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Use of a Photo-electric Cell in Respiration Apparatus.*

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In the course of studies on the use of helium in obstructive dyspnea it became evident that varying the pressure of the inhaled atmosphere modified materially the effort required to ventilate the lungs. Inspiration was especially aided by inhaling a helium oxygen mixture under a positive pressure of one to 7 cm. of water in dyspnea such as that encountered in severe asthma.[1] Although moderate positive pressures appeared to have some usefulness in expiration by preventing marked deflation of the smaller bronchi and bronchioles, more marked pressures were found fatiguing. Various pulmotors were tried in which inspiration was achieved by positive pressure and expiration by negative pressure but they had the disadvantage of requiring excessive pressures before the shift from inspiration to expiration was possible. They were adapated to the unconscious rather than the conscious patient.

The basic mechanism we employed was a rebreathing apparatus with positive pressure blowers which forced air through soda-lime and made contact with the patient either with a mouth-piece or a mask. The blower in the inspiratory arm of the apparatus provided positive pressure, whereas the blower in the expiratory arm created a negative pressure, each capable of control and measurement by pressure control valves and gauges. The photo-electric cell was used to operate the solenoid valve which opened and closed depending upon the interruption of a beam of light passing through a photo-tube which contained a delicate vane that swung forward and backward as air was inhaled or exhaled.

The detail of the mechanism is shown in Fig. 1. The light source (F) throws a beam of light through the air current vane (D). The vane may take any one of three positions (a) vertical, when there is no movement of gas in the tube, (b) horizontal and to the left, when gas is moving from right to left as to inspiration, (c) horizontal and to the right, when gas is moving from left to right as in expiration. The van interrupts the beam of light in the expiratory position. During the inspiratory position the beam of light strikes

* This work was supported by a grant from the National Research Council.

[1] Barach, A. L., *Ann. Int. Med.*, 1935, **9**, 739 *J. A. M. A.* To be published.

the photo-tube (E) which generates a current that activates a photo-electric relay which in turn sets up a current that operates the solenoid (H), opening the valve (G). The gas mixture employed then passes from 1 to 2 only. In the unactivated position of the solenoid, valve G permits the gas to pass from 2 to 3 only.

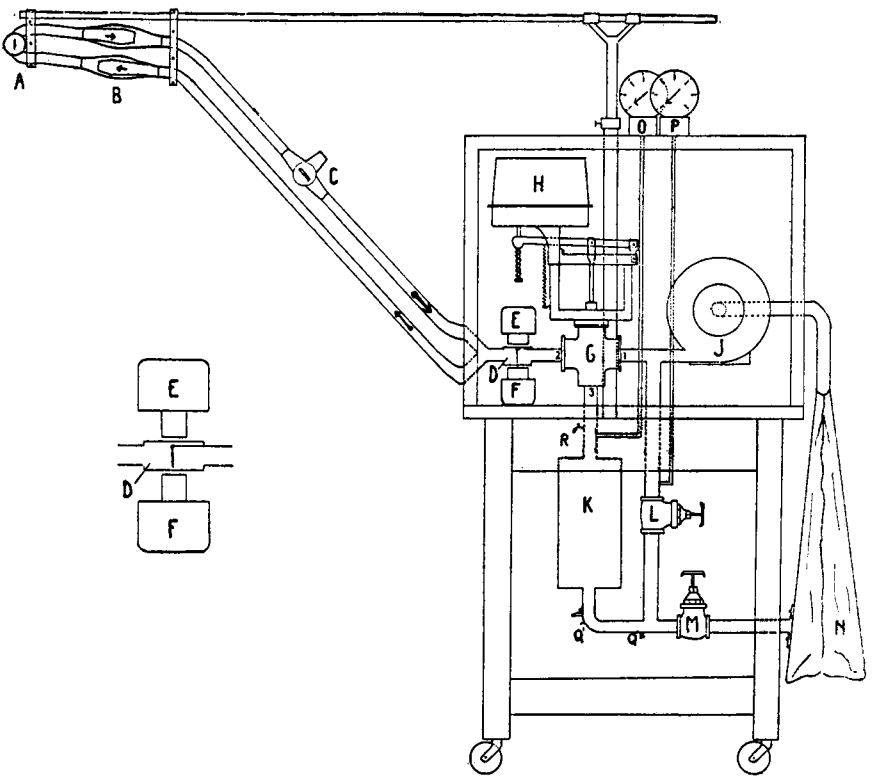

FIG. 1.

A—Mouthpiece holder valve
B—Directional flutter valves
C—3-way by-pass valve
D—Air-current vane
E—Photo tube
F Light source
G—3-way solenoid valve
H—Solenoid
J—Motor blower—high speed 6,000 R.P.M.
K—Soda lime container
L—Inspiratory pressure control valve
M—Expiratory pressure control valve
N—Bag
O—Expiratory pressure gauge
P—Inspiratory pressure gauge

The apparatus may be used for various purposes. To obtain large positive pressures on inspiration and minimal positive pressure on expiration, the patient is attached to the mouthpiece holder A. On inspiration the vane swings in his direction (left horizontal position) and valve G permits gas to pass from motor blower J through the 1-2 path at a positive pressure which can be controlled

by the inspiratory control valve L, and measured by the gauge P. The smaller the opening in the valve the larger will be the positive pressure during inspiration. At the end of inspiration, the vane falls to the vertical position. On expiration the vane swings to the right horizontal position, cutting off the light beam. Valve G is now turned so that the expired air passes through the 2-3 path. In passing through the soda-lime can K, the CO_2 of the expired air is absorbed. The positive pressure on expiration is controlled by valve M. With the valve wide open there is present only minimal pressures incident to the tubing resistance. With the valve partially closed, varying positive pressures may be obtained which can be read on gauge O.

When a positive pressure is desired in inspiration and a negative pressure in expiration both motor blower units must be used (and valve M). The motor blower unit which accomplishes suction is placed in the space Q 1-Q 2. This motor sucks from the soda-lime can K and blows toward the bag. We have been studying this type of mechanism in pulmonary emphysema.

The effects of positive and negative pressures on various types of dyspnea may be studied by this apparatus. The photo-electric cell operates with such speed that there is an exceedingly slight delay in the opening and closing of the solenoid valve, namely, one-tenth of a second. Although the apparatus is a delicate one and may be disturbed by rough handling, it has been used both in the laboratory and on the wards. We have chiefly employed it in severe asthma up to the present but other uses, such as for resuscitation, are being studied.

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Filtration Studies on Reactive Infusion Fluids.*

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This is a report of attempts to remove by various methods of filtration the reactive agent or agents from infusion fluids known to cause a reaction when injected intravenously. The reaction is characterized in the human being and in the dog by fever, often chills,

* Aided by a grant from the Works Progress Administration.