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Operating instructions



Fig. 1: Radiometer, Crookes type 06676-00

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2 PURPOSE AND CHARACTERISTIC

The Crookes radiometer 06676-00 (Fig. 1) serves to detect radiation in the infrared and visible regions of the spectrum. The explanation of its mode of action can be taken as confirmation of basic concepts of gas kinetics.

The Crookes radiometer consists of a glass vessel containing a fused-in winged cross with four mica plates, each blackened on one side (radiometer system) on a rotating shaft. All blackened surfaces point in the same direction of rotation. As the gas pressure inside the vessel is adjusted to about 10^{-2} mbar, the free path length of the gas molecules is of the order of $(\lambda) = 1$ cm.

3 FUNCTIONAL AND OPERATING ELEMENTS

We will first consider only the events occurring for a single wing of the radiometer. On average, just as many gas molecules impinge on its blackened surface as on its unblackened surface. 1. When the winged cross is illuminated with daylight, with a light-bulb, an Hg high pressure lamp or with a heat radiator, e.g. 04036-93, the blackened surfaces of the wings are warmed up more strongly than the unblackened surfaces, because of their higher absorption. A temperature drop within the wings, from the blackened to the unblackened side, therefore results. Because of this, the gas molecules which strike the blackened (warmer) surface will be reflected with greater speed (energy) than the molecules which strike the unblackened (colder) surface. As action and reaction are equal, the gas molecules exert a larger recoil effect on the blackened surface than on the unblackened surface. The sum of all the individual recoils generates the radiometer force. The direction of this force coincides with the direction of the temperature drop which is generated in the wings. The force exerted causes the winged cross to be kept in continual rotation.

1 SAFETY PRECAUTIONS



Caution

- Carefully read these operating instructions completely before operating this instrument. This is necessary to avoid damage to it, as well as for user-safety.
- Only use the instrument for the purpose for which it was designed.
- Protect the device from dust, moisture and vapours. Clean the device with a slightly damp, lint-free cloth. Harsh cleaning agents or solvents are unsuitable.
- Do not open the unit.

2. The significance of the temperature drop within the wings for the movement of the winged cross can be shown in the following way: Direct a convergent bundle of light from an Hg high pressure lamp onto the winged cross of the radiometers, so that in each case only an unblackened area of a wing is focussed on by the condensor. As scattered light at first causes a sufficient warming of the blackened areas, the winged cross initially rotates in the same direction as in the previous experiment. After a sufficient period of irradiation, however, the temperature of the blackened areas which are warmed by the scattered light, and the temperature of the directly illuminated, unblackened areas, become comparable and the rotation slows down. Now remove the source of radiation. The direction of rotation reverses. Not only the absorption, but also the emission of the blackened surfaces is greater than that of the unblackened surfaces (Kirchhoff's Law). The blackened surfaces therefore cool down more quickly, and a temperature drop from the unblackened to the blackened surfaces results. According to the observations made in the preliminary experiment, the direction of rotation must also therefore reverse. The movement is then again in the direction of the drop in temperature.

3. The reversal in the direction of rotation of the winged cross can also be attained by an intensive irradiation of the blackened areas. It only occurs, however, sometime after the source of radiation has been removed. The higher emission of the blackened areas must again be used to explain this occurrence. It results in a quicker cooling down of the blackened areas and so generates a temperature drop in the reverse direction.

4 TECHNICAL DATA

- Winged cross with 4 mica plates blackened on one side, on a rotating shaft in an evacuated glass vessel.
- Height: 210 mm.
- Diameter of sphere: 70 mm.

5 WASTE DISPOSAL

The packaging mainly consists of environmentally-friendly materials that should be returned to the local recycling stations.



Do not dispose of this product with normal household waste. If this unit needs to be disposed of, please return it to the address that is stated below for proper disposal.

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