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DEVICE FOR THE ANALYSIS-FREE DIAGNOSTICS OF DEFECTS OF KINEMATI--ETC(U)
AUG 78 V P MAKSIMOV, V A KARASEV
UNCLASSIFIED FTD-ID(RS)T-1318-78 NL

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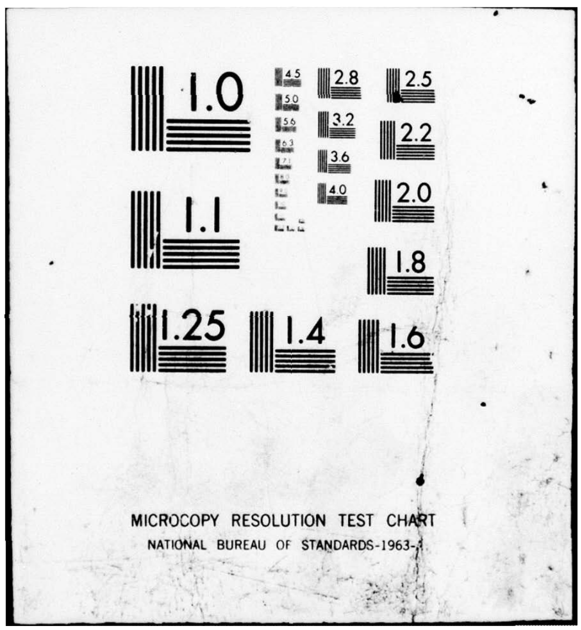
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FOREIGN TECHNOLOGY DIVISION

AIR FORCE SYSTEMS COMMAND

DEVICE FOR THE ANALYSIS-FREE DIAGNOSTICS OF DEFECTS OF KINEMATICALLY CONNECTED ROTATING PARTS

By

V.P. Maksimov, V.A. Karasev and B.P. Solov'yev

FOREIGN TECHNOLOGY DIVISION

EDITED TRANSLATION

FTD-ID(RS)T-1318-78 31 August 1978

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English pages: 4

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U. S. BOARD ON GEOGRAPHIC NAMES TRANSLITERATION SYSTEM

Block	Italic	Transliteration	Block	Italic	Transliteration
А а	*А а*	A, a	Р р	*Р р*	R, r
Б б	*Б б*	B, b	С с	*С с*	S, s
В в	*В в*	V, v	Т т	*Т т*	T, t
Г г	*Г г*	G, g	У у	*У у*	U, u
Д д	*Д д*	D, d	Ф ф	*Ф ф*	F, f
Е е	*Е е*	Ye, ye; E, e*	Х х	*Х х*	Kh, kh
Ж ж	*Ж ж*	Zh, zh	Ц ц	*Ц ц*	Ts, ts
З з	*З з*	Z, z	Ч ч	*Ч ч*	Ch, ch
И и	*И и*	I, i	Ш ш	*Ш ш*	Sh, sh
Й й	*Й й*	Y, y	Щ щ	*Щ щ*	Shch, shch
К к	*К к*	K, k	Ъ ъ	*Ъ ъ*	"
Л л	*Л л*	L, l	Ы ы	*Ы ы*	Y, y
М м	*М м*	M, m	Ь ь	*Ь ь*	'
Н н	*Н н*	N, n	Э э	*Э э*	E, e
О о	*О о*	O, o	Ю ю	*Ю ю*	Yu, yu
П п	*П п*	P, p	Я я	*Я я*	Ya, ya

*ye initially, after vowels, and after ъ, ь; e elsewhere.
When written as ё in Russian, transliterate as yё or ё.

RUSSIAN AND ENGLISH TRIGONOMETRIC FUNCTIONS

Russian	English	Russian	English	Russian	English
sin	sin	sh	sinh	arc sh	$\sinh^{-1}$
cos	cos	ch	cosh	arc ch	$\cosh^{-1}$
tg	tan	th	tanh	arc th	$\tanh^{-1}$
ctg	cot	cth	coth	arc cth	$\coth^{-1}$
sec	sec	sch	sech	arc sch	sech^{-1}
cosec	csc	csch	csch	arc csch	csch^{-1}

Russian	English
rot	curl
lg	log

DEVICE FOR THE ANALYSIS-FREE DIAGNOSTICS OF DEFECTS OF KINEMATICALLY CONNECTED ROTATING PARTS

V.P. Maksimov, V.A. Karasev and B.P. Solov'yev

The invention belongs to the field of analysis-free diagnostics of parts and assemblies of power plants, for example, gas-turbine engines.

Well-known are devices for the detection of defects of kinematically connected rotating parts with the automatic tuning to the measured frequency, and these contain a vibration sensor connected to the measuring and controlling channel with an analyzer and frequency comparison device.

