NASA TECH BRIEF

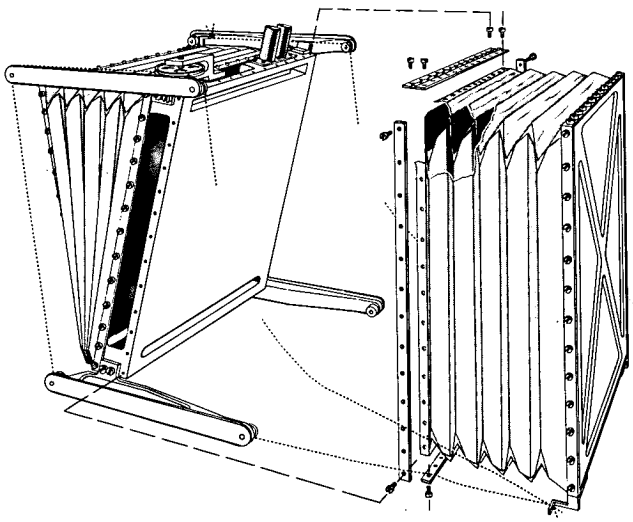
Ames Research Center

Balanced-Bellows Spirometer

The spirometer is an apparatus used to measure total lung capacity, maximum breathing capacity, tidal volume, functional residual capacity, and oxygen uptake. Spirometers can be used to assess the effects of space travel (as well as high-altitude and high-speed travel in the earth's atmosphere) on creatures which breathe air. Unfortunately, the acceleration forces which occur during takeoff, landing, and other maneuvers in test flights as well as the forces associated with test centrifuges often interact with ordinary laboratory spirometers; for example, spirometers which use water as a gas seal obviously can not perform properly in acceleration fields, and ordinary dry-type spirometers are usually too large for use in test chambers. Since dry-type spirometers necessarily include an expandable and contractable chamber, an acceleration force along any axis tends to restrict chamber movement, but the dry-type spirometers can be used if the acceleration force is allowed to act along a neutral axis.

A compact balanced-bellows dry-type spirometer has been designed to be insensitive to acceleration fields along any or all coordinate axes, thus, it provides a true indication of the respiratory action of the test subject without need for calibration in acceleration fields.

The active component of the improved spirometer consists of two equal-size bellows mounted on opposite sides of a metal wall; a passage through the metal wall permits them to perform as a single chamber. An air inlet is attached to one bellows and an outlet to the other. The bellows are pivotally connected to opposite edges of the metal wall; they are interconnected mechanically so that the tendency of one bellows to move toward or away from the metal wall under the influence of acceleration forces is resisted by an equal and opposite tendency of the other. Consequently, the bellows are not affected by acceleration forces,



and they are free to move in accordance with the force of the air pressure produced by the lungs of the test subject.

The bellows are identical in shape, size, and construction, and are made of 0.106-mm (0.004-inch) thick polyvinyl chloride-acetate film with corner reinforcements of 0.254-mm (0.010-inch) polyvinyl chloride film. Metal plates and screws, metal hinges and screws, and cements are used to secure the bellows to the intervening metal wall, and two "string" loops (any material other than an elastomeric type) are used to interconnect them.

(continued overleaf)

Note:

No additional documentation is available. Specific questions, however, may be directed to:

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Reference: B72-10279

Patent status:

This invention has been patented by NASA (U.S. Patent No. 3,420,225). Inquiries concerning nonexclusive or exclusive license for its commercial development should be addressed to:

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