Pneumatic Suspension of the Forging Hammer

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Abstract. During the forging process, the significant impact forces from working parts of a power forging hammer appear. Usually, forging hammers are tightly connected to the ground or use standard suspension systems based on, e.g. wooden beams. Then the impact forces may be easily transmitted to the ground of a building. These transmitted forces may negatively affect the construction of the building. The paper proposes one possible solution to a suspension system based on pneumatic springs and telescopic hydraulic dampers. The proposed suspension system uses a base block tightly connected to the forging hammer. The efficiency of this solution is evaluated through vibrations measured on the machine with pneumatic suspension and the ground and then compared with vibrations measured on the forging hammer tightly connected to the ground. In the case of the pneumatically suspended forging hammer, evaluated RMS of measured values showed a significant decrease of transmitted vibrations to the ground. Vibrations decreased to a level of 2%.

Keywords: Pneumatic Suspension · Vibroisolation · Power Forging Hammer

1 Introduction

The paper evaluates the benefit of pneumatic suspension of the power forging hammer (see Fig. 1), respecting the vibrations measured on the machine and the ground during the operation [1, 2]. Also, vibrations from the suspended forging hammer are compared with vibrations from the forging hammer without pneumatic suspension, suspended according to the producer's recommendations. The aim of this study was to minimise vibrations transmitted from a working mechanism of the forging hammer to the ground.

2 Materials and Methods

The pneumatic forging hammer is specific for its great forces that may be transmitted, by using the standard suspension, to the ground and the construction of a building [3, 4].

A design of the power hammer contains a separated anvil that should be suspended, according to the producer, by oak beams in the space of the hammer ground. It might be noted that through this type of suspension, an impact force of the hammer is transmitted

J. Homišin et al. (Eds.): ICMD 2020, AHE 17, pp. 62–68, 2023.
https://doi.org/10.2991/978-94-6463-182-1_9

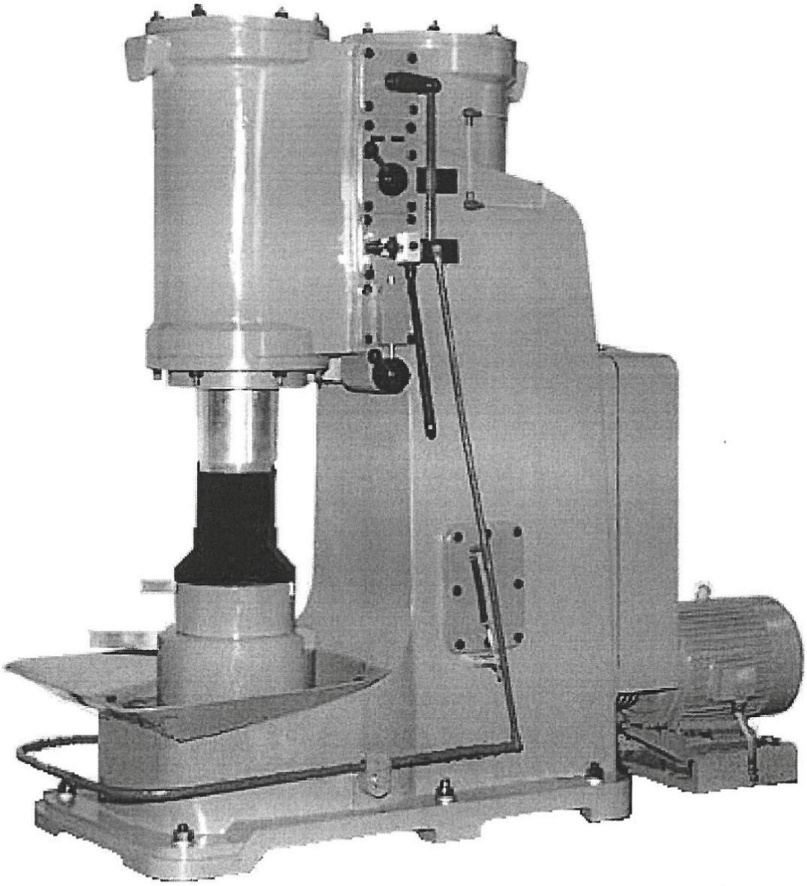

Fig. 1. The pneumatic forging hammer.

from a hammer to the anvil, oak beams and the ground of a forging building. The intensity of shocks is substantial (Fig. 2).

