EXPERIMENT PROCEDURE:

- **Determine the torsional coefficient D_r of the coupled spring.**
- **Determine the moment of inertia J as a function of the distance r of the added weights from the axis of rotation.**
- **Determine the moment of inertia J as a function of the value m of the added weights.**

1

OBJECTIVE

Determine the moment of inertia of a horizontal rod with additional weights attached.

SUMMARY

The moment of inertia of a body about its axis of rotation depends on the distribution of its weight in relation to the axis. This is to be investigated for the case of a horizontal rod to which two additional weights are attached symmetrically about the axis of rotation. The rod is coupled to a torsion spring, and its period of oscillation increases as its moment of inertia, which is determined by the additional weights and their distance from the axis, is raised.

REQUIRED APPARATUS

Quantity	Description	Number
1	Rotating System on Air Bed (230 V, 50/60 Hz) Rotating System on Air Bed (115 V, 50/60 Hz)	**1000782 or** **1000781**
1	Supplementary Kit for Rotating System on Air Bed	**1000783**
1	Laser Reflection Sensor	**1001034**
1	Digital Counter (230 V, 50/60 Hz) Digital Counter (115 V, 50/60 Hz)	**1001033 or** **1001032**

BASIC PRINCIPLES

The inertia of a rigid body that acts against a change of its rotational motion about a fixed axis is described by the moment of inertia J. It depends on the distribution of weight in relation to the axis of rotation. The greater the distance of a weight from the axis of rotation the greater also is the moment of inertia it causes.

In the experiment, this is investigated using the example of a rotating disc carrying a horizontal rod, to which two additional weights of mass m are attached symmetrically at a distance r from the axis of rotation. For this system the moment of inertia is:

(1) $$J = J_0 + 2 \cdot m \cdot r^2$$

J_0: moment of inertia without the additional weights.

If the rotating disc is coupled elastically by a coil spring to a rigid stand, the moment of inertia can be determined from the period of torsional oscillation of the disc about its rest position. The relationship is as follows:

(2) $$T = 2\pi \cdot \sqrt{\frac{J}{D_r}}$$

D_r : torsional coefficient of the coil spring.

Thus, the greater the moment of inertia J of the disc with the attached horizontal rod, as dependent on the mass m and the distance r, the longer the period of oscillation T.

EVALUATION

From (2) the following equation is derived to determine the moment of inertia:

$$J = D_r \cdot \frac{T^2}{4\pi^2}$$

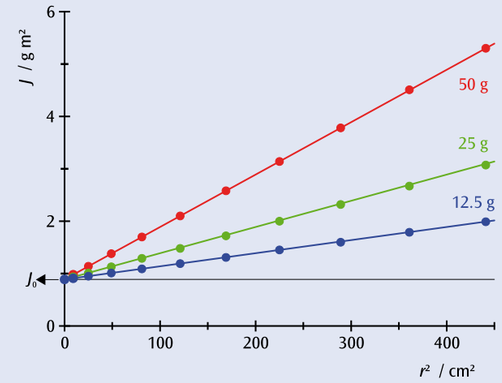

Fig. 1: Moment of inertia J of rotating disc with horizontal rod as a function of the square of the distance r from the axis of rotation for three different additional weights of mass m.