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APPARATUS FOR ANALYZING A GAS

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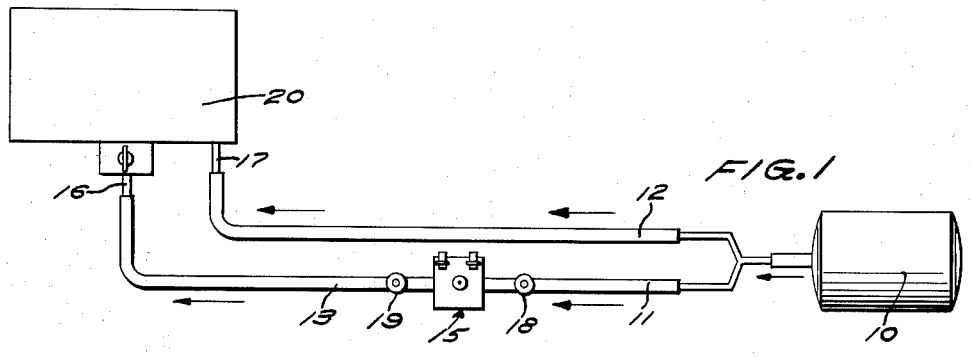


FIG. 1

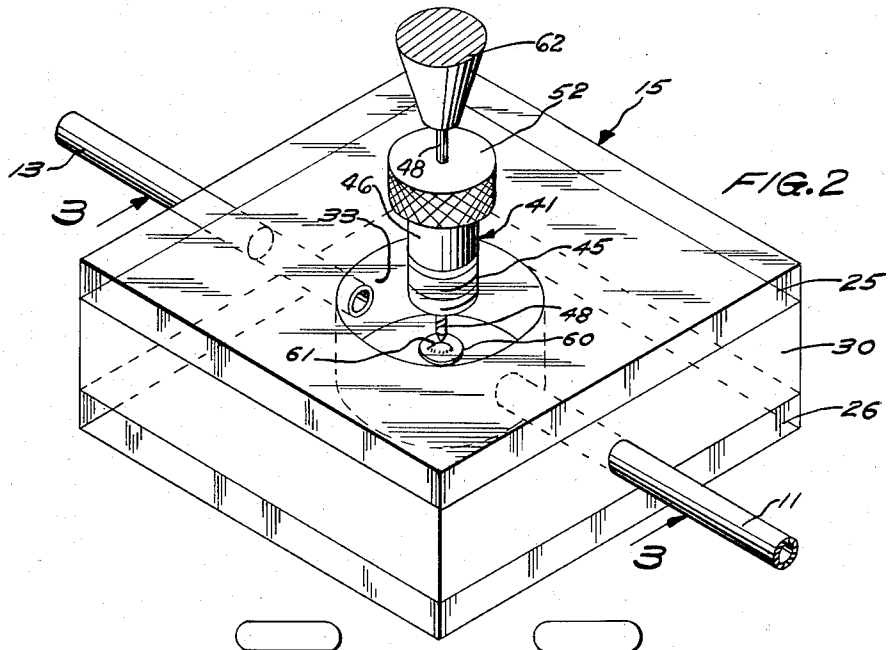


FIG. 2

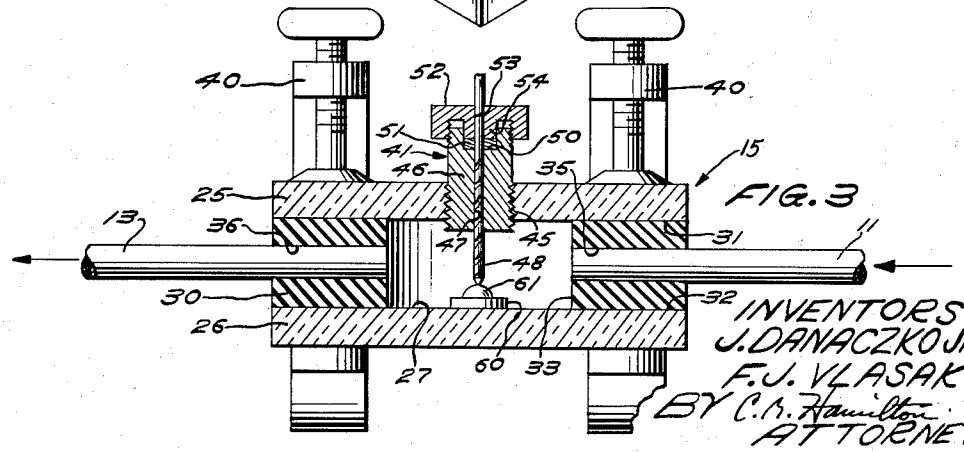


FIG. 3

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APPARATUS FOR ANALYZING A GAS

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This invention relates to apparatus for analyzing a gas and more particularly to apparatus for releasing an occluded gas bubble from a sample material into an inert gas and passing the gas through an analyzer.

