The Physics Experiments of Robert Wichard Pohl (1884–1976)

For decades, Robert Wichard Pohl taught his famous lectures of introductory physics in the old lecture hall of the Physics Institute at Goettingen University. These lectures became the foundation for three volumes entitled „Introduction into Physics". Now, using Professor Pohl's original instruments in the same lecture hall in which he taught, this set of videos captures his extraordinary ingenuity and once more brings to life Pohl's great experimental skills.

Dancing steel ball

Video title: Dancing steel ball

Signature: C 14842

Series title: The Physics Experiments of Robert Wichard Pohl (1884-1976)

Abstract: A steel ball is dropped onto a heavy steel plate. It collides elastically with the plate and rises back to almost its initial height, whereupon the motion repeats itself periodically, with an amplitude determined by the initial height. The total force acting on the ball is highly non-linear. Energy dissipation leads to a slow decrease of the mechanical energy, and thus of the amplitude, as the experiment progresses. At the same time, the frequency increases.

Source: Pohls Einführung in die Physik - Mechanik, Akustik und Wärmelehre. Lüders, Klaus; Pohl, Robert Otto (Hrsg.) 19. Aufl., 2005, Springer Berlin Heidelberg New York; p. 51

Key words: Mechanics, free fall, elastic collision, conservation of mechanical energy, amplitude-dependent frequency, non-linear forces, energy dissipation

Goal of the experiment: Demonstration of a periodic motion with non-linear forces, dependence of the period on the amplitude, and dissipation of mechanical energy.

Experimental setup: A steel ball is dropped onto a carefully levelled heavy steel plate. By releasing the ball magnetically, its initial velocity is minimized.

Experiment: The ball collides elastically with the plate and rises back to almost its initial height, whereupon the motion repeats itself periodically, with an amplitude determined by the initial height. This is nice to watch in shadow projection. Since the period is determined by the height from which the ball is dropped, the period is amplitude-dependent. The total force acting on the ball is highly nonlinear, consisting of the constant force of gravity together with the very large force exerted for a very short time during the collision. In the experiment, energy dissipation (heating of the steel and the air) leads to a slow decrease of the mechanical energy, and thus of the amplitude, as the experiment progresses. This, in turn leads to a decrease of the period of the dancing ball.

(Notice some discontinuity in the motion of the dancing ball, which is caused by the frequency with which the pictures are taken with the movie camera.)

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