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(71) Applicant: **MOCON, INC.** [US/US]; 7500 Mendelssohn Avenue North, Minneapolis, Minnesota 55428 (US).

(72) Inventor: **ASCHEMAN, Timothy A.**; 9819 226th Lane Northwest, Elk River, Minnesota 55330 (US).

(74) Agent: **SHERRILL, Michael**; Suite 212, 4756 Banning Avenue, White Bear Lake, Minnesota 55110 (US).

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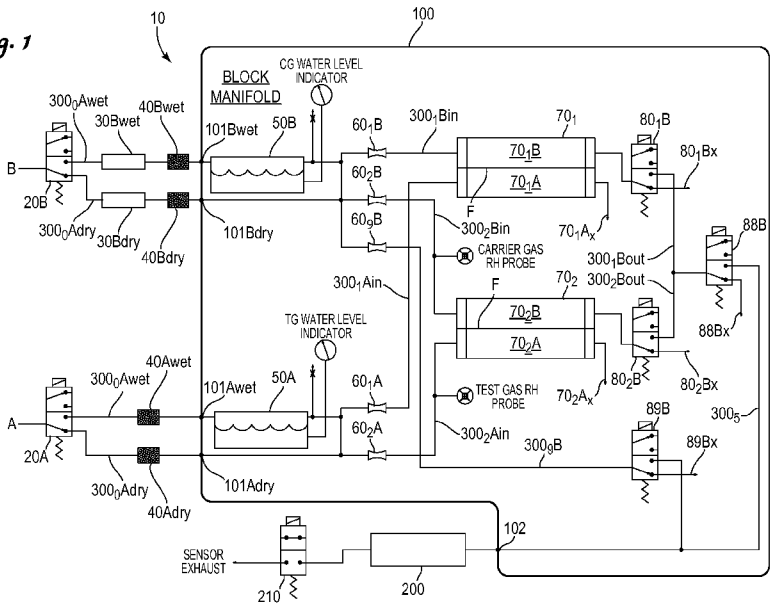
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(54) Title: TARGET-ANALYTE PERMEATION TESTING INSTRUMENT WITH SENSOR FEED LINE CONDITIONING SYSTEM

Fig. 1



(57) Abstract: A target-analyte permeation testing instrument (10) characterized by a sensor feed line (300_nB_{out} and 300_5) conditioning system.

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TARGET-ANALYTE PERMEATION TESTING INSTRUMENT WITH SENSOR FEED LINE CONDITIONING SYSTEM

BACKGROUND

[0001] Permeation instruments are used to measure the transmission rate of a target analyte, such as oxygen, carbon dioxide or water vapor, through various samples, such as membranes, films, envelopes, bottles, packages, containers, etc. (hereinafter collectively referenced as "test films" for convenience). Typical test films are polymeric packaging films such as those constructed from low density polyethylene (LDPE), high density polyethylene (HDPE), oriented polypropylene (OPP), polyethylene terepthalate (PET), polyvinylidene chrloride (PVTDC), etc. Typically, the film to be tested is positioned within a test chamber to sealing separate the chamber into first and second chambers. The first chamber (commonly referenced as the driving or analyte chamber) is filled with a gas containing a known concentration of the target analyte (commonly referenced as a driving gas). The second chamber (commonly referenced as the sensing chamber) is flushed with an inert gas (commonly referenced as a carrier gas) to remove any target analyte from the cell. A sensor for the target analyte is placed in fluid communication with the sensing chamber for detecting the presence of target analyte that has migrated into the sensing chamber from the driving chamber through the test film. Exemplary permeation instruments for measuring the transmission rate of oxygen (O_2), carbon dioxide (CO_2) and water vapor (H_2O) through test films are commercially available from Mocon, Inc. of Minneapolis, Minnesota under the designations OXTRAN, PERMATRAN-C and PERMATRAN-W, respectively.

[0002] Permeation testing instruments employ a very low mass flow through rate through the instrument to limit the creation of any pressure differentials in the instrument that could impact humidification of the test and/or carrier gases or create a pressure-induced driving force across a test film. This low mass flow rate through the instrument imposes a significant time delay between measurements from different testing cells as the feed line to the sensor is flushed with the carrier gas from the sensing chamber of the newly selected testing cell.

[0003] A substantial need exists for a permeation instrument capable of contemporaneously measuring target-analyte transmission rates from a plurality of testing cells with minimal changeover time between measurements from different testing cells.

