INVESTIGATION OF VIBRATIONS OF VIBROINSULATED FOUNDATIONS OF FORGE PUNCH HAMMERS

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Below are presented results of an instrument investigation of vibrations of vibroinsulated foundations under forge punch hammers with weights of falling parts of 16 and 25 tons. Plans of the foundations were worked out by the TsNII Promzdanii with participation by the V. A. Kucherenko TsNIISK. The instrument investigation of vibrations of vibroinsulated foundations was conducted by the V. A. Kucherenko TsNIISK with the participations of G. L. Kedrov, E. M. Mironov, and V. A. Znamenskii.

Recordings of the vibrations of the foundation block made with a Geiger recorder are shown in Fig. 1. Vibrations recorded during the first settling blows are shown in Fig. 1a, those corresponding to the last, strong hardest blows of the falling parts of the hammer on the forging are shown in Fig. 1b, c. The graphs show serrations due to blows of the hammer on the foundation block resulting from its falling after rebound from the gasket. It is seen in Fig. 1 that prior to the blow the foundation block rises somewhat from its original position. This is explained by the fact that during the motion of the falling parts of the hammer their weight does not act on the foundation and that in addition the plate rises upward under the action of the pressure in the upper cylinder. In examining the curves of vibrations caused by the latter blows it can be noticed that during the time equal to the interval between hammer blows, vibrations of the foundation block practically completely cease. Thus during a series of blows each successive blow is applied when the vibrations of the foundation caused by the preceding blow have practically completely ceased and only displacements of foundation are observed which are due to the motion of falling parts of the hammer and to pressure of compressed air in the upper cylinder.

Vibrations of vibroinsulated foundations were measured under conditions of normal operation of punch hammers. Vibrations with the greatest amplitudes possible with the use of the given hammers were recorded. As a rule vibrations caused by the entire series of blows required to punch out a component were recorded. The Geiger recorder installed in the grillage registered relative displacements between the foundation block and the grillage. Vibrations of the grillage were registered by VÉGIK vibrographs.

A synchronous recording of vibrations of the foundation block and of the grillage showed that these vibrations are in phase and therefore the absolute displacement of the foundation block at any instant of time is equal to the sum of the relative displacement of the foundation block and of the absolute displacement of the grillage.

In the work of forge hammers there are observed recoils of the anvil from the gaskets which are explained by the fact that the deformation of the gasket caused by the blow of the falling parts of the hammer on the anvil is considerably greater than its static settling due to the weight of the anvil.

In an examination of forge hammers it was found that after blows of falling parts of the hammer, clearances of the order of 2-3 mm arise between the plate and the upper part of the anvil as well as between its individual parts.

Vertical vibrations of the grillage were recorded by the VÉGIK vibrographs with considerable distortions during the first half period because during impacts there arise eigenvibrations of the seismic pendulum of the vibrograph which are superimposed on the recorded vibrations. Because the attenuation of the seismic pendulum is quite large, distortions are observed practically only over a small time interval at the beginning of the record (Fig. 2). These recordings do not make it possible to judge directly the greatest


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settling of the grillage. A supplementary laboratory experiment was therefore conducted on a vibration system in which attenuation, frequency of eigenvibrations, and amplitude were the same as those of the grillage. Vibrations of this system (Fig. 3) were recorded simultaneously by the VÉGIK vibrograph and the Geiger recording apparatus. The latter recorded vibrations without any distortions. An analysis of the test data showed that by drawing an envelope it is possible to determine with a great degree of accuracy the actual value of the maximum amplitude which takes place during the first half period of vibrations.

Recordings of the displacement of the foundation block and of the grillage showed that their vibrations were in phase with a frequency of the basic tone.

Actually the vibroinsulated foundation has higher frequencies of eigenvibrations. However, these vibrations are so small that they cannot be determined from recordings of displacements. Yet the necessary information on vibrations with higher frequencies can be obtained from recordings of accelerations since vibrations with small amplitude but high frequency are readily detected on the accelerogram.

Recordings of accelerations of the foundation block and of falling parts of the hammer are given in Fig. 4. Because of the low sensitivity of the sensor the magnitude of the acceleration of the falling parts of the hammer cannot be determined from the accelerogram (Fig. 4d). It does, however, show well the qualitative picture of the phenomenon, i.e., the regularity of changes in acceleration of falling parts of the hammer during the time of their fall.

The experimental recordings of vibrations of the foundation block (see Fig. 1) and of the grillage (see Fig. 2) show that during the first half period of the basic tone of vibrations the recoil of the plate from the anvil and of the anvil from the gasket under the anvil practically cease. The system seems to quiet down and continues to produce vibrations of the basic tone only.

A comparison of amplitudes of vibrations of the foundation block according to the basic tone with theoretical diagrams shown in Fig. 5a, b made it possible to reveal the error arising in the case when the pliability of the gasket under the anvil which turned out to be equal to 3% is neglected.

The theoretical diagrams depicted in Fig. 5a, b similarly made it possible to reveal the error arising when the mass of the grillage is neglected, an error which proved to be insignificantly small.

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Fig. 1. Vibrations of the foundation block.

Fig. 2. Vibrations of the grillage.

Fig. 3. Vibrations of the grillage. With the VÉGIK vibrograph (a); with the Geiger apparatus (b).