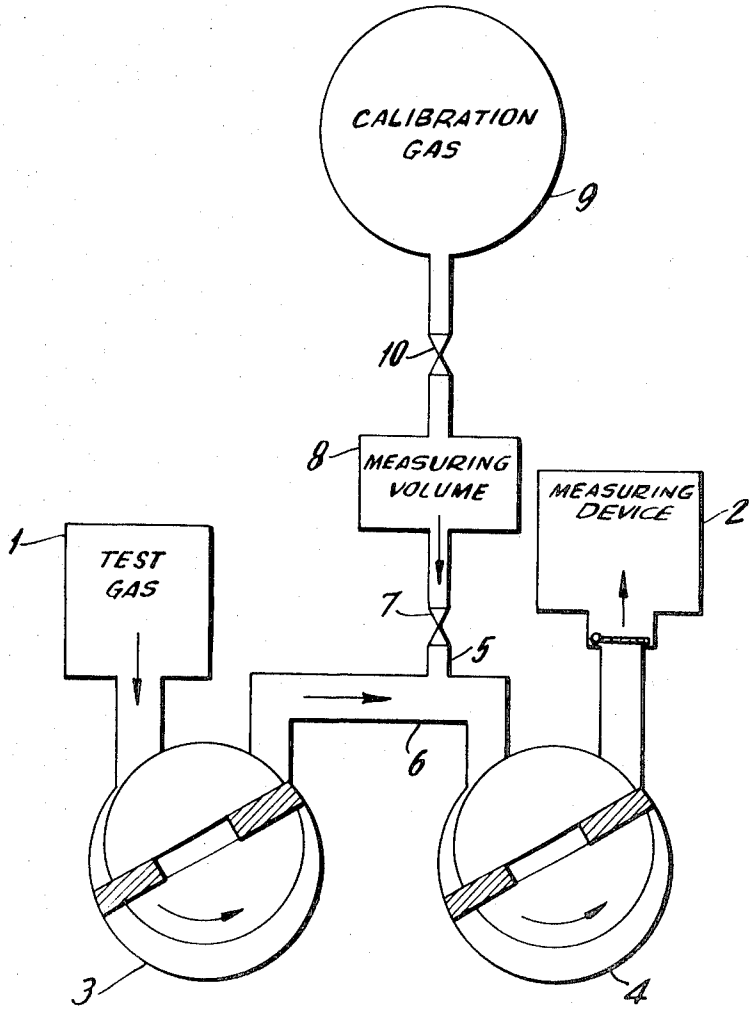
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CALIBRATION ARRANGEMENT FOR AN APPARATUS FOR MEASURING THE GAS CONTENT OF MATERIAL

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CALIBRATION ARRANGEMENT FOR AN APPARATUS FOR MEASURING THE GAS CONTENT OF MATERIAL

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ABSTRACT OF THE DISCLOSURE

An arrangement for the quantitative analysis of gases which are liberated from the gas source includes a pump system connected to the source, to collect the gas to be analyzed, a gas collecting space connected to the pump system discharge, and a device for inserting measured amounts of calibration gas, from a source thereof, into the gas collecting space. The pump system comprises a two-stage or multi-stage pump system, with the stages being interconnected by connection lines. The calibrating gas insertion device is connected into the connecting line between two successive pump stages.

BACKGROUND OF THE INVENTION

Arrangements for the analysis of gases liberated from a gas source, for example, gases which are liberated from a metal sample which is heated in a hot vacuum extraction furnace, customarily comprise a pump system connected to the gas source and a gas collecting space into which the gases to be analyzed are pumped, the gases subsequently being analyzed, such as quantitatively, by means of suitable measuring devices. For the purpose of calibrating such an arrangement, a calibration system has hitherto been connected at the location of the source of the gas to be analyzed or, in other words, at the suction side of the pump system and, through the pump system, a predetermined amount of the calibration gas is inserted into the gas collection space. For example, the calibration gas has been inserted directly into the vacuum extraction furnace.

This known procedure or arrangement has the disadvantage that the required calibration gas connecting lines, with their shut-off valves, enlarge the volume on the suction side of the pump system. This has an unfavorable consequence during the subsequent analysis of the gases liberated from the gas source, particularly if the pumps used have a small suction capacity. The reason for this is that, if the extraction of the sample is to take place sufficiently complete within a predetermined period, such as, for example, one second, with the analysis being complete to a degree of, for example, 99%, then the quotient formed from the free volume, which is connected at the suction side of the pump system, and the suction capacity of the pump, is not supposed to exceed a predetermined amount. In the example given above, this amount is 0.22 s. For this reason also, the furnace volume cannot exceed a predetermined value which, in the illustrated example, is 60 $cm.^3$, if a pump is used which has a predetermined suction capacity such as, for example, 1 $m^3/h.=280$ $cm.^3/s.$ Since, however, valves of the kind which are required for insertion of exactly those calibration gas amounts have already a dead volume of the same magnitude, such an arrangement is not feasible from a practical standpoint. Therefore, new solutions must be sought.

