THE USE OF A SIMPLE CONSTANT PRESSURE GASOMETER IN PHYSIOLOGICAL AND TOXICOLOGICAL EXPERIMENTS

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(Received September 1, 1958. Presented by Active Member AMN SSSR V. N. Chernigovskii)

By the use of the apparatus described, in conjunction with a Marriott's jar, it is possible to obtain samples or a continuous flow of gas at a given constant pressure, greater or less than atmospheric pressure or equal to it. Such a constant pressure gasometer is very useful in the performance of many experiments:

1) in the determination of the volume of oxygen absorbed by an animal in experiments of long duration;

2) in the performance of prolonged exercises by animals by the static method in chambers of small volume, with maintenance of a constant concentration of oxygen in the chamber and measurement of the volume of oxygen absorbed by the animals;

3) in the introduction of gas into a chamber during the performance of dynamic tasks by animals;

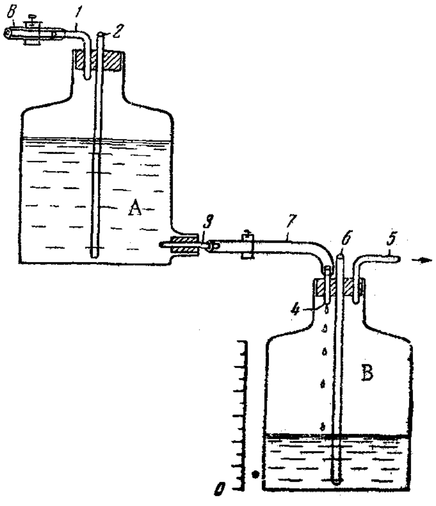
4) in the performance of experiments on the action of various concentrations of oxygen in a gaseous mixture at normal atmospheric pressure on animals;

5) in the storage of large volumes of gas so that samples may be taken from it at constant pressure.

The construction of the gasometer and the method of connecting its parts are shown in the illustration. The bottle A, with a delivery tube (capacity 1-20 liters, depending on the purpose of the experiment) is fitted with a cork, through which pass 2 tubes: one of these is short (1) and the other (2) reaches almost to the bottom of the bottle. A tube 3, inserted in the lower opening of this bottle, is connected by the rubber tube 7 to a short tube 4, which passes through the cork of a second bottle B. Tube 1 is also connected to a rubber tube 8, with a clamp. In the working position the clamp on tube 8 is closed, and the bottle A plays the role of a Marriott's jar. Besides the tube 4, the cork which closes the second bottle B also passes another short tube 5 and a long tube 6, reaching almost to the bottom of the bottle. Water from the vessel A enters through the short tube 4, and gas is supplied from the gasometer through the tube 5. Tubes 6 and 2 are used when charging the gasometer. The bottle B is calibrated, the divisions being marked (frombelow upwards) on a strip of paper glued to the bottle.

The bottles must be so arranged that their relative levels can be changed. In the working state, bottle A is filled with water and bottle B with gas. The pressure at which the gas is to be supplied from the gasometer is determined by the relative levels of the lower orifices of tube 2 in the bottle A and tube 4 in bottle B.

The bottles are arranged in this way when the gasometer is used for storage of gas, for maintenance of a constant concentration of oxygen in exercising chambers, or for determination of the volume of oxygen absorbed by animals. In the last two cases, soda lime or other absorption is placed in the chambers containing the animals, to absorb the carbon dioxide. In these conditions, the carbon dioxide exhaled by the animals is absorbed and does not affect the value of the pressure in the chamber. The consumption of oxygen leads to a fall in the pressure in-



Construction of the constant pressure gasometer and the method of assembly. For explanation, see text.

side the chamber, which causes oxygen to enter the chamber from the gasometer in volume equal to that used up. When the experiments performed require animals to be kept in a gaseous mixture with various concentrations of oxygen, the relative levels of the bottle A and B are the same as those described above (see Figure).

Apparatus based on the use of the Marriott's jar, for determination of the oxygen demand of animals kept in normal or altered concentrations of oxygen, have been used also in chambers described by other authors.

When gas has to be delivered from the gasometer into a chamber at an increased pressure, bottle A is placed at a correspondingly higher level than bottle B. If the gas should be supplied from the gasometer only at a given pressure below atmospheric, bottle A is placed below bottle B. The necessary difference in levels is easily calculated if it is remembered that the pressure of emission of gas from the gasometer (in cm of water) is equal to the difference between the levels of the lower orifices of tubes 2 and 4 (in cm).

The method described may also be used to supply gas to a chamber during exercise tests on animals by the dynamic method. In this case the bottle A is fixed above bottle B, and the tube 5 is controlled either by a screw clamp or by attachment of a cock. By changing the position of this cock or clamp, the volume of gas emitted from the gasometer may be regulated from zero to a given maximum value, which depends on the diameter of the tubes used in the gasometer.

Certain observations on the use of the gasometer may be given. When the gasometer is first charged, bottle B must be completely filled with water as a first step (best distilled), bottle A being empty. During filling of the gasometer with gas, the order of working is as follows. The clamp on tube 7 is closed and that on tube 8, attached to glass tube 1, is opened. The upper ends of tubes 6 and 2 are connected by a rubber tube (not shown in the figure). The appropriate gas is then pumped into the bottle B through tube 5 by means of a Komovskii (or other) pump; water is thus displaced into bottle A. When bottle B is full of gas the Komovskii pump is turned off (excess gas, at a slightly raised pressure during pumping, escapes from the gasometer), the rubber tube connecting tubes 2 and 6 is removed, and the clamp on tube 8 is closed. The clamp is then removed from tube 7 and the gasometer is ready for use. Other methods may be used for filling the gasometer.

When the gasometer is used for delivery of oxygen at atmospheric pressure or a slightly higher pressure, it is essential to make sure that no air bubbles are present in tube 4 and in the rubber tube connecting it to the delivery tube of bottle A, which would interfere with the working of the gasometer. They may be removed by sucking gas vigorously through tube 5.

SUMMARY

Employment of a simple constant pressure gasometer with the aid of a Marriott type of vessel is described. It enables a constant flow of gas to be obtained at a given pressure. It may be used in physiological and toxicological experiments.