SUMMARY OF THE INVENTION

[0004] A first aspect of the invention is a target-analyte permeation testing instrument for measuring target-analyte permeation rate of a test film in test cell, characterized by a sensor feed line conditioning system.

[0005] A first embodiment of the instrument has a target-analyte sensor and at least one test cell operable for retaining a test film in a testing chamber so as to sealingly divide the testing chamber into a driving chamber and a sensing chamber. The target-analyte permeation testing instrument is characterized by (i) a length of common conduit in fluid communication with the shared target-analyte sensor, (ii) individual dedicated lengths of conduit, each in fluid communication with the length of common conduit and each operable for delivering a fluid subjected by the instrument to a different target-analyte exposure experience, with at least one of the individual dedicated lengths of conduit in fluid communication with the sensing chamber of the at least one test cell, (iii) a dedicated valve associated with each dedicated length of conduit operable between venting and flow through states, and (iv) a common valve associated with the length of common conduit operable between venting and flow through states.

[0006] A second embodiment of the instrument has a shared target-analyte sensor and a plurality of test cells each defining a testing chamber with each test cell operable for retaining a test film to sealingly divide the testing chamber into a driving chamber and a sensing chamber. The target-analyte permeation testing instrument is characterized by (i) a length of common conduit in fluid communication with the shared target-analyte sensor, (ii) individual dedicated lengths of conduit in fluid communication with each of an associated sensing chamber and the length of common conduit, each dedicated length of conduit operable for carrying fluid from the sensing chamber of an associated test cell to the length of common conduit, (iii) a dedicated valve associated with each dedicated length of conduit operable between venting and flow through states, and (iv) a common valve associated with the length of common conduit operable between venting and flow through states.

[0007] A second aspect of the invention is a method of measuring target-analyte transmission rate through a test film utilizing a target-analyte permeation testing instrument according to the first aspect of the invention.

[0008] A first embodiment of the second aspect of the invention is a method of measuring target-analyte transmission rate through a test film utilizing a target-analyte permeation testing instrument according to the first embodiment of the first aspect of the invention. The method includes initial set-up and subsequent testing steps. The set-up steps include the steps of (i) obtaining a target-analyte permeation testing instrument according to the first embodiment of the first aspect of the invention, (ii) loading a test film into the at least one test cell, (iii) providing a flow of target-analyte containing driving gas through the driving chamber of the at least one test cell containing a test film, and (iv) providing a flow of inert carrier gas through the sensing chamber of the at least one test cell containing a test film. The testing steps includes the sequential steps of (a) measuring target-analyte concentration in the sensing chamber of the at least one test cell by setting the dedicated valve for the individual dedicated length of conduit associated with the sensing chamber of the at least one test cell to flow-through, setting the common valve to flow-through, setting all other dedicated valves to vent, and measuring concentration of target-analyte in fluid communication with the target-analyte sensor, (b) conditioning the instrument for ensuing measurement of target-analyte concentration in a fluid delivered to the common length of conduit through a different individual dedicated length of conduit for a conditioning period by setting the common valve to vent, setting the dedicated valve for the individual dedicated length of conduit associated with the sensing chamber of the at least one test cell to vent, setting the dedicate valve associated with the different individual dedicated length of conduit to flow-through, and leaving all other dedicated valves to vent, and (c) measuring target-analyte concentration in the fluid delivered to the common length of conduit through a different individual dedicated length of conduit by setting the common valve to flow-through.

[0009] A second embodiment of the second aspect of the invention is a method of simultaneously measuring target-analyte transmission rate through a plurality of test films utilizing a target-analyte permeation testing instrument according to the second embodiment of the first aspect of the invention. The method includes initial set-up and subsequent testing steps. The set-up steps include the steps of (i) obtaining a target-analyte permeation testing instrument according to the second embodiment of the first aspect of the invention, (ii) loading a test film into each of at least two test cells, (iii) providing a flow of target-analyte containing driving gas through the driving chamber of each test cell containing a test film, and (iv) providing a flow of

inert carrier gas through the sensing chamber of each test cell containing a test film. The testing steps includes the sequential steps of (a) measuring target-analyte concentration in the sensing chamber of a first test cell by setting the associated dedicate valve to flow-through, setting the common valve to flow-through, setting all other dedicated valves to vent, and measuring concentration of target-analyte in fluid communication with the target-analyte sensor, (b) conditioning the instrument for ensuing measurement of target-analyte concentration in the sensing chamber of a second test cell for a conditioning period by setting the common valve to vent, setting the dedicated valve associated with the sensing chamber of the first test cell to vent, setting the dedicate valve associated with the sensing chamber of the second test cell to flow-through, and leaving all other dedicated valves to vent, and (c) measuring target-analyte concentration in the sensing chamber of the second test cell by setting the common valve to flow-through.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] Figure 1 is a schematic plumbing diagram of one embodiment of the invention.

DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT

Nomenclature Table

10	Target-Analyte Permeation Testing Instrument
20A	Test Gas RH Control Valve
20B	Carrier Gas RH Control Valve
$30B_{wet}$	Catalyst Chamber in Wet Carrier Gas Line
$30B_{dry}$	Catalyst Chamber in Dry Carrier Gas Line
$40A_{wet}$	Particle Filter in Wet Test Gas Line
$40A_{dry}$	Particle Filter in Dry Test Gas Line
$40B_{wet}$	Particle Filter in Wet Carrier Gas Line
$40B_{dry}$	Particle Filter in Dry Carrier Gas Line
50A	Water Reservoir for Test Gas
50B	Water Reservoir for Carrier Gas
60_n	Capillary Restrictors
60_1A	Capillary Restrictor for Test Gas Channel to First Test Cell

60_2A	Capillary Restrictor for Test Gas Channel to Second Test Cell
60_1B	Capillary Restrictor for Carrier Gas Channel to First Test Cell
60_2B	Capillary Restrictor for Carrier Gas Channel to Second Test Cell
60_9B	Capillary Restrictor for Carrier Gas Channel to Rezero Valve
70_n	Testing Cells
70_nA	Driving Chamber of Test Cell n
70_nB	Sensing Chamber of Test Cell n
70_nAx	Exhaust from Driving Chamber of Test Cell n
70_1	First Testing Cells
70_1A	Driving Chamber of First Test Cell
70_1Ax	Exhaust from Driving Chamber of First Test Cell
70_1B	Sensing Chamber of First Test Cell
70_2	Second Testing Cells
70_2A	Driving Chamber of Second Test Cell
70_2Ax	Exhaust from Driving Chamber of Second Test Cell
70_2B	Sensing Chamber of Second Test Cell
80_nB	Carrier Gas Sensing Chamber Exit Valve for Testing Cell n
80_1B	First Test Cell Carrier Gas Exit Valve
80_1Bx	Exhaust from Sensing Chamber of First Test Cell
80_2B	Second Test Cell Carrier Gas Exit Valve
80_2Bx	Exhaust from Sensing Chamber of Second Test Cell
88B	Common Channel Conditioning Valve
88Bx	Exhaust from Common Channel Conditioning Valve
89B	Rezero Valve
89Bx	Exhaust from Rezero Valve
100	Block Manifold
$101A_{wet}$	Test Gas Water Reservoir Inlet Port
$101A_{dry}$	Test Gas Water Reservoir Bypass Inlet Port
$101B_{wet}$	Carrier Gas Water Reservoir Inlet Port
$101B_{dry}$	Carrier Gas Water Reservoir Bypass Inlet Port
102	Carrier Gas Outlet Port to Sensor

200	Target-Analyte Sensor
210	Sensor Exhaust Valve
300_n	Gas Flow Line n
300_0A_{wet}	Test Gas Water Reservoir Inlet Line
300_0A_{dry}	Test Gas Water Reservoir Bypass Inlet Line
300_0B_{wet}	Carrier Gas Water Reservoir Inlet Line
300_0B_{dry}	Carrier Gas Water Reservoir Bypass Inlet Line
300_1A_{in}	Test Gas First Testing Cell Inlet Line
300_1B_{in}	Carrier Gas First Testing Cell Inlet Line
300_2A_{in}	Test Gas Second Testing Cell Inlet Line
300_2B_{in}	Carrier Gas Second Testing Cell Inlet Line
300_nB_{out}	Carrier Gas Outlet Line for Testing Cell n
300_1B_{out}	Carrier Gas First Testing Cell Outlet Line
300_2B_{out}	Carrier Gas Second Testing Cell Outlet Line
300_5	Shared Carrier Gas Testing Cell Outlet Line
300_9B	Carrier Gas Rezero Line
A	Driving or Test Gas Source
B	Inert or Carrier Gas Source
F	Test Film

Description

[0011] Referring generally to Figure 1, the invention is a target-analyte permeation testing instrument **10** characterized by a sensor feed line conditioning system.

