segments, limited elevating power of bearing and so on.
Necessary experimental researches are determined trying to ascertain dependence of rotor rotation accuracy from frequency of rotor rotation.

2. TESTING OBJECT AND SYSTEMS
Systems of research: investigative system; system of regulation of frequency of rotor rotating; system of lubrication and refrigeration; system of measurement and system of analyses results.

Investigative systems

Investigative technological systems with tilting-pad journal bearings (Fig. 1a) and with sleeve liquid-friction bearings (Fig. 1b). Investigative system could be any pair of two elements that is working with friction of sliding (1 element – lubricant - 2 element).



a b

Figure 1. Technological systems: a-with tilting-pad journal bearings, b – with sleeve liquid-friction bearings

System of regulation of frequency of rotor rotating

It is using step less system of regulation of frequency of rotor rotating of German firm "INDRAMAT" for rotating of rotor system with bearings of friction of sliding Pressure of network 380 V, power of electricity energy 6.5 kW; frequency of rotating of step less regulation 0-8000 rev/min. Step less system of regulation of frequency of rotor rotating consists of asynchronous three-phase electricity energy and its block of control, and with its help is doing start and stop of electricity energy. It is reassembling programmed module AS31 for block of control to tally with mechanic of asynchrony energy. Module is doing function of transducer constructional, it has programmed equipment and necessary parameters of compatibility in memory of time.

System of lubrication and refrigeration

Hidrosystem of stand is separating to supply tribological system with liquid. Prime elements of system of lubrication and refrigeration: container of liquid, hydro pump, electricity energy; monometer, filter of liquid, protective valve; body, rotor; hydrodynamic bearings of sliding friction; muff; asynchronous electricity energy; manifolds.

System of measurement and analyses results

System of measurement consists: non-contact transducers of measurement of bias, transducers of measurement of vibrorates, photoelectric transducer of measurement of phase, transducers of special temperature of measurement and different boosters too, apparatus for 0 fixing and blocks of supply.

For measuring of rotors rotation defections mechatronical systems had applied firm Germany Hettinger Baldwin Messtechnik CMBH (HBM) transducers of non-contact inductive improvement mod. Tr. 102.

Sensitiveness of transducer belongs from elementary interval L_A and from its banquet ΔL. When small bridge is balance wheel, inside interval L_R is equal exterior elementary interval L_A.

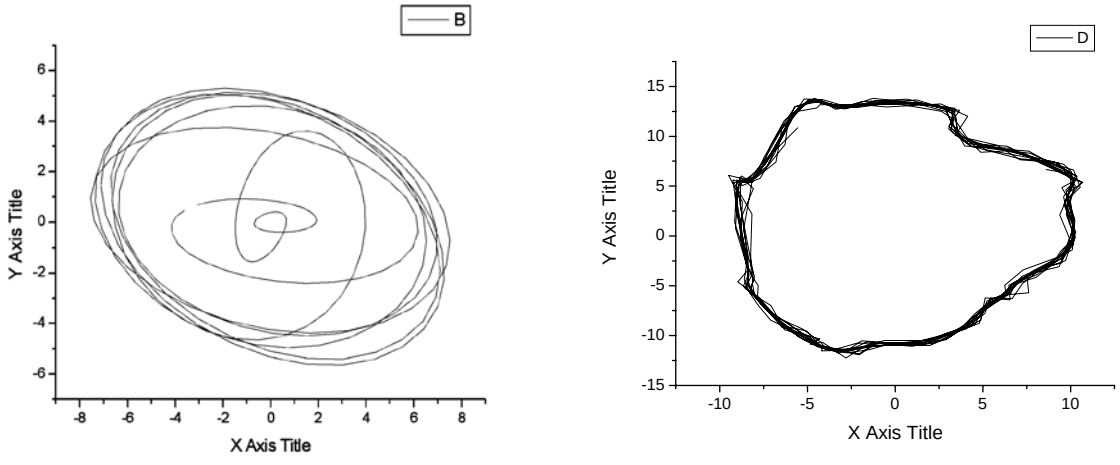
Accelerometers distinguish itself the widest interval of measuring vibrations signals frequency compare witch transducers of changes and speeds.