The pneumatic forging hammer is, from a dynamical point of view, a machine that is specific for great impact forces in the vertical direction and centrifugal forces from a driver mechanism in the horizontal direction.

The pneumatic suspension is based on a tight connection of the anvil with the frame of the forging hammer. The whole assembly is attached to the base block suspended by pneumatic and rubber springs (see Fig. 3). The purpose of the proposed design is to transmit impact forces to the frame of the forging hammer. The impact force is eliminated in the frame, and only inertia forces are transmitted to the ground of the building.

Considering two major exciting forces in the vertical and horizontal direction, different stiffnesses of elastic connections under the front and back parts of the forging hammer appear. The motion of the forging hammer during the operation is then mainly tilting in the vertical plane of symmetry. Tilting is damped by telescopic hydraulic dampers [5].

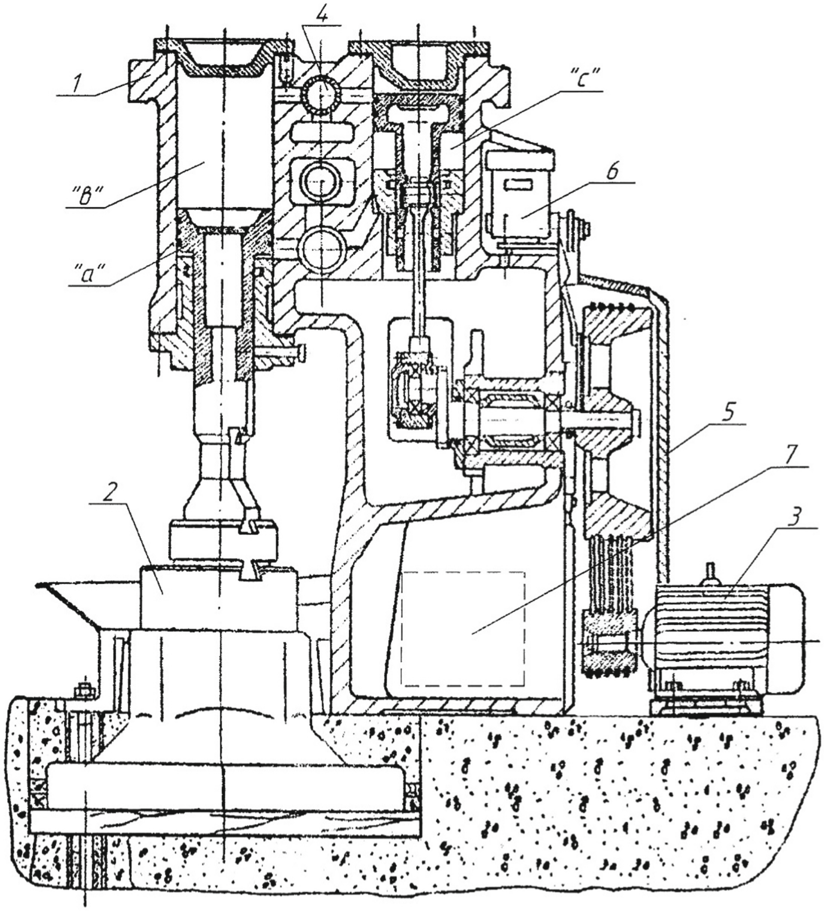

Fig. 2. The standard suspension of the power forging hammer.

3 Results and Discussion

Vibrations of the forging hammer with mounted pneumatic suspension and the ground were measured during the forging process (see Fig. 4).