[0012] The instrument **10** has a target-analyte sensor **200** and a plurality of test cells **70_n** for measuring target-analyte permeation rate of test films **F_n**. Each test cell **70_n** defines a testing chamber and is operable for retaining a test film **F** to sealingly divide the testing chamber into a driving chamber **70_nA** and a sensing chamber **70_nB**. The cells **70_n** are preferably secured to a block manifold **100**, preferably a solid block cast metal manifold **100** into which the appropriate channels and compartments are formed. A plurality of channels **300_n** are in fluid communication with the testing chamber of each cell **70_n**, a pressurized source of driving gas **A**, a pressurized

source of inert gas **B**, and a target-analyte sensor **200**. The plurality of channels **300$_n$** are configured and arranged to selectively carry driving gas from the pressurized source of driving gas **A** to the driving chamber **70$_n$A** of each cell **70$_n$**, carry driving gas from the driving chamber **70$_n$A** of each cell **70$_n$** to a driving gas exit port **70$_n$Ax**, selectively carry inert gas from the pressurized source of inert gas **B** to the sensing chamber **70$_n$B** of each cell **70$_n$**, and selectively carry inert gas from the sensing chamber **70$_n$B** of each cell **70$_n$** to a the target-analyte sensor **200**.

[0013] The instrument **10** can include a refillable first water reservoir **50A** in selective fluid communication with the source of driving gas **A** and in fluid communication with the driving chamber **70$_n$A** of each cell **70$_n$**, and a second refillable water reservoir **50B** in selective fluid communication with the source of inert gas **B** and in fluid communication with the sensing chamber **70$_n$B** of each cell **70$_n$**.

[0014] An exemplary two-cell embodiment of the invention **10** employing the optional block manifold **100** is depicted in Figure 1. The permeation testing instrument **10** preferably includes humidification systems for each of the test gas and carrier gas, such as described in US Patents 7,578,208 and 7,908,936, the disclosures of which are hereby incorporated by reference.

[0015] A source of dry test gas **A** fluidly communicates with a first humidification system that includes a wet line **300$_0$A$_{wet}$** in fluid communication with a water reservoir **50A** and a dry line **300$_0$A$_{dry}$** that bypasses the water reservoir **50A**. A test gas RH control valve **20A** controls flow of test gas through the wet line **300$_0$A$_{wet}$** and dry line **300$_0$A$_{dry}$** according to a duty cycle for achieving the desired humidification level of the test gas.

[0016] The test gas wet line **300$_0$A$_{wet}$** enters the block manifold **100** at inlet port **101A$_{wet}$**. The test gas dry line **300$_0$A$_{dry}$** enters the block manifold **100** at inlet port **101A$_{dry}$**.

[0017] Upon exiting the water reservoir **50A**, humidified test gas in the wet line **300$_0$A$_{wet}$** is combined with dry test gas in the dry line **300$_0$A$_{dry}$** and the combined test gas directed by test gas inlet lines **300$_1$A** and **300$_2$A** to the driving chambers **70$_1$A** and **70$_2$A** in the first testing cell **70$_1$** and second testing cell **70$_2$** respectively. Test gas flows through and exits each of the driving chambers **70$_1$A** and **70$_2$A** through an outlet port (unnumbered) and is vented from the block manifold at vent ports **70$_1$Ax** and **70$_2$Ax** respectively.

[0018] Particle filters **40A**$_{wet}$ and **40A**$_{dry}$ are preferably provided in the test gas wet line **300$_0$A**$_{wet}$ and test gas dry line **300$_0$A**$_{dry}$ respectively, for removing any entrained particulate matter from the test gas before it enters the block manifold **100**.

[0019] In a similar fashion, a source of dry carrier gas **B** fluidly communicates with a second humidification system that includes a wet line **300$_0$B**$_{wet}$ in fluid communication with a water reservoir **50B** and a dry line **300$_0$B**$_{dry}$ that bypasses the water reservoir **50B**. A carrier gas RH control valve **20B** controls flow of carrier gas through the wet line **300$_0$B**$_{wet}$ and dry line **300$_0$B**$_{dry}$ according to a duty cycle for achieving the desired humidification level of the carrier gas.

[0020] The carrier gas wet line **300$_0$B**$_{wet}$ enters the block manifold **100** at inlet port **101B**$_{wet}$. The carrier gas dry line **300$_0$B**$_{dry}$ enters the block manifold **100** at inlet port **101B**$_{dry}$.