A shortcoming of such a device is that the automatically tunable high-frequency oscillator, which is found in the controlling channel, possesses intrinsic instability which does not allow obtaining the necessary accuracy of measurements of the level at a frequency carrying information about the defect with fluctuations of revolutions of the rotor within ±0.2%.

The purpose of the invention is to create a device which allows detecting defects in the kinematically connected rotating parts with fluctuations of revolutions of the rotor within less than ±0.2%.

To do this, in the proposed device the analyzer is made in the form of a multi-stage frequency multiplier, the input of which is connected with a filter and the output with the frequency comparison device. Here the multiplication factor of the analyzer corresponds to the ratio of the differences of the measurable and intermediate frequencies to the frequency of the first rotor harmonics.

A block diagram of the proposed device is given on the drawing.

The device contains a vibration sensor 1, housing 2 of the engine to be inspected, remote cathode follower 3, filter 4 tuned to the measurable frequency, filter 5 tuned to the first rotor frequency of vibrations of the housing, balanced mixer 6, frequency multipliers 7-9, filter 10 tuned to the intermediate frequency, detecter with an averager 11, and needle indicator 12.

The vibration sensor 1 is installed onto the housing 2 of the engine to be inspected. A signal is fed from the vibration sensor through the remote cathode follower 3 to the measuring and controlling channels of the device. Included at the input of the measuring channel is the narrow-band filter 4 tuned to the frequency of the measurable signal. This filter is intended for the removal (attentuation) of combination frequencies not containing information about the part to be diagnosed.

The narrow-band filter 5 tuned to the first rotor harmonic f_p is installed at the input of the controlling channel. The passband of this or another filter is selected so that there would be no noticeable changes in the amplitude of the measurable signal with fluctuations of revolutions of the rotor within $\pm 0.5\%$ of the established rating. Installed at the output of the filter 5 are series-connected frequency multipliers 7-9. The general multiplication factor of the frequency is selected from the calculation

$$k = \frac{f_c - f_{np}}{f_p},$$

where f_{np} is the intermediate frequency the value of which must be within 3-4 f_p,

f_c - frequency of the measurable signal,

f_p - frequency of the first rotor harmonic.

The frequency of the last stage of the frequency multiplier is $f_r = kf_p$. The measurable signal with frequency f_c and signal with frequency f_r of the last stage ofthe frequency multiplier proceed to the balanced mixer 6. Installed at the ouput of the mixer is the narrow-band filter 10, which is tuned to the intermediate frequency

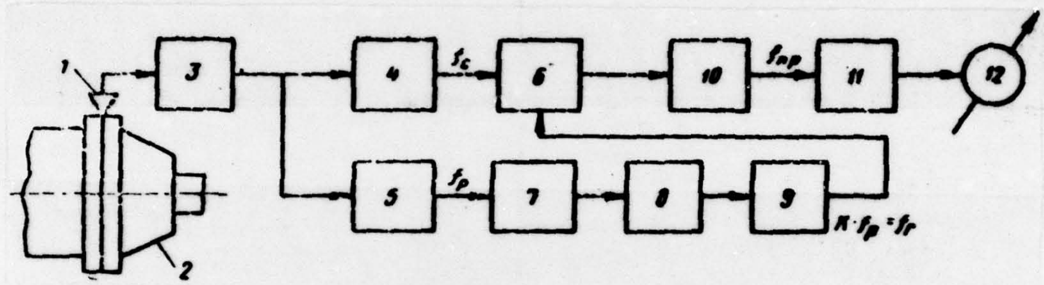
$$f_{пр} = f_c - kf_p.$$

The signal is fed from this filter through the detector with the averager 11 to the needle indicator 12.

In the proposed device the error in measurement depends only on fluctuations in revolutions of the rotor, which, in turn, leads to a certain change in the sensitivity owing to the non-uniformity of the frequency characteristics of the filter 4, which is tuned to the measurable frequency f_c, and filter 10, which is tuned to the intermediate frequency. The dependences between the intensity of vibrations of the housing at frequency f_c and the state of the part being diagnosed or the controllable parameter are determined experimentally on the basis of the analysis and comparison of spectrograms of vibrations of engines found in a normal technical state and engines with deviations from the normal state.

Object of the invention

The object of the invention is to create a device for the analysis-free diagnostics of defects of kinematically connected rotating parts with automatic tuning to the measurable frequency. This device contains a vibration sensor which is connected to the measuring and controlling channels with an analyzer and a frequency comparison device. The device is distinguished in that for the purpose of increasing the accuracy of the diagnostics of the defects and simplification of the design, in it the analyzer is made in the form of a multichannel frequency multiplier, and here the amplification factor of the analyzer corresponds to the ratio of differences in the measurable and intermediate frequencies to the frequency of the first rotor harmonic.



Figure