For measuring of absolute vibrating accelerations are used firm of Danish "Bruel & Kjaer" piezoelectric accelerometers (mod. 4370). It's the main characteristics are: sensitiveness according to change 10...10,12 pC/ms^{-2}, or 99.0...99.4 pl/g; sensitiveness according to voltage 8,84 mV/ms^{-2}, or

86,9 mV/g; capaciousness in common with hook is 1144 pF; resistively – 2000 MΩ min in room temperature.
Accelerometer is statement on the frame of rotor. Witch disposition of strengthening lets to fix accelerometer in any point of measuring.
To establish phase is used photoelectrical phase's transducers of original construction. The special plate DAD1210 of loading-withdrawal is feeding transducer.
In diagnostically transducers all transducers of measuring except (strobe) are lay out 90° corners of phases in one plane of shafts transverse.
Such exposition of transducers lets to measure the position of shafts neck sliding bearing of rotor turning including and zero. Orientation of transducers its not necessary has to be vertical or horizontal. It's choosing most comfortable position of mechanism position.
System of measurement results and analyses consists: computer with special plate DAD1210 that is installing in computer and different programmable batches.
The plate of input-output DAD1210 of universal electric signals is used for transmissions information to computer, for strengthen of transducers signals and for government of experiment.
Plate is connected block of apportionment of address, which is formatted signal of contrivance engaging of every plate, buffering of plate with computering highway, registers of governing and condition, which are configured plate and are reflected effect of mechanism of plate, which are programming module of intervals formation of time length, changing of analogical signal to numerical module, which consists of two electrical commutator of analogue signal, programming booster and analog code transducer (ADC), module of changing of numerical code to analogue signal, which consists of government scheme of two-code-analogue transducers and commutations of analogue signal. Mechanisms of plate are occupied 24 addresses in the space of address of exterior mechanisms of computer.

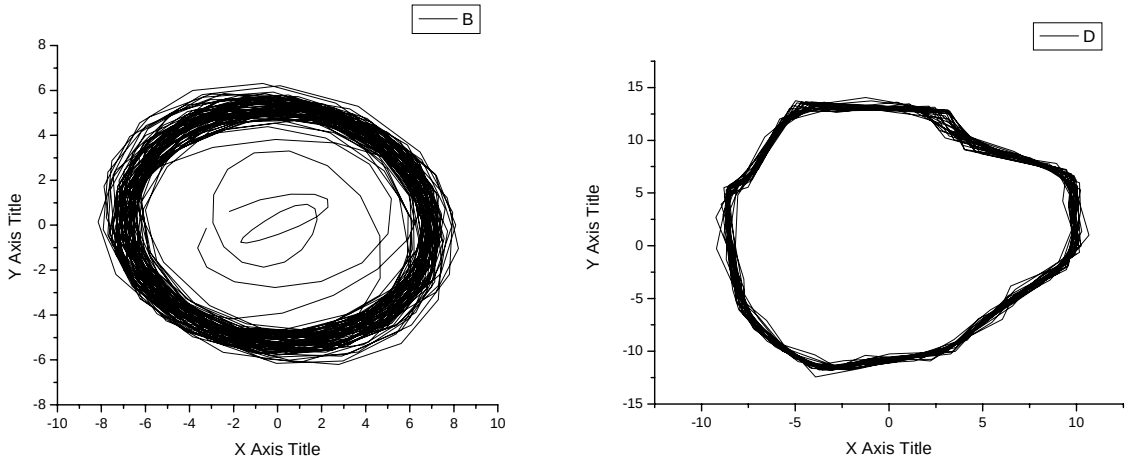
3. MEASUREMENTS RESULTS

It is getting primary results of measurement doing experimental researches. Orbits of revolution rotors are got doing analysis of primary signals. Results of analyses present to Fig. 2, 3.



a b

Figure 2. The orbits of the rotor axis: a - tilting-pad journal bearing rotating speed 2000 rev/min, b- the orbits of the rotor axis Sleeve bearing Rotating speed 2000 rev/min



a b

Figure 3. The orbits of the rotor axis: a - tilting-pad journal bearing rotating speed 4000 rev/min, b - the orbits of the rotor axis sleeve liquid-friction bearing rotating speed 4000 rev/min

4. CONCLUSIONS

Sifting bushing and Tilting-pad journal bearing orbits by 2000 rev/min and 4000 rev/min we can see, that bushing orbits of bearings are 10 μm within the pale, and thickness of orbit is formed 1 μm. Tilting-pad journal bearing orbits are fluctuated 6-8 μm within the pale, but its thickness is reached 2-2,5 μm.

So fabricating bearings for technological machines, it needs to use bushing, because high accuracy of working it is necessary here and Tilting-pad journal bearing is suitable for rotary systems better.

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