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Tomasz JARZYNA¹

PROBLEMS WITH BALANCING OF ROTORS MACHINES
AND DEVICES FIXED ON VIBRATING BASE

Summary: In this work the problems of rotor balancing fixed on a flexible base were investigated. The results of vibration on laboratory stand were presented. At the end of the work possibilities of rotor balancing were estimated.

Key words: vibration, rotor balancing, vibrating base

1. INTRODUCTION

The negative impact of vibration on devices and machines which are fixed on the movement bases are known very well. The problems which are still analyzed are reasons of vibration and their reduction.

Machine vibration can be caused by the static and dynamic unbalancing of the rotary elements, impulses impact (bearing slackness, joint clearance, etc.) and construction factors. These elements have influence on initiating parametrical vibration. The other causes of vibration are: magnetic or aerodynamic effects and many different [1, 2].

The basic reason of generated vibration is unbalancing rotation elements as results of unsymmetrical distribution of mass relative to rotation axis [3, 4].

The balancing process usually is made in exploitation place. If the base on which the machine is fixed is immovable then the balancing of the machine is comparatively easy. However, if the device is a part of a larger installation which can not be turned off then the base surface is a source of kinematic forces of different values frequencies and amplitudes. In this case the balancing is very difficult.

In this work the problems of rotor balancing fixed on flexible base were investigated. Additionally relations between frequencies of bases and unbalancing rotor were estimated too.

2. TESTS METHODS

The laboratory experiment were made on special stand where an unbalancing rotor with drive was fixed on flexible base (Fig. 1, 2). The vibration (amplitude and frequencies) were introduced by vibration inductor. The vibration were measured in three points:

¹ Dr inż. Tomasz Jarzyna, Uniwersytet Technologiczno-Przyrodniczy, Wydział Inżynierii Mechanicznej, Bydgoszcz, e-mail: tjarzyna@utp.edu.pl

- 1 – on beating housing,
- 2 – on base,
- 3 – on vibration inductor.

The laboratory stand is use to investigate many dynamics phenomena. Is possible to blockade motion of each subsystem. At the experiment were blockade motion of shaft supports and engine however clear was base supported on four flat springs. Influence of engine's unbalancing was protect for using clutch between shaft and engine. The vibration were control by the vibration generator Svantek Svan 401. The registration of vibration were made by the diagnostic analyzer KSD 400. Registration parameters of the device:

- quantity of samples by channel: 4-262144,
- frequency of sampling: 16-100000 or 200000 Hz,
- time interval in measurements: 0,1-3600 s,
- measurements interval in function of spins: 10-500 rpm.

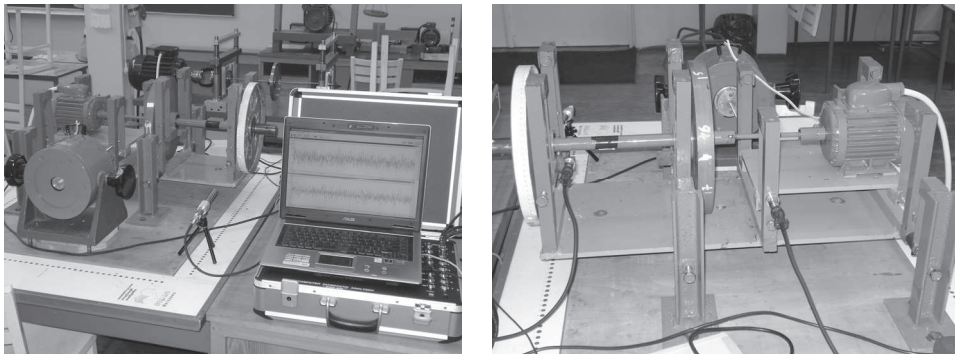


Fig. 1. Research stand
Rys. 1. Stanowisko badawcze

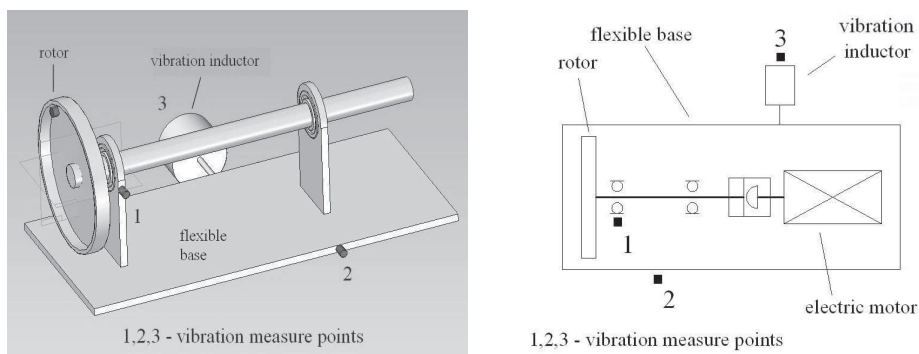


Fig. 2. Scheme of research stand with vibration measure points
Rys. 2. Schemat stanowiska badawczego z miejscami pomiaru drgań