[0021] Upon exiting the water reservoir **50B**, humidified carrier gas in the wet line **300$_0$B**$_{wet}$ is combined with dry carrier gas in the dry line **300$_0$B**$_{dry}$ and the combined carrier gas directed by carrier gas inlet lines **300$_1$B** and **300$_2$B** to the sensing chambers **70$_1$B** and **70$_2$B** in the first testing cell **70$_1$** and second testing cell **70$_2$** respectively. Carrier gas flows through and exits each of the sensing chambers **70$_1$B** and **70$_2$B** through an outlet port (unnumbered) and is directed by dedicated outlet channels **300$_1$B**$_{out}$ and **300$_2$B**$_{out}$ respectively, to a common channel **300$_5$** in fluid communication with a target-analyte sensor **200** located external to the block manifold **100**.

[0022] Common channel **300$_5$** exits the block manifold **100** at outlet port **102**.

[0023] Particle filters **40b**$_{wet}$ and **40b**$_{dry}$ are preferably provided in the carrier gas wet line **300$_0$B**$_{wet}$ and carrier gas dry line **300$_0$B**$_{dry}$ respectively, for removing any entrained particulate matter from the carrier gas before it enters the block manifold **100**.

[0024] Target-analyte catalytic converters **30b**$_{wet}$ and **30b**$_{dry}$ are preferably provided in the carrier gas wet line **300$_0$B**$_{wet}$ and carrier gas dry line **300$_0$B**$_{dry}$ respectively, for converting any target-analyte in the carrier gas (*e.g.*, O_2) to a molecular species (*e.g.*, H_2O when the target analyte is O_2) that will not be detected by the target-analyte sensor **200**.

[0025] Capillary restrictors **60_1A**, **60_2A**, **60_1B** and **60_2B** are preferably provided in the test gas inlet lines **300_1A** and **300_2A**, and carrier gas inlet lines **300_1B** and **300_2B** respectively, for facilitating a consistent and equal flow of gas into the driving chambers **70_1A** and **70_2A** of the testing cells **70_1** and **70_2**, and the sensing chambers **70_1B** and **70_2B** of the testing cells **70_1** and **70_2** respectively. The capillary restrictors **60_n** are preferably side mounted onto the block manifold **100**.

[0026] Valves **80_1B** and **80_2B** are provided in the dedicated outlet channels **300_1B_{out}** and **300_2B_{out}** respectively, for selectively and mutually exclusively allowing passage of carrier gas, containing any target-analyte that has permeated through the test film **F**, from each of the sensing chambers **70_1B** and **70_2B** into sensing engagement with the sensor **200**. When closed, the valves **80_1B** and **80_2B** vent carrier gas, containing any target-analyte that has permeated through the test film **F**, to atmosphere through vent ports **80_1Bx** and **80_2Bx** in the manifold **100**. The valves **80_nB** are preferably side mounted onto the block manifold **100**.

[0027] As referenced previously, permeation testing instruments **10** employ a very low mass flow through rate through the instrument **10** to limit the creation of any pressure differentials in the instrument **10** that could impact humidification of the test and/or carrier gases or create a pressure-induced driving force across a test film **F**. In the embodiment depicted in Figure 1, this low mass flow rate through the instrument **10** imposes a significant time delay between measurements from different testing cells **70_n** as both the "stale" carrier gas contained in the length of the testing cell outlet line **300_nB_{out}** for the upcoming testing cell **70_n** to be measured and the "inapplicable" carrier gas contained in the length of the shared outlet line **300_5** from the previously measured testing cell **70_n** is flushed from the lines and replaced with fresh carrier gas, containing any target-analyte that has permeated through the test film **F**, from the upcoming testing cell **70_n**. The channel conditioning feature employs a common channel conditioning valve **88B** in the shared outlet line **300_5** for allowing, in coordination with opening and closing of valves **80_nB** for the upcoming and previous testing cells **70_n**, for advanced venting of "stale" carrier gas contained in the length of the outlet line **300_nB_{out}** for the upcoming testing cell **70_n**. The common channel conditioning valve **88B** is operable as between a flow-through state, in which carrier gas is directed to the sensor **200**, and a vent state, in which carrier gas is vented to

atmosphere through a vent port **88Bx** in the block manifold **100**. The common channel conditioning valve **88B** is preferably side mounted to the block manifold **100**.

[0028] The instrument **10** depicted in Figure 1 includes an optional rezero feature. Rezero is a method of measuring residual target-analyte contained in the carrier gas during performance of testing that includes the steps of bypassing the test cell(s) **70n** and directly measuring the carrier gas target-analyte level, which is then subtracted from the measured transmission rate of the target-analyte level for each sample.