An acceleration at chosen places of the forging hammer and the ground was measured. From measured data, the representative acceleration near the impact force of the hammer was used to evaluate the transmission of vibration [6–8].

Time graphs of acceleration measured on the machine and the ground are shown in Fig. 5. Comparing the data, a substantial effectivity of pneumatic suspension is visible.

The RMS (root mean square) may be evaluated through measured acceleration in the time domain (see Fig. 6). According to the RMS, the efficiency of pneumatic suspension may be quantified. Figure 7 shows that the pneumatic suspension decreases vibrations to the level of 2%.

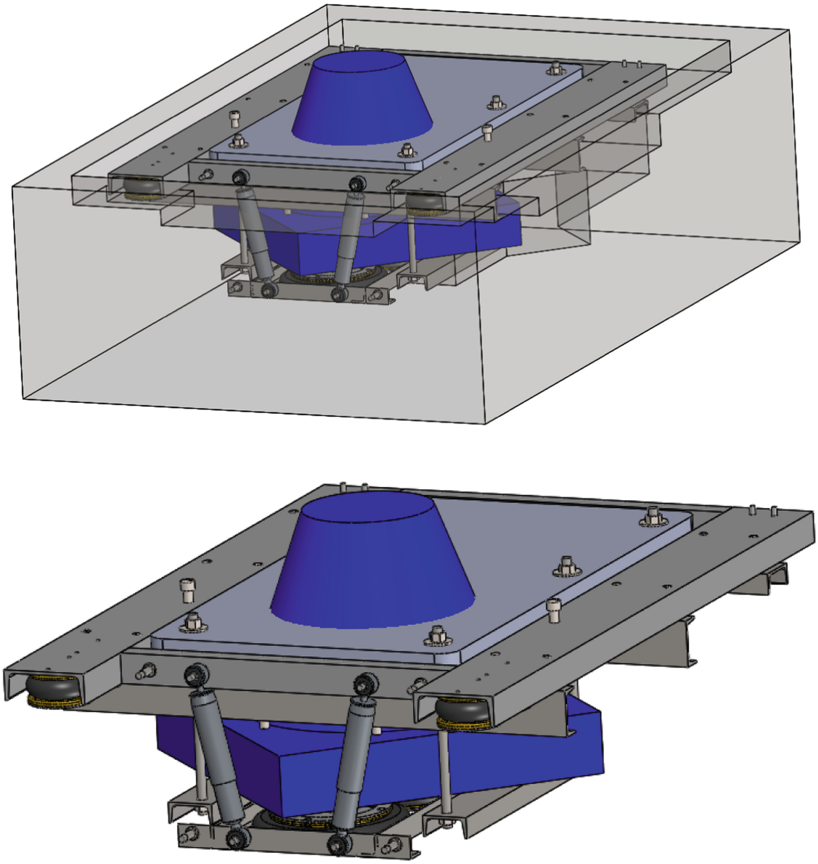

Fig. 3. The pneumatic suspension of forging hammer.

Vibrations of the forging hammer without pneumatic suspension were measured. The forging hammer is fixed to the ground through anchor bolts, then the vibrations measured on the machine can be considered as vibrations on the ground close to the machine (see Fig. 7). The level of these vibrations is substantial.

Results of vibrations measurement during the operation of the forging hammer showed significant transmission of vibrations to the ground by standard suspension realised according to the producer recommendation (Fig. 7). In the case of pneumatic suspension, vibrations transmitted to the ground decreased to 2% of the source value. The impact force of the pneumatically suspended forging hammer stayed at the original level, which is related to its behaviour. Impact forces originated by short-time contact of two bodies is not affected by their connection to the ground.

Fig. 4. The measurement of transmission vibrations to the ground.