In the process of producing certain materials, occluded gas bubbles often appear in the finished product. Such irregularities reduce strength and dependability of the product and are otherwise highly detrimental. It is therefore extremely important to be able to determine what gases are forming the bubbles in the material so that production methods might be changed accordingly to prevent the formation of the bubbles in the finished product.

It is a primary object of this invention to provide an apparatus of simple and economical construction for recovering the gas from an occluded gas bubble in a material, preparatory to analyzing the occluded gas.

Another object of the invention resides in a specially constructed air tight chamber to retain a sample having an occluded gas bubble and providing for the passage of a carrier gas therethrough.

Another object of the invention is to provide an air tight chamber which can be readily varied in size.

A further object of the invention is to provide a sample retaining chamber with an air tight entryway for a tool designed for penetrating the sample to release an occluded gas bubble therein.

An additional object of the invention resides in the provision of apparatus for confining a sample of material having occluded gas bubbles therein and piercing the sample to release the occluded gas in a chamber in the path of a carrier gas passing through the chamber to a gas analyzer.

An additional object of the invention resides in the provision of apparatus for releasing an occluded gas from a metal sample into a stream of carrier gas passing to an analyzer without contaminating the occluded gas.

With these and other objects in view the present invention contemplates apparatus for releasing, in an air tight chamber, the occluded gas in a bubble formed in a sample by drilling into the bubble. The gas thus released into the chamber is transported to a gas analyzer by a carrier gas directed through the chamber and over the metal sample.

Other objects and advantages of the invention will become apparent by reference to the following detailed description and the accompanying drawings wherein:

Fig. 1 is a schematic view of a test system showing the paths of a carrier gas relative to an occluded gas capturing apparatus and a gas analyzer, embodying the principles of the present invention;

Fig. 2 is a perspective view of the occluded gas capturing apparatus with a sample in position to be visually aligned with a drill; and

Fig. 3 is a cross sectional view of the assembled occluded gas capturing apparatus with the drill inserted through a seal in an air tight chamber in alignment with a bubble formed in the sample.

Referring to the drawings there is illustrated a gas capturing and analyzing system (Fig. 1) having a supply of carrier gas **10**, such as helium or other inert gas, for supplying the carrier gas through parallel tubes **11** and **12**. The tube **11** channels a portion of the carrier gas of the source **10** to an occluded gas capturing apparatus **15**. The gas leaving the apparatus **15** passes through a tube **13** to a sample receiving port **16** of any well known type gas analyzer **20** such as a gas partitioner chromatograph. When the gas partitioner chromatograph is used, a tube **12** passes a portion of the carrier gas from the source **10** to a second port **17**. This is for the purpose of maintaining a gas pressure equilibrium in the apparatus at the point of injection of the sample gas as required for normal operation of a gas partitioner chromatograph to prevent contamination of the sample from the air surrounding the sample receiving port.

The gas capturing chamber **15** shown in Fig. 1 is illustrated in greater detail in Figs. 2 and 3. Two heavy sheets of transparent plastic material **25** and **26** form the outer walls of the capturing chamber **15**. A piece of foam rubber or similar gas tight compressible material **30** having parallel sides **31** and **32** is positioned between the transparent sheets **25** and **26**. The rubber member **30** is formed with an aperture **33** and two openings **35** and **36** extend radially therefrom to receive tubes **11** and **13**. The shape of the aperture **33** does not have to be cylindrical as shown but could for example be frustoconical or hemispherical. The openings **35** and **36** in member **30** are of sufficiently small diameter to maintain an air tight seal with the tubes **11** and **13**. Tubes **11** and **13** have valves **18** and **19**, respectively, close to the capturing apparatus **15**. These valves can be closed to completely isolate the capturing apparatus **15**.

Transparent members **25** and **26** and the rubber member **30** are held together in a stacked relationship by a pair of C-clamps **40**. By varying the force applied by the clamps **40** the volume of chamber **33** formed in the rubber **30** can be varied accordingly. This is especially true when the chamber **33** is frustoconical or hemispherical. A seal structure, designated generally by the numeral **41**, is provided to seal off the aperture **33** while permitting entry of a drill **48** therethrough. The rigid transparent member **25** has a threaded aperture **45** with a cylindrical seal member **46** forming a part of the structure **41** threadably mounted therein. The member **46** has a longitudinal bore **47** therethrough to receive a drill **48**. The member **46** also has a recess **50** formed therein into which is placed the packing material **51**. A cap **52**, having an aperture **53** to receive the shank of the drill **48**, is threadably mounted to the cylindrical member **46** and has a raised annular portion **54** slidably fitted in the recess **50**. Rotation of the cap causes the annular portion **54** to force the packing material **51** against the shank of the drill **48** to maintain an air tight seal between the drill shank and the cylindrical member **46**. A sample **60**, having an occluded gas bubble imperfection **61**, is positioned in the chamber with the bubble **61** in alignment with drill **48**.