[0029] The rezero feature includes a rezero line **3009B** upstream from the testing cells **70n** for bypassing the testing cells **70n** and carrying carrier gas directly to the sensor **200**. A rezero valve **89B** is provided in the rezero line **3009B** for selectively directing carrier gas to the sensor **200** or venting carrier gas from the block manifold **100** at vent port **89Bx**. The rezero valve **89B** is preferably side mounted to the block manifold **100**.

[0030] A capillary restrictor **609B** is preferably provided in the carrier gas rezero line **3009B** for facilitating a consistent and equal flow of carrier gas into the sensing chambers **701B** and **702B** of the testing cells **701** and **702** respectively. The capillary restrictor **609B** is, as with the other capillary restrictors, preferably side mounted onto the block manifold **100**.

[0031] The sensor **200** is selected to measure the appropriate target-analyte (*e.g.*, oxygen (O_2), carbon dioxide (CO_2) or water vapor (H_2O)). Selection of a suitable sensor **200** is well within the knowledge and expertise of a person having routine skill in the art. The sensor **200** is preferably a coulox sensor and is equipped with an exhaust valve **210** for preventing atmospheric contamination of the sensor when there is no flow of carrier gas to the sensor **200**.

Use

[0032] Relatively rapid contemporaneous measurement of target-analyte transmission rate through a plurality of test films F can achieved with the target-analyte permeation testing instrument **10**. The method includes initial set-up and subsequent testing steps.

[0033] The set-up steps include (i) obtaining a target-analyte permeation testing instrument **10** in accordance with the invention, (ii) loading a test film **F** into each of at least two

testing cells **70_n**, (iii) providing a flow of target-analyte containing driving gas through the driving chamber **70_nA** of each testing cell **70_n** containing a test film **F**, and (iv) providing a flow of inert carrier gas through the sensing chamber **70_nB** of each testing cell **70_n** containing a test film **F**.

[0034] Based upon the embodiment depicted in Figure 1, the testing steps includes the sequential steps of (a) measuring target-analyte concentration in the sensing chamber **70_1B** of a first testing cell **70_1** by setting the associated dedicate valve **80_1B** to flow-through, setting the common channel valve **88B** to flow-through, setting all other dedicated valves **80_2B** to vent, and measuring concentration of target-analyte in fluid communication with the target-analyte sensor **200**, (b) conditioning the instrument **10** for ensuing measurement of target-analyte concentration in the sensing chamber **70_2B** of a second testing cell **70_2** for a conditioning period by setting the common channel valve **88B** to vent, setting the dedicated valve **80_1B** associated with the sensing chamber **70_1B** of the first testing cell **70_1** to vent, setting the dedicate valve **80_2B** associated with the sensing chamber **70_2B** of the second test cell **70_2** to flow-through, and leaving all other dedicated valves (none depicted in the embodiment of Figure 1) to vent, and (c) measuring target-analyte concentration in the sensing chamber **70_2B** of the second test cell **70_2** by setting the common channel valve **88B** to flow-through.

I claim:

1. A target-analyte permeation testing instrument for measuring target-analyte permeation rate of a test film in a test cell, the instrument having (-) a target-analyte sensor, and (-) at least one test cell operable for retaining a test film in a testing chamber so as to sealingly divide the testing chamber into a driving chamber and a sensing chamber, the target-analyte permeation testing instrument characterized by (i) a length of common conduit in fluid communication with the shared target-analyte sensor, (ii) individual dedicated lengths of conduit, each in fluid communication with the length of common conduit and each operable for delivering a fluid subjected by the instrument to a different target-analyte exposure experience, with at least one of the individual dedicated lengths of conduit in fluid communication with the sensing chamber of the at least one test cell, (iii) a dedicated valve associated with each dedicated length of conduit operable between venting and flow through states, and (iv) a common valve associated with the length of common conduit operable between venting and flow through states.

2. A target-analyte permeation testing instrument for measuring target-analyte permeation rate of a test film in a test cell, the instrument having a shared target-analyte sensor and a plurality of test cells each defining a testing chamber with each test cell operable for retaining a test film to sealingly divide the testing chamber into a driving chamber and a sensing chamber, the target-analyte permeation testing instrument characterized by (i) a length of common conduit in fluid communication with the shared target-analyte sensor, (ii) individual dedicated lengths of conduit in fluid communication with each of an associated sensing chamber and the length of common conduit, each dedicated length of conduit operable for carrying fluid from the sensing chamber of an associated test cell to the length of common conduit, (iii) a dedicated valve associated with each dedicated length of conduit operable between venting and flow through states, and (iv) a common valve associated with the length of common conduit operable between venting and flow through states.

