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CONSIDERATIONS ON THE STUDY OF DYNAMIC ABSORBER

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Abstract: The paper presents a study of torsional vibration reduction using dynamic absorber. It accomplishes both static balancing and the dynamics. It is compare the results obtained. This study will continue with the mathematical model which will be presented later.
Keywords: torsional vibrations, engine, unbalance, static balancing, dynamic balancing.

1. INTRODUCTION

The paper studies the reduction of the torsional vibrations in a four-storke engine with four aligned cylinders, which is situated on a trial stand.

According to the causes leading to the unbalance, there are two types of balancing: static and dynamic balancing.

The dynamic balancing removes all traces of the unbalance produced by the centrifugal force which occurs due to the fact that the main insertion axis is not parallel to the rotational axis but rather intersecting it and the load centre of the piece and its parts does not coincide with its rotational axis. In this case, the balancing is done in two perpendicular planes on the rotational axis by adding counterweights at the two ends.

Static balancing removes the unbalance produced by the centrifugal force that appears because the main inertial axis is parallel to the rotation axis and the axial mechanical moment of inertia modifies its value about the rotation axis. In this case, balancing is done only in the perpendicular plane of the rotation axis by adding counterweights to one of the ends. Balancing is the method which verifies and corrects the mass distribution of a rotor so that the vibration of the fissures in support and/or the forces in the ties to be within the recommended limits for a speed corresponding to the working speed.

The experiment is performed on a In order to be able to calculate the torsion vibrations of such a complex elastic system, the prerequisite is that this should be changed into a simpler equivalent dynamic system, composed of a rectilinear elastic shaft of a negligible mass loaded with reduced circular masses.

2. DYNAMIC BALANCING

The mechanical system is formed from the engine crankshaft together with its mobile parts (pistons, segments, vaults, rods, and linings), flywheel and one of the balances mass mounted on the flywheel – the mass which represents the dynamic absorber. The corresponding mechanical system is the one composed of five reduced masses m_v, m_1, m_2, m_3, m_4, m_v which receives a dynamc absorber represented in figure 1.

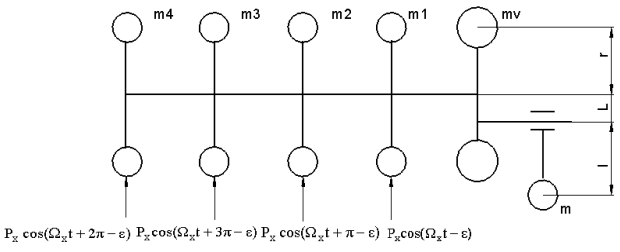

Fig. 1 Mechanical system

The dynamic absorber is replaced by an equivalent dynamic system formed of the reduced mass m_5 and the elastic shaft of a neglijible mass with an elastic constant c_{v5}.

Mass m_1 is considered reduced mass associated with the first cylinder, the mass m_2 is the reduced mass corresponding cylinder 2, m_3 is the reduced mass corresponding cylinder 3, m_4 is the reduced mass corresponding cylinder 4, m_v is the reduced mass corresponding flywheel and m_5 is the reduced mass corresponding dynamic absorber (figure 1).

The mechanical system was established starting from the following simplifying hypothese: the angular speed is constant – in reality the angular speed varies.

The following steps are performed:

-it chooses the balancing program - the program chosen for the balancing is called IMPAQ and the instrument is BENSTONE. The balancing method chosen is the dynamic balancing using two planes;

- it sets the type of sensors;

- it sets the balancing clearance according to ISO 1940, starting the dynamic balancing in the two planes (fig. 2, fig. 3) and corection of the rotor.

The rotor is spinned and measurements are performed. Plane P1 has 12 threaded reamings at M6, and plane P2 has 24 threaded reamings at M6. Plane P1 was mounted masses on reaming 1 and 2 and plane P2 was mounted masses on reaming 4 and 5, according to the suggestions of the software.

3. VIBRATION MEASUREMENTS

The vibrations are measured in three different cases: unbalanced engine, statically balanced engine and dynamically balanced engine.

The vibration measurements are done in five points on the engine block (figure 2) were done using the SVAN 958.

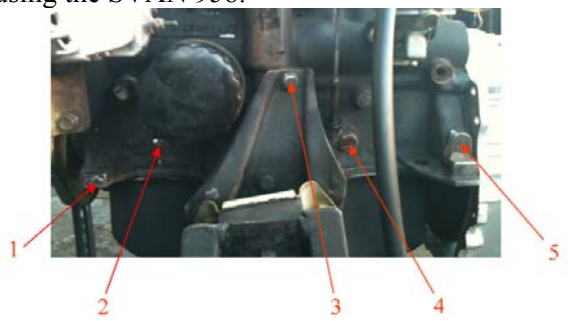

Fig.2 The points in which measurements were performed

The experiment records the RMS accelerations in all the five points taken into account for each of the three cases.

