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MEASUREMENT THE TORSIONAL MOMENT AND RANDOM PARAMETERS IN INDUSTRIAL CONDITIONS BY SPECIFIC INSTRUMENTS

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Abstract – Contemporary intensive development of technology puts ever-increasing demands on the reliability of products. The increase in the reliability level is emphasised also in transport machines and equipments. This all requires a further improvement of the method of designing and strength checking of a construction.

A practical example of loading system analysis in presented which demonstrates use the special instrument to measurement of distribution the force and torsion moment in cardan-joint for control purposes and uses the special instrument to generally measurement of distribution random loading parameter.

Keywords: Torsion moment, specific measuring instrument, transport machines.

1.THE WAYS HOW TO REACH THE SOLUTION GOALS

1.1 Measurement of torsion moment

The use of loading date from rotating machinery to determine machine health has a long history.
It is intended to show how to get and interpret good results from analyses, with particular reference to points, which arise in transmission systems, applications.

Two major difficulties occur in performing this system:
- since the values of forces and moments cannot be directly measured, they are inferred from strain measuring of the cardan-joint, foil strain gauges are used,
- however they are only the pure data in a research laboratory, and it would be very interesting to compare them with the data obtained on actual mobile machine wheel-type tractor.

The outward appearance of the load cell which is designed for specific measuring of the pure cardan-joint characteristic, as shown in Fig. 1.

The load cells are installed on the cardan-joint for measuring the timing values of torsion moment. They are also installed on the cardan-joint
of the axle caster, as well as, of the axle casing for measuring the timing values of exit torsion moment.

The signals generated from the load cells are put into the digital data memory mounted in the laboratory or e.g. in the wheel-type of tractor. The signal will be subject to interference correction, operation and co-ordinate conversion and will be put into memory. We have obtained satisfactory data from the experimental carried out with a special note on maximum force and torsion moment.

We think it would be quite interesting to carry out analysis of wheel-type of tractor movements with four load cells installed in each of the cardan-joint.

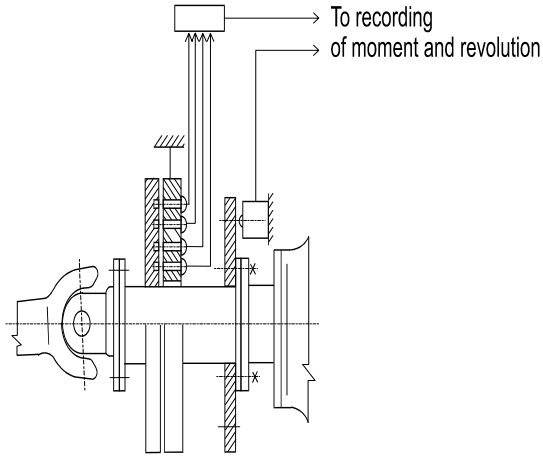

Fig. 1 Schematic drawing of specific measuring instrument

They are found from this experiment, that the load cells and the digital data memory combines to provide very useful data to promote the performance of the wheel-type tractor and the gearing system, and will contribute greatly to the development of new products of mobile machine and gearing system.

The districted torsion moment parameters by measuring instrument as for the timing values of exit torsion moment are shown in Fig. 2.