Operation

In operation, to capture the gas from the occluded bubble **61** of the sample of metal **60**, the sample is placed on the surface **27** of the transparent member **26** at a predetermined central point thereon. The foam rubber member **30**, with tubes **11** and **13** inserted therein, is placed on the member **26** against surface **27** thereof and with its aperture **33** surrounding the sample **60**. The transparent member **25**, having the seal member **46** threadably mounted therein, is placed over the rubber member **30** with the drill aperture **47** of the seal structure **41** in

approximate alignment with the bubble 61 of the sample. The drill 48 mounted in a chuck 62 is inserted through the aperture 47 of the seal structure to a point adjacent to bubble 61 of the sample 60. The seal cap 52 is adjusted to act against the packing 51 to form a seal around the drill shank. With the members thus positioned the drill 48 may be visually aligned with the bubble 61 of the sample 60, by moving plates 25 and 26. When the drill is properly aligned with the bubble 61, C-clamps 40 are placed over members 25, 26 and 30 and are tightened in place (Fig. 3), with a force sufficient to compress the member 30 and collapse the chamber 33 to a minimum volume without crushing the sample. Also, when the clamps 40 are thus applied the members 25, 26 and 30 will be held in proper position with the drill 48 in alignment with the bubble 61.

Carrier gas is allowed to pass from source 10 (Fig. 1) through the tube 11 and open valve 18, through the sample capturing chamber 15, through open valve 19 and on into the analyzer 20. Gas also passes through tube 12. The system is thus bled of all foreign gases.

When the lines 11, 12 and 13 are sufficiently bled, the valves 18 and 19 are closed and the drill 48 is rotated and moved against the sample to cut into and open the bubble 61 thereby allowing the gas therein to be released into the chamber 33. The chamber 33 is collapsed to a minimum by the clamps 40 as pointed out above and therefore the chamber has the high concentration of gas from the bubble. Valves 18 and 19 are then opened and a stream of carrier gas is passed through the gas capturing chamber 15 carrying with it the concentrated unknown gas from the bubble. The gas thus released in the stream of carrier gas is carried on through tube 13 to the inlet port 16 of the gas analyzer. The gas is thereby applied to a gas analyzer to determine the character or composition of the gas which originally formed the occluded bubble of the sample 60.

It is to be understood that the above-described arrangements are simply illustrative of the application of the principles of this invention. Numerous other arrangements may be readily devised by those skilled in the art which will embody the principles of the invention and fall within the spirit and scope thereof.

What is claimed is:

1. An apparatus for releasing a gas bubble occluded in metal sample, which comprises a rigid base plate for supporting a metal sample in a predetermined position, a rigid transparent cover plate parallel to the base plate having a threaded aperture therein in alignment with a gas bubble occluded in the metal sample, a resilient body having substantially parallel sides positioned between the base plate and the cover plate, said resilient body having an aperture therein perpendicular to the plates in alignment with the threaded aperture of the cover plate and having two radial openings extending therefrom through the resilient body, a drill bit air seal threadably mounted in the cover plate, a reciprocating drill inserted through the air seal, and clamps to hold the base plate, cover plate and resilient member in stacked relation with the drill bit in alignment with the occlusion of the metal sample.

2. Apparatus for analyzing a gas bubble entrapped within a sample, which comprises a rigid base plate for supporting the sample, a rigid cover plate parallel to the base plate and having an aperture therethrough in alignment with the gas bubble in the sample, a seal member within the aperture in said cover plate, a washer of a resilient compressible material positioned between said base plate and said cover plate so as to surround the sample, clamps to hold said base plate, cover plate and washer in stacked relationship and to compress said washer so as to form an air-tight chamber around the sample of a volume which can be controlled by adjustment of said clamps, means reciprocable in air-tight relationship through the seal member for piercing the gas bubble whereby the gas is released into the chamber, a gas analyzer, and means for passing a carrier gas through the chamber to carry the released gas to said gas analyzer.

References Cited in the file of this patent

Gas Chromotography, A.I.M., Keulemans Reinhold Publishing Corp., 1957, pp. 11, 67, 68.