Problems with balancing of rotors machines and devices fixed on vibrating base

Rotational speed of rotor was established on 1068 rpm, which is equal frequency $f = 17,8$ Hz. Rotor of research stand was balanced. Unbalancing equal 4440 gmm and unbalancing degree- 213° were affirmed. After that vibration inductor was started and frequency of vibration force was changed. Generated vibration frequency of base was changed from 5 to 20 Hz, amplitude was constant and equal 1 mm. For different frequencies of base vibration was trying to balancing of rotor. During balancing unbalancing mass and unbalancing degree were registered. Amplitude, speed and acceleration of vibration were also registered.

3. TESTS RESULTS

Research of influence of base vibration on balancing process was started from force frequency 5 Hz. The frequency was increased for 0,5 Hz. Possibility of balancing of rotor in frequency range from 5 Hz to 17,6 Hz and from 18 Hz to 20 Hz was affirmed in tests. Unbalancing mass and unbalancing degree are not much different from average value in these. For vibration frequency of base almost equal to frequency of rotational speed (17,8 Hz) object balancing was impossible. Tests results are showed on charts (Fig. 3-6).

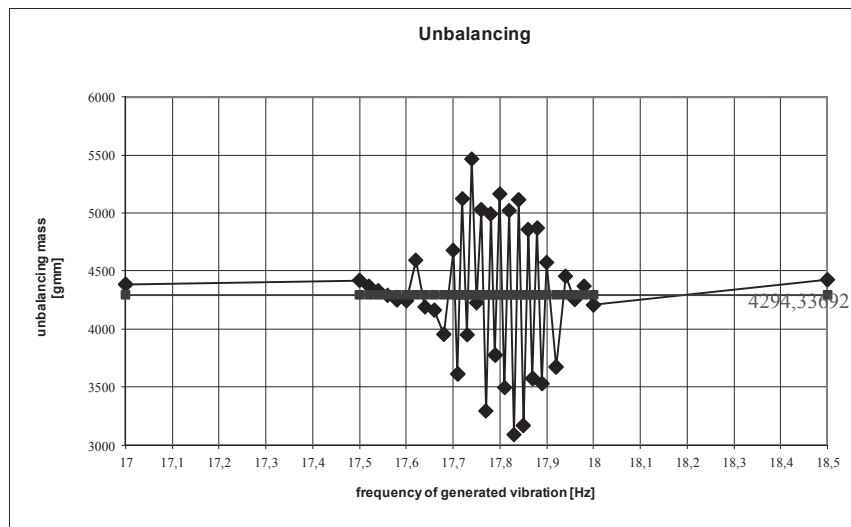


Fig. 3. Unbalancing mass versus base frequency
Rys. 3. Niewyważenie masowe względem częstości podstawowej

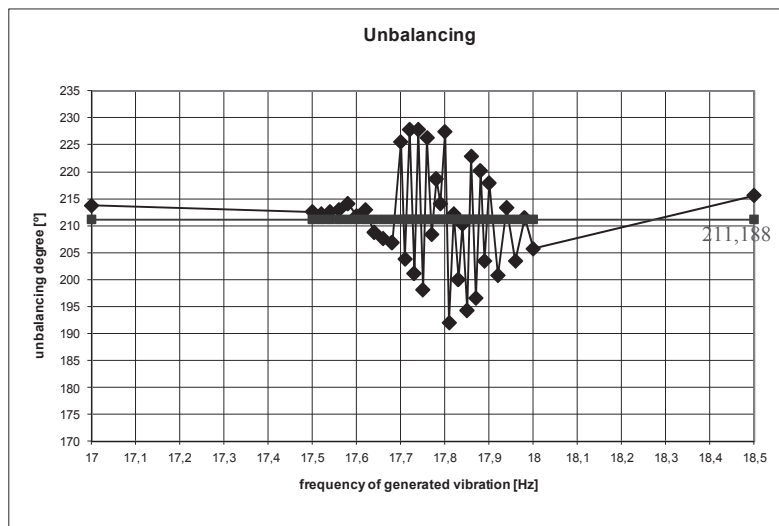


Fig. 4. Unbalancing degree versus base frequency
 Rys. 4. Stopień niewyważenia względem częstości podstawowej

Particular measurements in this area were made from 17,6 Hz to 18 Hz with step 0,02 Hz. Unbalancing and unbalancing angle were variable, much different from average value in these range. Speed and acceleration of vibration were increased (Fig. 5, 6).