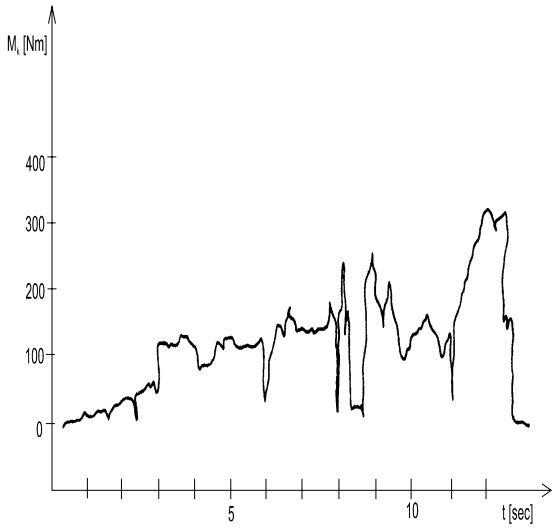

Fig. 2 Drawing distributed exit torsion moment for the timing values

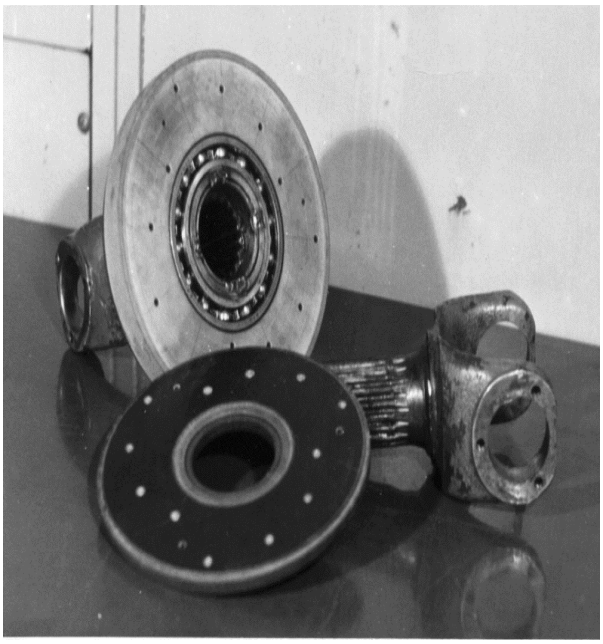

Fig. 4 The detail view on the specific measuring instrument

The detail view on the specific measuring instrument is shown in Fig. 3 and Fig. 4.

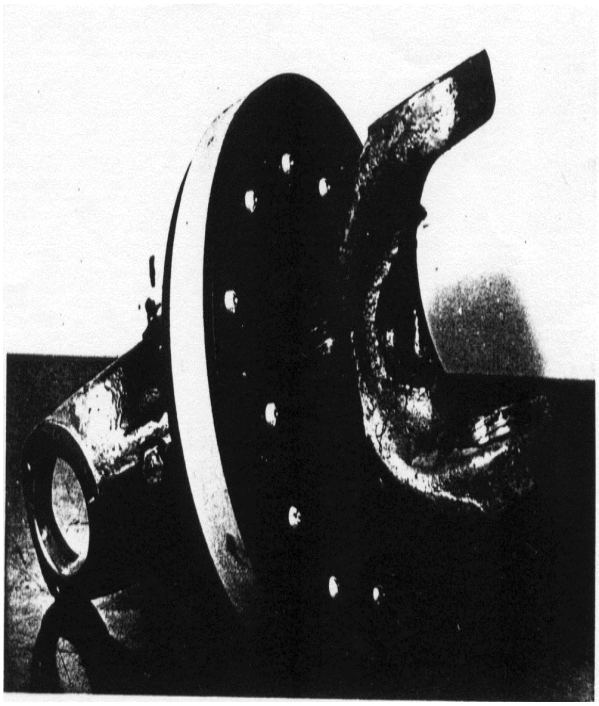

Fig. 3 The general view on the specific measuring instrument

1.2 Measurement random parameters

The principle measurement of random signals is make by the special measuring instrument.

Fig. 5 The general view on the specific measuring instrument

The substance of construction makes up the mechanical gauge connected with the indicator. The instrument works together with photocell, which take effect to star of the recording equipment. The instrument can be installed on the critical points of the construction, as shown in Fig. 5.

Long-time tests can be running independently from climatic conditions. Very valuable results of experimental tests of the construction make for recording of signals of random loads under long-time operating state to render possible the special measuring instrument.

The detail views on the specific measuring instrument are shown in Fig.6.