The figures 3, 4, 5, 6 and 7 represent the graphics for these accelerations. The measurements are done at an engine rotation of 1650 rot./min before and after a dynamic balancing.

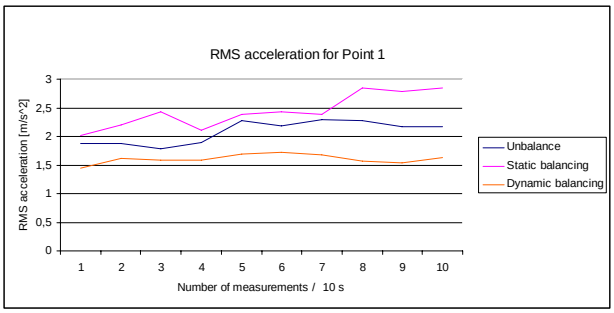

Fig. 3 The RMS acceleration for recording Point 1

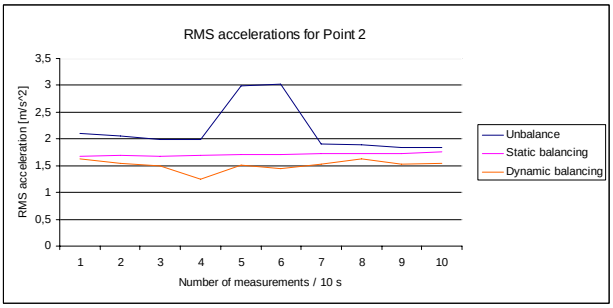

Fig. 4 The RMS acceleration for recording Point 2

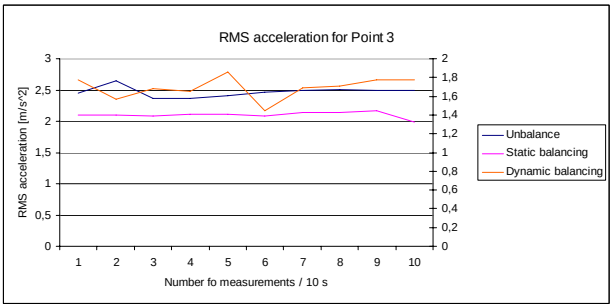

Fig. 5 The RMS acceleration for recording Point 3

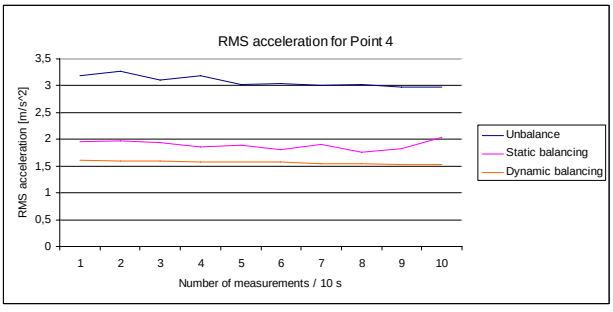

Fig. 6 The RMS acceleration for recording Point 4

The graphic shows that, the RMS acceleration values are lower than the ones recorded for the unbalanced shaft.

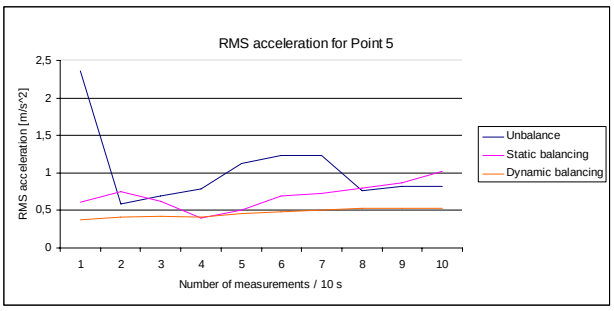

Fig. 7 The RMS acceleration for recording Point 5

The measurements show that, by assimilating one of the balancing masses with the dynamic absorber, the dynamic balancing leads to a lower vibration level.

The analysis of this data shows that the dynamic balancing offers better results than the static one.

4. CONCLUSIONS

The reason for the balancing – the causes which produced the unbalance: the symmetry axis of the two masses does not coincide with the rotation axis and the inertial mechanical moment is variable during the rotation of the crankshaft.

The conclusion of the paper is that the pendulum dynamic absorber does not introduce a new resonance phenomenon.

The measurements show that the dynamic balancing, by regarding one of the balancing masses as a dynamic absorber, minimizes the effect of the vibrations transmitted to the engine shaft.

In a future paper will be presented the mathematical model and results of mathematical modelling.

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CONSIDERAȚII ASUPRA STUDIULUI ABSORBITORULUI DINAMIC

Rezumat: Lucrarea prezintă un studiu de reducere a vibrațiilor de torsiune utilizând absorbitori dinamici. Se realizeaza atât echilibrarea statica cât şi cea dinamică. Se compară rezultatele obținute. Acest studiu va continua cu modelul matematic care va fi prezentat ulterior.

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