A STRAIN GAUGE FOR PHYSIOLOGICAL USE
A Preliminary Communication

BY

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This strain gauge has been developed for investigation into respiratory movements, particularly in neonates. It consists of a fine rubber tube filled with aqueous colloidal graphite. The dimensions of the rubber tube used are: bore $1\frac{1}{2}$ mm, wall thickness $\frac{1}{4}$ mm, and length 24 cm. The resistance of this assembly is 300,000 ohms. The electrodes consist of silver tubes, 2.4 mm ($1\frac{5}{8}$ inch) bore, 0.4 mm (1/64 inch) wall thickness and length 1.2 cm ($\frac{1}{4}$ inch), to which the rubber tubes are tightly tied. Electrical connection is provided by a small pin silver-soldered to the silver tube (fig. 1). Short lengths of rubber tube are fitted over the open ends of the electrodes prior to filling with colloidal graphite and sealed afterwards by clamping with small pieces of lead sheet. One should ensure that the gauge is well sealed and it is inadvisable to use silicone rubber owing to its permeability.

The strain gauge is used in a bridge network (fig. 2) with a voltage source of between 1.4 volts and 9 volts, depending on the sensitivity required.

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**Fig. 1**
Electrode.

**Fig. 2**
Circuit diagram showing strain gauge coupled into bridge network, etc.
Fig. 3
Recordings taken of a 6-year-old boy supine.
The output is taken to a standard D.C. amplifier and writer.

The strain gauge increases in its resistance by 2 per cent for every 1 per cent increase in extension, and the relationship between resistance and extension is linear. The graph shown (fig. 4) relates the voltage output of the bridge to the extension of the strain gauge for different values of battery. There is no detectable noise although there is a slight steady voltage of a few millivolts at the electrodes due to polarization. No drift from this cause has been encountered.

To illustrate the use of the apparatus recordings are shown (fig. 3) of thoracic and abdominal movements during respiration of a supine subject whilst (A) asleep, (b) conscious and (c) anaesthetized. The way that the thoracic movement lags behind the abdominal during anaesthesia is well shown.

Samples of aqueous colloidal graphite were kindly supplied by Acheson Colloids Ltd., Prince Rock, Plymouth, under the trade name of "Aquadag".