Fig. 6 The view of the special measuring instrument

2. ANALYSIS AND SOLUTION

The signal of response may be analysed by statistical characteristic of stochastic function.

The output data expressing one of the statistical characteristic of loading in a graphical way.

The dependence between random loads and life, N_f , of components must be completed by a variable, $R(N_f)$, which expresses digital guarantee in the probability form.

Parameter distribution may be expressed as

$$R(N_f) = \exp. -(N_f - N_{min} / N_{sig} - N_{min})^k \qquad (1)$$

where: N_{min} is a minimum of the longevity,

N_{sig} is a modal value of the longevity,

k is a parameter of distribution

The determination of the parameters of this distribution are achieved by the moments of function numerically

Results of the measurement of torsion moment have expressed the statistical curve , as shown in Fig. 7.

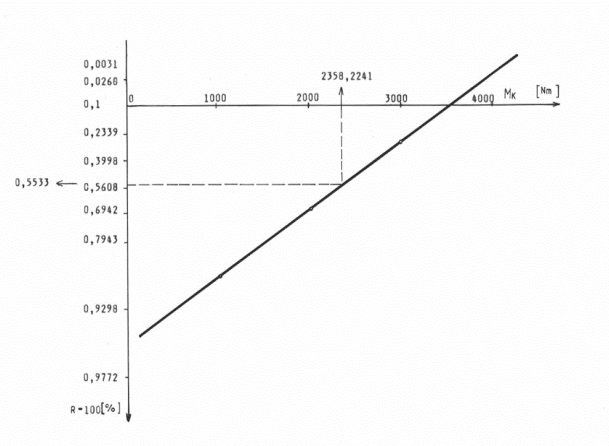

Fig. 7 Statistical curve for wheel-type tractor

The output data expressing one of the statistical characteristics of loading in a graphical way can be seen in Fig.6. It is a dependence of the reliability estimation expressed by means of the function of failure-free probability for the particular testing system.

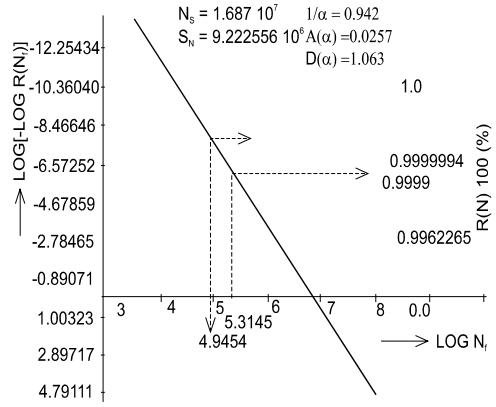

Fig. 6. The graphical function of failure-free probability

The determination of the parameters k, N_{min} , N_{sig}, are achieved by the moments numerically.
Common value of n-th moment for variables

$$(N_f - N_{min}) / (N_{sig} - N_{min}) \text{ is: } \quad m_n = \Gamma (1 + n/k)$$

The coefficient of obliquity is definite with second and third central moment:

$$m_3 / (m_2)^{3/2} = [\Gamma (1 + 3/k) - 3\Gamma (1 + 2/k) .\Gamma (1 + 1/k) + + \Gamma^3 (1 + 1/k)] / [(\Gamma (1 + 2/k) - - \Gamma^2 (1 + 1/k))]^{3/2} \quad (2)$$

With parameters of distribution, we may define the result by the statistical curve of longevity, which in a form of probability characterised the longevity form Eq.(1) :

$$\ln (-\ln R (N_f)) = k [\ln (N_f - a) - \ln b + \ln \ln e] \quad (3)$$

The determination of the parameters of this distribution is achieved by the moments of function numerically.

3. CONCLUSION

The applications of these methods, which this paper will be showed, have been made upon the special-purpose machine in a laboratory and in industrial conditions directly.

This system control has been conceived independently of climatic conditions.

Conditions can be exactly reproduced to compare and to evaluate new designs or redesigns and good approximation to system control was expected and achieved.

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