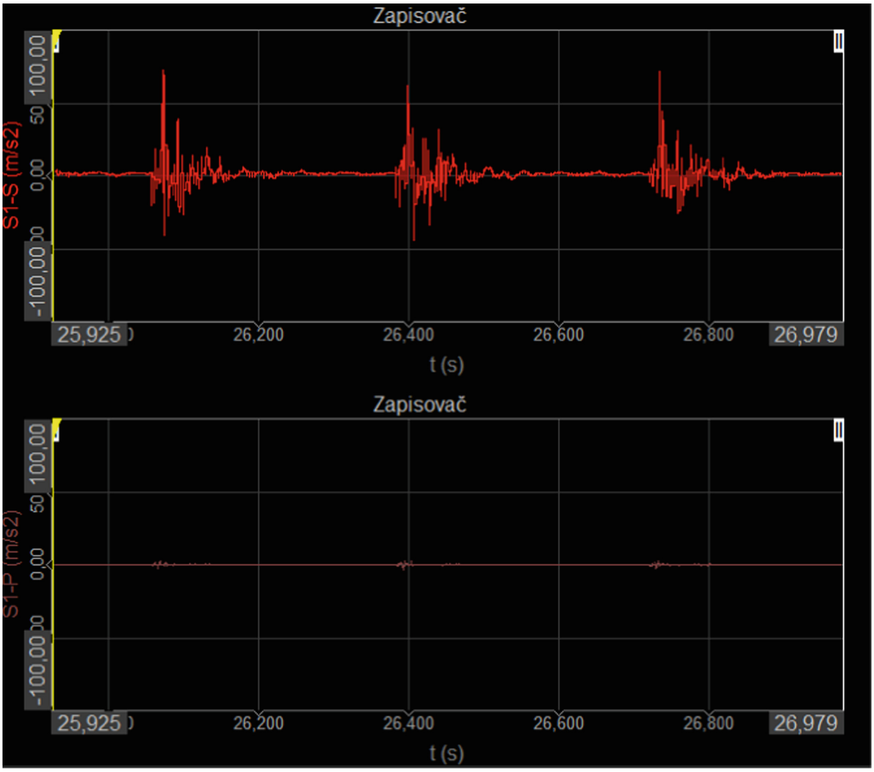

Fig. 5. Time graphs of acceleration measured on the machine (green) and the ground (orange).

Fig. 6. The RMS of vibrations on the machine (left) and the ground (right).

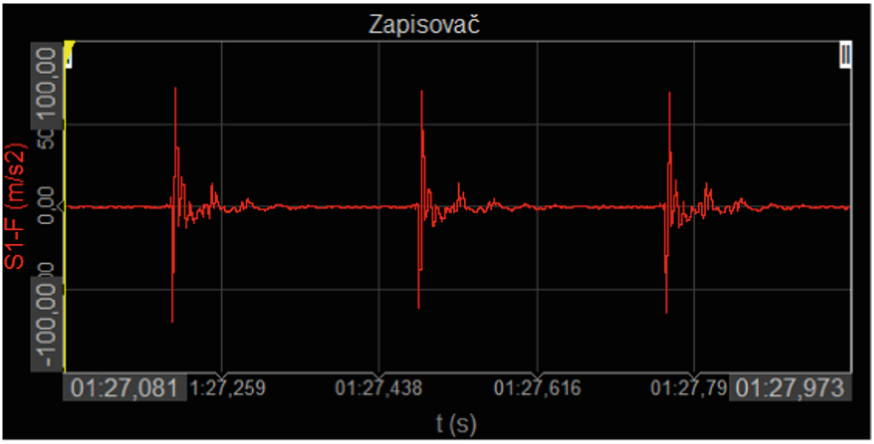

Fig. 7. Vibrations of forging hammer fixed to the ground.

4 Conclusions

The evaluation of pneumatic suspension of the power forging hammer proved its high efficiency for minimising transmitted vibrations and impact forces to the ground. Based on experiences, the proposed pneumatic suspension is profitable for its long service life and permanent dynamical behaviour that secures efficiency.

Acknowledgements. This work was supported by the Student Grant Competition of the Technical University of Liberec under project No. SGS-2019-5036.

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