3. A method of measuring target-analyte transmission rate through a test film utilizing the target-analyte permeation testing instrument of claim 1, comprising the steps of:

(a) obtaining a target-analyte permeation testing instrument according to claim 1,

(b) loading a test film into the at least one test cell,

(c) providing a flow of target-analyte containing driving gas through the driving chamber of the at least one test cell containing a test film, and

(d) providing a flow of inert carrier gas through the sensing chamber of the at least one test cell containing a test film, followed by the sequential steps of:

(e) measuring target-analyte concentration in the sensing chamber of the at least one test cell by setting the dedicated valve for the individual dedicated length of conduit associated with the sensing chamber of the at least one test cell to flow-through, setting the common valve to flow-through, setting all other dedicated valves to vent, and measuring concentration of target-analyte in fluid communication with the target-analyte sensor,

(f) conditioning the instrument for ensuing measurement of target-analyte concentration in a fluid delivered to the common length of conduit through a different individual dedicated length of conduit for a conditioning period by setting the common valve to vent, setting the dedicated valve for the individual dedicated length of conduit associated with the sensing chamber of the at least one test cell to vent, setting the dedicate valve associated with the different individual dedicated length of conduit to flow-through, and leaving all other dedicated valves to vent, and

(g) measuring target-analyte concentration in the fluid delivered to the common length of conduit through a different individual dedicated length of conduit by setting the common valve to flow-through.

4. The method of claim 3 wherein the different individual dedicated length of conduit is operable for delivering fluid to the length of common conduit from the sensing chamber of another test cell.

5. The method of claim 3 wherein the different individual dedicated length of conduit is operable for delivering inert carrier gas to the length of common conduit that has bypassed all test cells.

6. A method of simultaneously measuring target-analyte transmission rate through a plurality of test films utilizing the target-analyte permeation testing instrument of claim 2, comprising the steps of:

(a) obtaining a target-analyte permeation testing instrument according to claim 2,

(b) loading a test film into each of at least two test cells,

(c) providing a flow of target-analyte containing driving gas through the driving chamber of each test cell containing a test film, and

(d) providing a flow of inert carrier gas through the sensing chamber of each test cell containing a test film, followed by the sequential steps of:

(e) measuring target-analyte concentration in the sensing chamber of a first test cell by setting the associated dedicate valve to flow-through, setting the common valve to flow-through, setting all other dedicated valves to vent, and measuring concentration of target-analyte in fluid communication with the target-analyte sensor,

(f) conditioning the instrument for ensuing measurement of target-analyte concentration in the sensing chamber of a second test cell for a conditioning period by setting the common valve to vent, setting the dedicated valve associated with the sensing chamber of the first test cell to vent, setting the dedicate valve associated with the sensing chamber of the second test cell to flow-through, and leaving all other dedicated valves to vent, and

(g) measuring target-analyte concentration in the sensing chamber of the second test cell by setting the common valve to flow-through.

