EXPERIMENTAL STUDY OF THE STABILITY OF A ROD COMPRESSED BY A FOLLOWER FORCE

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Abstract

Full Text

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MECHANICS

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EXPERIMENTAL STUDY OF THE STABILITY OF A ROD COMPRESSED BY A FOLLOWER FORCE

(Presented by Academician B. P. Konstantinov, 14 VI 1965)

Numerous theoretical works have been devoted to the question of the stability of rods under the action of nonconservative forces ([1]). Below are reported the results of what is apparently the first experimental study of the phenomenon.

Fig. 1. Successive positions of the axis of the rod during oscillations (from a motion-picture record)

A horizontally positioned rod, fixed at one end, was loaded at the other end by a follower compressive force, which was produced by the outflow of a jet of compressed air from cylinders attached to this end of the rod. The weight of the cylinders was taken up by long sup—

···weights; moreover, the horizontal components of the tensions in the suspensions that arose during deflections and rotations of the end of the rod were balanced by means of a system of balancers. Thanks to this, the rod could oscillate practically in the absence of parasitic resistances.

The magnitude of the critical force proved to be approximately 6 times higher than the Euler force and close to the value obtained from the theoretical solution with allowance for the rotational inertia of the mass fixed at the end of the rod ([2]). Under a load below the critical value, the small oscillations arising in the rod did not grow. Under a load somewhat exceeding the critical value, oscillations arose with rapidly increasing amplitude. The latter were recorded on motion-picture film.

Fig. 2. Graph of the increase in displacements (1) and angles of rotation (2) of the end of the rod

Figure 2: Fig. 2. Graph of the increase in displacements (1) and angles of rotation (2) of the end of the rod

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Figure 1 presents a series of successive positions occupied by the rod during these oscillations. The direction of motion in each of the drawings is indicated by arrows. The increase in displacement of the center of the mass fixed at the end of the rod and in its angle of rotation is shown in Fig. 2. The experiment was stopped at the 71st sec, since the system reached rigid stops at the 65th–66th sec.

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2. Ya. G. Panovko, I. I. Gubanova, *Stability and Oscillations of Elastic Systems*, Nauka, 1964, pp. 77–84.

Note: Figure translations are in progress. See original paper for figures.