SUMMARY OF THE INVENTION

This invention relates to the quantitative analysis of gases liberated from a gas source and, more particularly, to an improved and simplified arrangement of this type in which the disadvantageous effect of the dead volume of the dosage system is eliminated.

An arrangement for the quantitative analysis of gases liberated from a gas source, embodying the invention, has, in common with the prior art, a pump system which is connected to the gas source for collecting the gas to be determined. Furthermore, the invention arrangement has a gas collecting space connected to the exhaust of the pump system, as well as an arrangement for the insertion of a dosed amount of calibration gas into the gas collecting space.

In accordance with the invention, the arrangement is characterized in that the pump system is arranged as a two-stage or multi-stage system, and the calibration gas dosage device merges or discharges into the connecting line between two pump stages.

With the invention arrangement, there can be obtained a quick and quantitative emptying of the calibrated volume of the calibration system, and furthermore a rapid and quantitative degassing of the sample in the furnace space, without requiring expensive additional arrangements.

An object of the invention is to provide an improved arrangement for the quantitative analysis of gases liberated from a gas source.

Another object of the invention is to provide such an arrangement in which a pump system, connected to the source, is designed as a plural-stage pump system with an insertion device for calibration gas being connected into a connecting line between two successive pump stages.

A further object of the invention is to provide such an arrangement which is simple, inexpensive, and efficient.

Another object of the invention is to provide such an arrangement in which the disadvantageous effect of the dead volume of the dosage system is prevented.

For an understanding of the principles of the invention, reference is made to the following description of a typical embodiment thereof as illustrated in the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWING

In the drawing, the single figure is a somewhat schematic diagram of a quantitative analysis arrangement embodying the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the drawing, a source, which liberates or gives off the gas to be analyzed, is indicated at **1**. In many cases, the source will liberate the gases under subatmospheric pressure conditions, for example, the source may be a vacuum hot extraction furnace. In accordance with the invention, a two-stage mechanical pump system is connected to gas source **1** for the purpose of collecting the gas to be analyzed and for supplying this gas to the gas measuring device **2**. Measuring device **2** may be of any suitable kind and may, for example, be based on measuring the infrared absorption of the bas, its heat conducting capacities, or other physical or chemical characteristics.

In the illustrated example, the two-stage pump system comprises rotary vane type vacuum pump stages **3** and **4**. The first pump stage **3** compresses gas from the pressure of source **1** to an average pressure. The second stage **4** compresses the gas from this average pressure to the pressure prevailing in the gas collecting space **2**. This last-mentioned pressure usually is also a subatmospheric pressure, and the gas collecting space, prior to starting

the analysis, is evacuated or exhausted by an additional pump which has not been illustrated.

In order to supply to the arrangement a calibration gas, for calibration purposes, a calibration purposes, a calibration gas inlet or insertion means **5** is provided and, in accordance with the invention, communicates with the space connecting pump stages **3** and **4**, specifically, it communicates with connecting line **6**.

The drawing illustrates a shut-off valve **7** in the calibration gas connecting line, the measuring volume **8** for the calibration gas, and a second shut-off valve **10** which permits insertion, from the calibration gas supply **9**, of a predetermined amount of calibration gas into the calibration gas measuring volume **8**. Subsequently, upon opening valve **7**, this measured volume of calibration gas flows into the gas collecting space **2**.

As compared to insertion of the calibration gas directly into the gas collecting space **2**, the invention arrangement, in which two-stage or multi-stage pump systems are provided, has the advantage that, in the connecting line between two pump stages, the pressure is so low that the calibration gas amount can be quantitatively inserted into the system. At the discharge side of the pump system, on the other hand, the pressure may, if desired, already be so high that the calibration gas is no longer completely drawn into the gas collecting chamber or space **2**.

The gas collected in space **2**, in accordance with the invention, is then subjected to analysis and investigation by means of measuring devices which are connected to the gas collecting chamber **2** or which form, with the gas collecting chamber **2**, a structural unit.

While a specific embodiment of the invention has been shown and described in detail to illustrate the application of the principles of the invention, it will be understood

that the invention may be embodied otherwise without departing from such principles.

What is claimed is:

1. In an arrangement for the quantitative analysis of gases which are liberated from a gas source, and including a pump system connected to the source, to collect the gas to be analyzed, a gas collecting chamber connected to the pump system discharge, and a device for inserting measured amounts of calibration gas into the gas collecting chamber, the improvement comprising, in combination, said pump system including plural pump stages interconnected by connection lines; and means connecting said insertion device into the connecting line between two pump stages.

2. The improvement claimed in claim **1**, in which said insertion device is connected into the connecting line between two successive pump stages.

3. The improvement claimed in claim **1**, in which said pump system is a two-stage pump system.

4. The improvement claimed in claim **3**, in which the first stage compresses the gas to be analyzed to an intermediate pressure and the second stage compresses the gas to be analyzed into the final pressure of the gas collecting space.

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