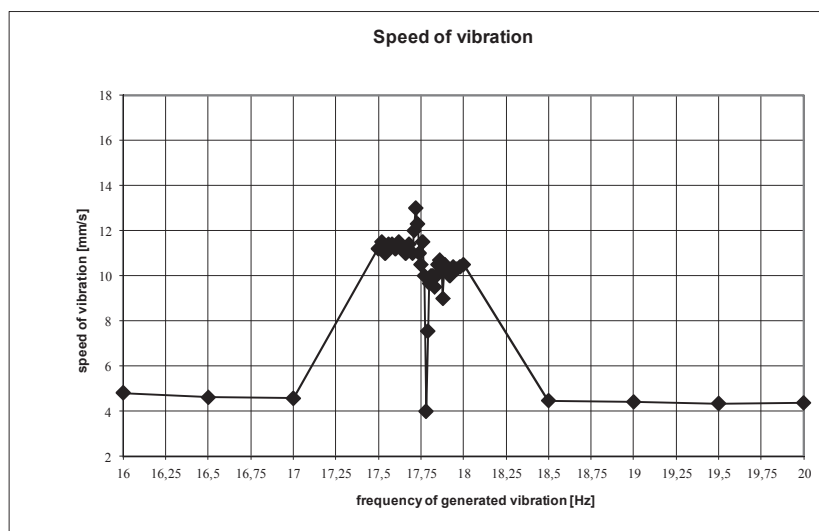


Fig. 5. Speed of rotor vibration versus base frequency
 Rys. 5. Prędkość drgań wirnika względem częstości podstawowej

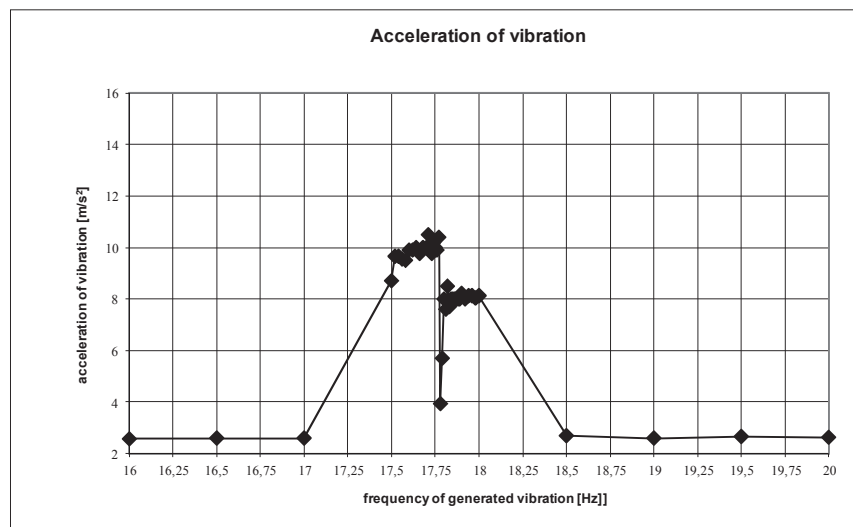


Fig. 6. Acceleration of rotor vibration versus base frequency
Rys. 6. Przyspieszenie drgań wirnika względem częstości podstawowej

CONCLUSIONS

On the ground of presented investigations one formulated following conclusions:

1. The balancing of devices rotors fixed on movement base is possible, when base and rotors frequencies have different values.
2. In the cause when frequencies are close, the beat effect appear.
3. In troubles with balancing of rotors, rotary speed should be changed.
4. The balancing depend on different causes like: construction, operating and usual wear factors.

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PROBLEMY WYWAŻANIA WIRNIKÓW MASZYN POSADOWIONYCH NA RUCHOMYM PODŁOŻU

Streszczenie: W artykule poruszono problem wyważania wirników maszyn posadowionych na ruchomym podłożu. Przedstawiono wyniki badań przeprowadzonych na stanowisku laboratoryjnym. Dokonano oceny możliwości wyważania wirnika maszyny w jej środowisku pracy.

Słowa kluczowe: drgania, wyważanie wirników, drgające podłoże