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Experimental Stress Analysis

BEARING TRANSDUCER

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Abstract: The paper is devoted to the issues related to several quantity measurements with use of forces measured directly in the bearings of machine components of various technological equipment, such as e.g. belt conveyors, strips rolling mills, etc. It is often necessary to measure in such equipment tension in strips and if it is impossible to install and use commercially available or specially manufactured load gauge transducers, the bearing transducers appear to be a suitable solution. The paper describes shortly an engineering design and method of calibration of one prototype of bearing transducer.

1. Introduction

A necessity of designing the transducer of this type arose on the basis of the requirement for measurement of overall tension and its non-uniformity along the width of the rolled strip on the reversing rolling stand. On the output side of the rolling stand it was possible to perform measurement with use of special bending load gauge transducers [1], however, on the input side of the stand the only possibility of tension measurement in the strip enabled by construction of the stand was via measurement of forces in the coiler bearings. This had initiated designing and manufacture of a prototype of the bearing transducer and searching of an appropriate method of its calibration.

2. Bearing Transducer

2.1. Engineering design of transducer

Engineering design of the bearing transducer prototype is shown in the Fig. 1. The transducer is based on the mass produced roller bearing NU 320, position 1, the inner ring of which has been replaced with a special measurement ring 2. Figure 2 shows a detailed working drawing of the measurement ring. It contains two circular holes, to which complete strain gauge bridges for measurement of weighting forces of the bearing are glued to. Power supply of strain gauge bridges and output signal from them are ensured via the cable connected to the strain gauge evaluation unit.

2.2. Transducer calibration

It was necessary to calibrate the manufactured prototype of the bearing transducer. A special loading device (see Fig. 3) was designed and manufactured for this purpose. The bearing transducer 1 is put on the axis, which is inserted into circular holes of the weighting frame. The transducer is being loaded via the strip 2, which is stretched by the weight at the end of the lever 3. The lever is balanced by a counterweight.

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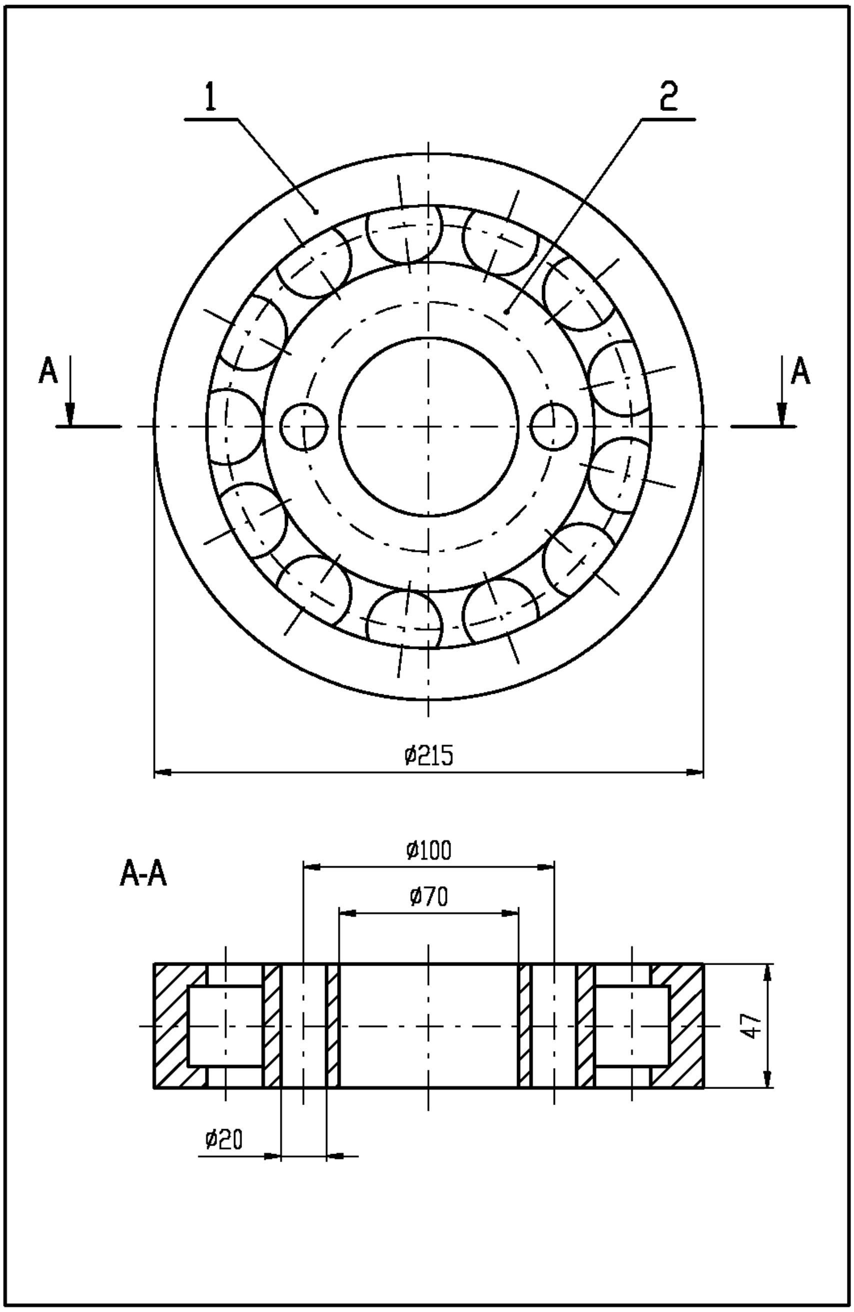

