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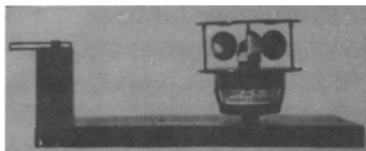
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A functional study of respiratory movements (determination of ventilation) includes the measurement of the strength of inhalation and exhalation, and their relationships. The strength depends on the power of the respiratory musculature, and is usually studied by means of a pneumomanometer or a pneumotaxometer.



Spirodynamometer – general appearance.

To determine the rate, and consequently the strength of the air stream during a maximally rapid inhalation, and also during the normal intake of breath, we used a cup-shaped anemometer, which was fixed to a stand 200 mm from the open end of a glass tube 80 mm in length and of 6 mm internal diameter; this tube was fixed exactly opposite the center of the anemometer cup, and at the same level. The glass tube was held in the stand by means of a spring clamp, so that it was readily replaced by another sterile tube for each subject. For patients with severely altered breathing movements, to determine the rate of

the air stream for a normal or for a maximally rapid inhalation, a second opening is provided which enables the anemometer to be fixed at a distance of 100 mm from the glass tube. For screening tests of physical-culture students, it is advisable to supply a third aperture which enables the anemometer to be fixed at a distance of 300 mm from the inner end of the glass tube.

The apparatus, which we have called a spirodynamometer, is shown in the figure.

Method of measurement. The external aperture of the glass tube of the spirodynamometer is placed level with the mouth of the subject. After a maximal inhalation, the breath is forced out as forcefully as possible through the

Subjects	Standing		Seated	
	velocity of air stream			
	maximal	normal	maximal	normal
Men	> 20 m/sec (II)	> 7 m/sec (II)	> 16 m/sec (II)	> 6 m/sec (II)
Women	> 15 m/sec (II)	> 5 m/sec (II)	> 12 m/sec (II)	> 5 m/sec (II)

Indications: Distance between the anemometer and the inner end of the glass tube are shown in Roman figures. I) 100 mm; II) 200 mm; and III) 300 mm

glass tube which is placed at 40 mm behind the outer edge of the stand. The maximum deviation of the pointer which indicates the magnitude of the maximal rate (force) of the air stream at exhalation is read from the scale placed 200 mm from the glass tube of the anemometer. When a deviation is produced corresponding to a velocity less than 5 m per second, the anemometer should be unscrewed and placed in the second opening 100 mm from the inner end of the glass tube, after which measurements may be continued. If the deviation corresponds to 25 m per second or more, which happens only rarely, the anemometer must be placed in the third position 300 mm from the inner end of the tube. The determination of the velocity (strength) of the air stream in a normal expiration is carried out in the second or 100 mm position.

It is advisable to carry out three successive measurements, though for scientific purposes, five are required; the maximum value of the maximum expiration is the value recorded, while for normal respiration, the mean is calculated.

Determination of the velocity of the air stream may be made while the subject is either seated or standing. The distance of the anemometer from the inner end of the glass tube may be I – 100 mm, II ~ 200 mm, or III – 300 mm.

Initial results. By determining the maximum and the normal rate of the air stream in the sitting and standing positions in 100 healthy subjects of various ages and professions, we have obtained the figures shown in the table.

Because these results were obtained on small numbers of subjects, they must be considered as preliminary.

Here we will note only that there is a tendency for larger values to be obtained in young people, sportsmen, and in people practising physical culture. In older people, smokers, and in people leading a sedentary life, there is a tendency to lower values.

The results obtained by means of the spirometer must always be interpreted in close connection with other external indications of respiratory movements, and the whole clinical picture must be taken into account.

SUMMARY

To investigate the normal and the maximal forced exhalation the use of cup anemometer is suggested. The instrument is attached at a definite distance from the tube through which the air is exhaled.