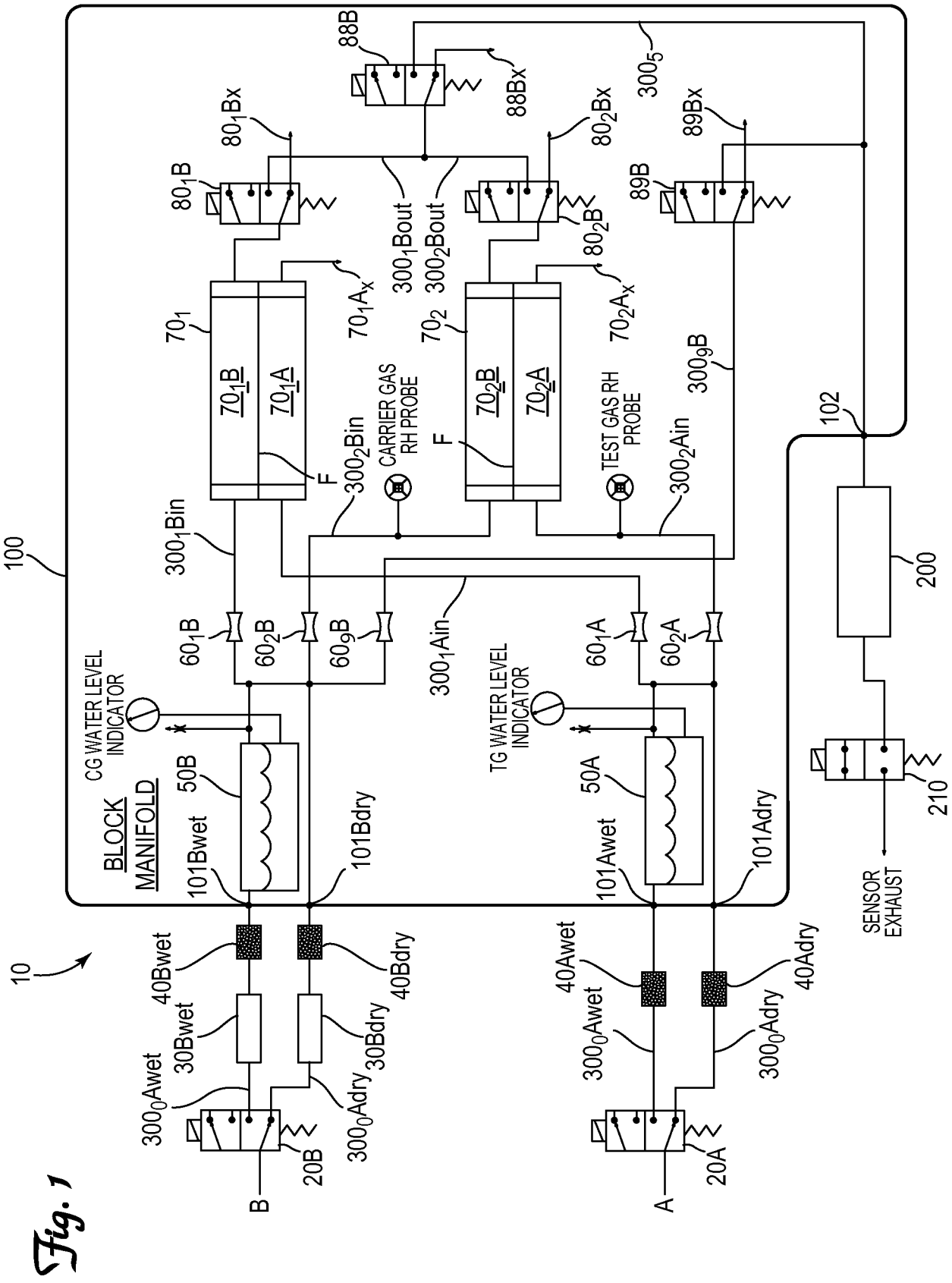

10
100
BLOCK MANIFOLD
CG WATER LEVEL INDICATOR
TG WATER LEVEL INDICATOR
CARRIER GAS RH PROBE
TEST GAS RH PROBE
SENSOR EXHAUST
B
A
F
88B
88Bx
89B
89Bx
50B
50A
102
200
210
20B
20A

Fig. 1

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US15/17196

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - G01N 35/00 (2015.01)
CPC - G01N 35/00
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC(8): B01J 19/00; G01N 15/08, 33/00, 35/00 (2015.01)
CPC: G01N 15/0826, 35/00, 2015/086, 2035/00455

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
PatSeer (US, EP, WO, JP, DE, GB, CN, FR, KR, ES, AU, IN, CA, INPADOC Data); Dialog ProQuest; IP.com; Google; Google Scholar; 'target-analyte,' permeation, testing, instrument, measure, 'target-analyte,' permeation

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y --- A	US 2010/0054998 A1 (MAYER, DW et al.) Mar. 4, 2010; abstract; figure 1; paragraphs [0001], [0008], [0106], [0107]	1, 2 --- 3-6
Y --- A	CA 2432452 C (INVERNESS MEDICAL LIMITED) June 27, 2002; abstract; page 2; lines 29-35; Claims 4, 5	1, 2 --- 3-6
Y	US 6066243 A (ANDERSON, CR et al.) May 23, 2000; abstract; column 9, lines 3-5	2
A	US 2002/0045243 A1 (LASKA, RC et al.) April 18, 2002; paragraph [0006]	3-6

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
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"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
01 May 2015 (01.05.2015)	08 JUN 2015
Name and mailing address of the ISA/ Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-8300	Authorized officer Shane Thomas PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

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