Figure 1: *Bearing transducer of cylindrical bearing NU 320*

It is obvious that magnitude of the output signal from the strain gauge bridges of the inner ring of transducer will depend on position of the bearing rollers in respect to the circular holes of the inner ring. That's why we have realised measurement of output signals while slightly turning of the outer ring of the bearing till two consecutive bearing rollers got to the position above the hole in the inner ring. The measurement was realised at a constant loading force of 4905 N, which corresponds to a weight of 50 kg at the end of the lever. Results of measurement are summarised in the Table 1 and plotted in the Fig. 4. At the same time the measurements were made at turning of the bearing outer ring at the moment, when each of thirteen bearing rollers was above the hole of the inner ring with strain gauges and when the output signal achieved the maximum value.

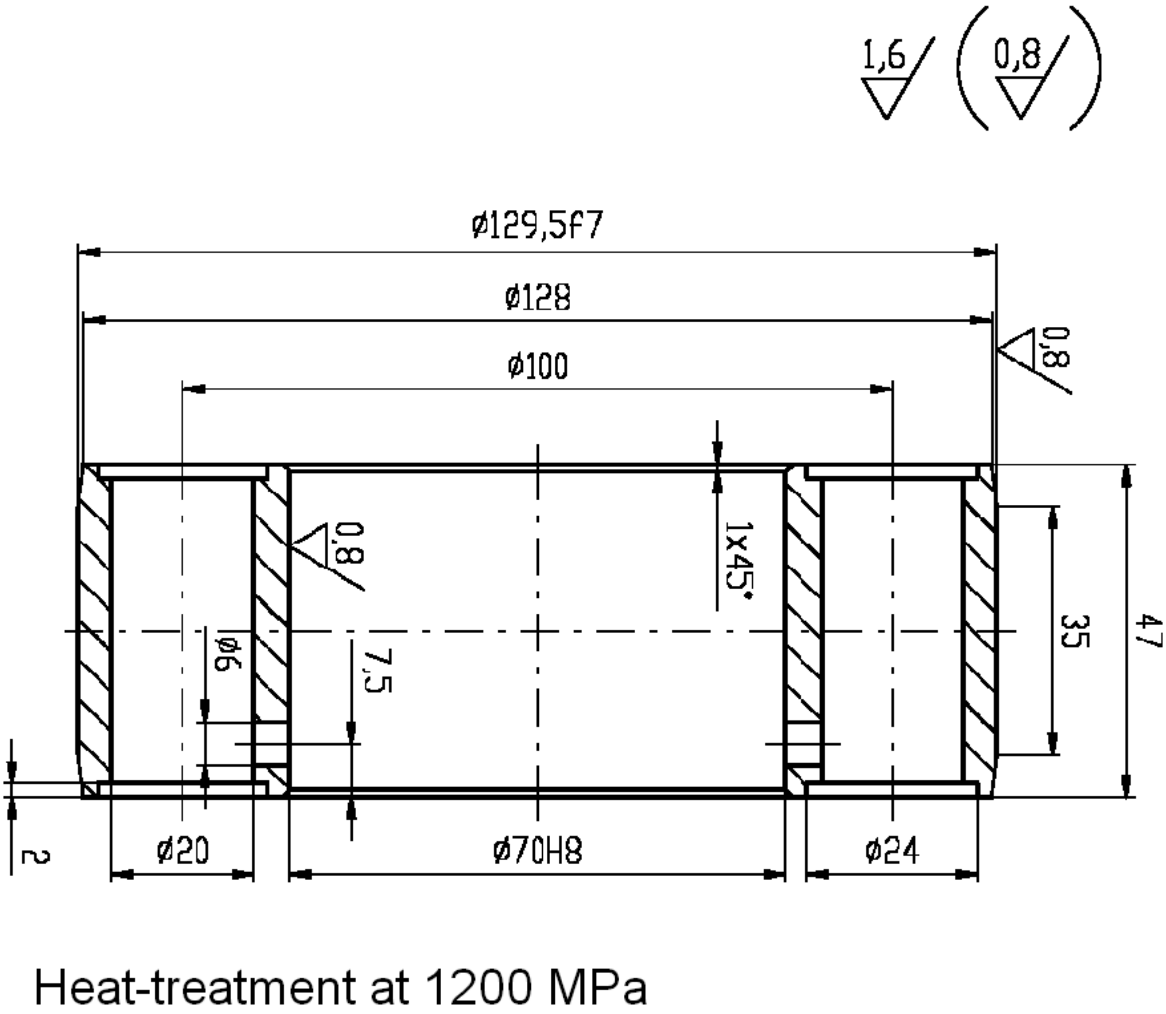

Figure 2: *Measuring element of bearing transducer*

Results of these measurements are given in the Table 2, a mean value of 217.5 μS corresponds to the measured results. Similarly realised measurements at various values of load have served as a basis for calibration of the bearing transducer of this type. At the measurement itself the measured maxima are evaluated from the record and appropriate weighting forces or tensions in the strip are assigned to them.

3. Conclusion

The paper describes shortly an engineering design of the bearing transducer and manner of its calibration. The bearing transducer can be advantageously used in case that there is no space available for situating of classical strain gauge transducers. It can be easily installed into already existing or newly designed machine parts of production equipment at very low initial costs.

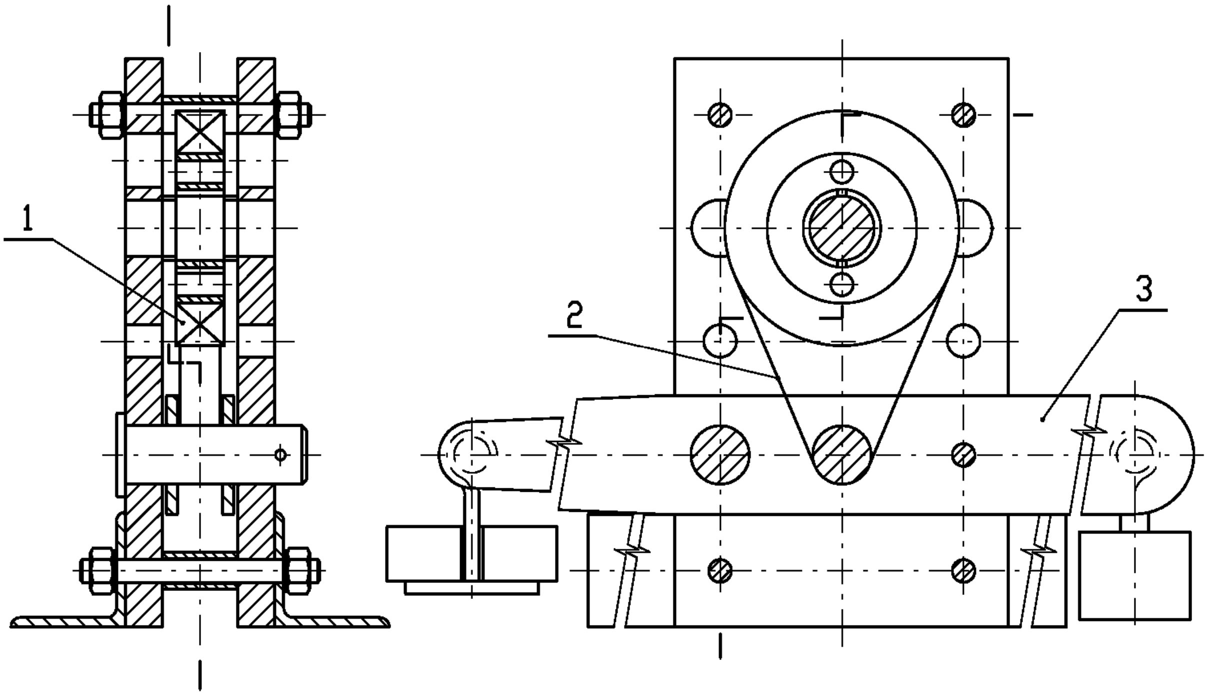

Figure 3: *Loading equipment for bearing transducer calibration*

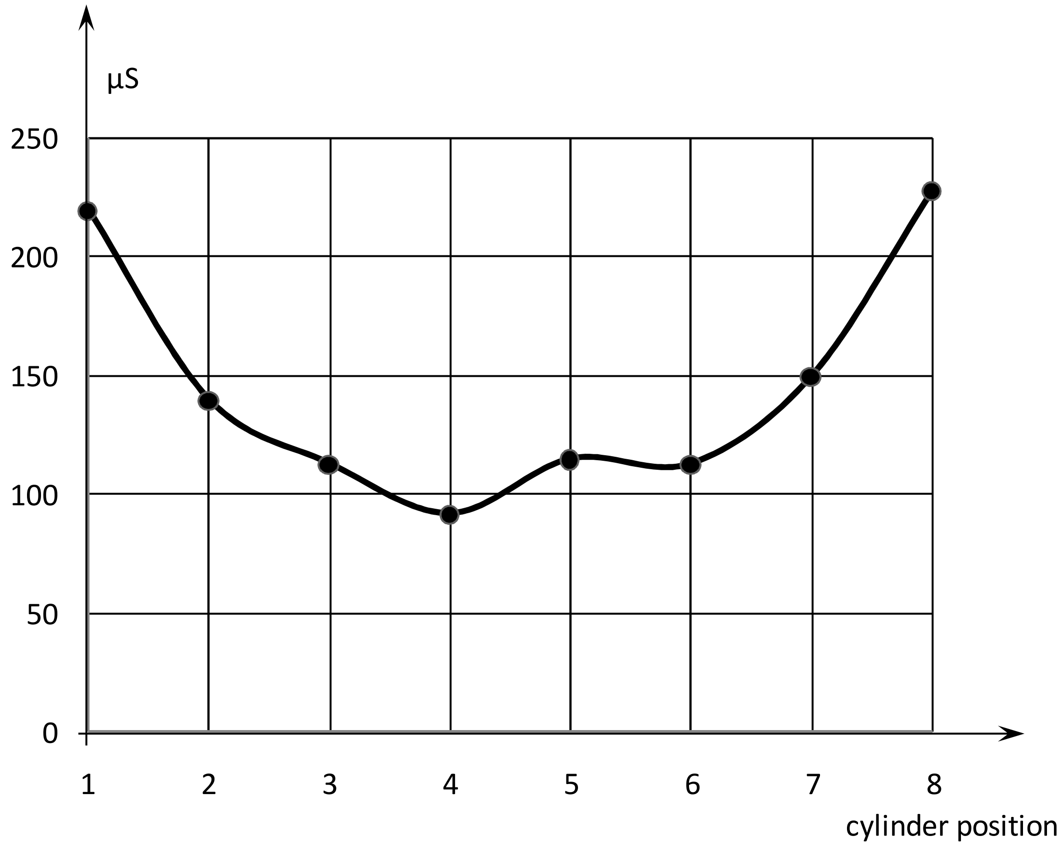

Figure 4: *Output signal in dependence on bearing cylinder position*

Table 1: *Output signal in dependence on bearing cylinder position*

Cylinder position	1	2	3	4	5	6	7	8
Output signal [µS]	220	140	113	92	115	113	150	228

Table 1: *Output signal in dependence on each bearing cylinder*

Cylinder number	1	2	3	4	5	6	7	8	9	10	11	12	13
Output signal [µS]	220	228	212	207	219	225	202	228	205	219	222	217	224

References

[1] Macura, P.; Fiala, A.: The measurement of forces and tensions at strip rolling, *Proceedings of Engineering Mechanics 2005*, Fuis, V., pp. 209-210, ISBN 80-85918-93-5, Svratka, May 2005, Institute of Thermomechanics ČSAV, Brno, 2005.