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Tucker

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(54) **DIFFUSER AND SOLIDS COLLECTION AND MEASUREMENT SYSTEM FOR USE IN CONJUNCTION WITH OIL AND GAS WELLS**

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(51) **Int. Cl.**

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B01D 21/02	(2006.01)
E21B 21/06	(2006.01)
B01D 21/00	(2006.01)
E21B 43/34	(2006.01)
B01D 21/30	(2006.01)

(52) **U.S. Cl.**
CPC ***E21B 21/066*** (2013.01); ***B01D 21/003*** (2013.01); ***B01D 21/0042*** (2013.01); ***B01D 21/30*** (2013.01); ***E21B 43/34*** (2013.01)

(58) **Field of Classification Search**
CPC E21B 21/065; E21B 21/066; E21B 43/34; B01D 21/003; B01D 21/0042; B01D 21/245; B01D 21/30
USPC 210/86, 113, 170.01, 521, 532.1, 747.1, 210/801; 175/66, 206; 166/75.12, 267; 73/152.04
See application file for complete search history.

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(57) **ABSTRACT**

A diffuser and solids collection system includes a first baffle section having an input for receiving from a petroleum well a fluid carrying solids and a first set of internal baffles for reducing a velocity of the fluid. A second baffle section in fluid communication with the first baffle section has a second set of internal baffles for further reducing the velocity of the fluid. A solids collection container separates the solids from the fluid received from the second baffle section. A weighing system, supported by the second baffle section and supporting the solids collection container, weighs the solids collected in the solids collection container.

20 Claims, 9 Drawing Sheets

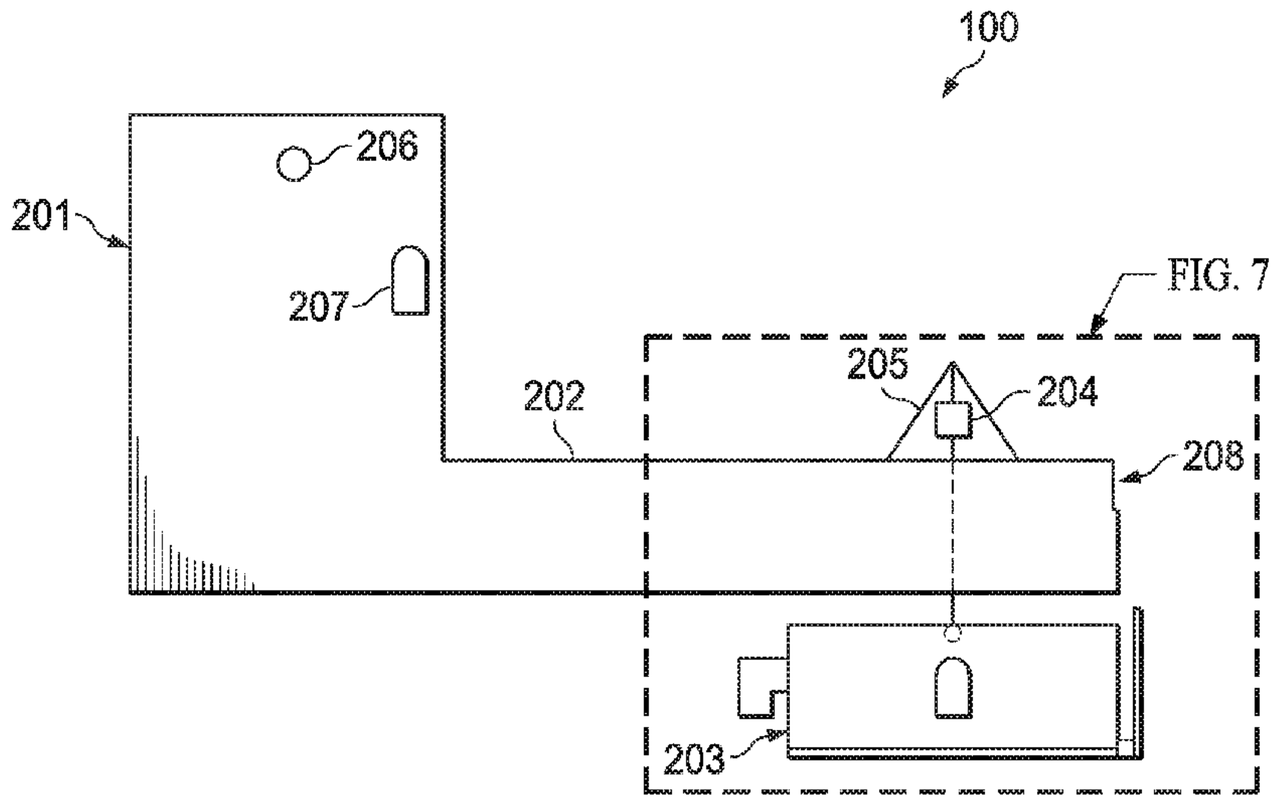

FIG. 7

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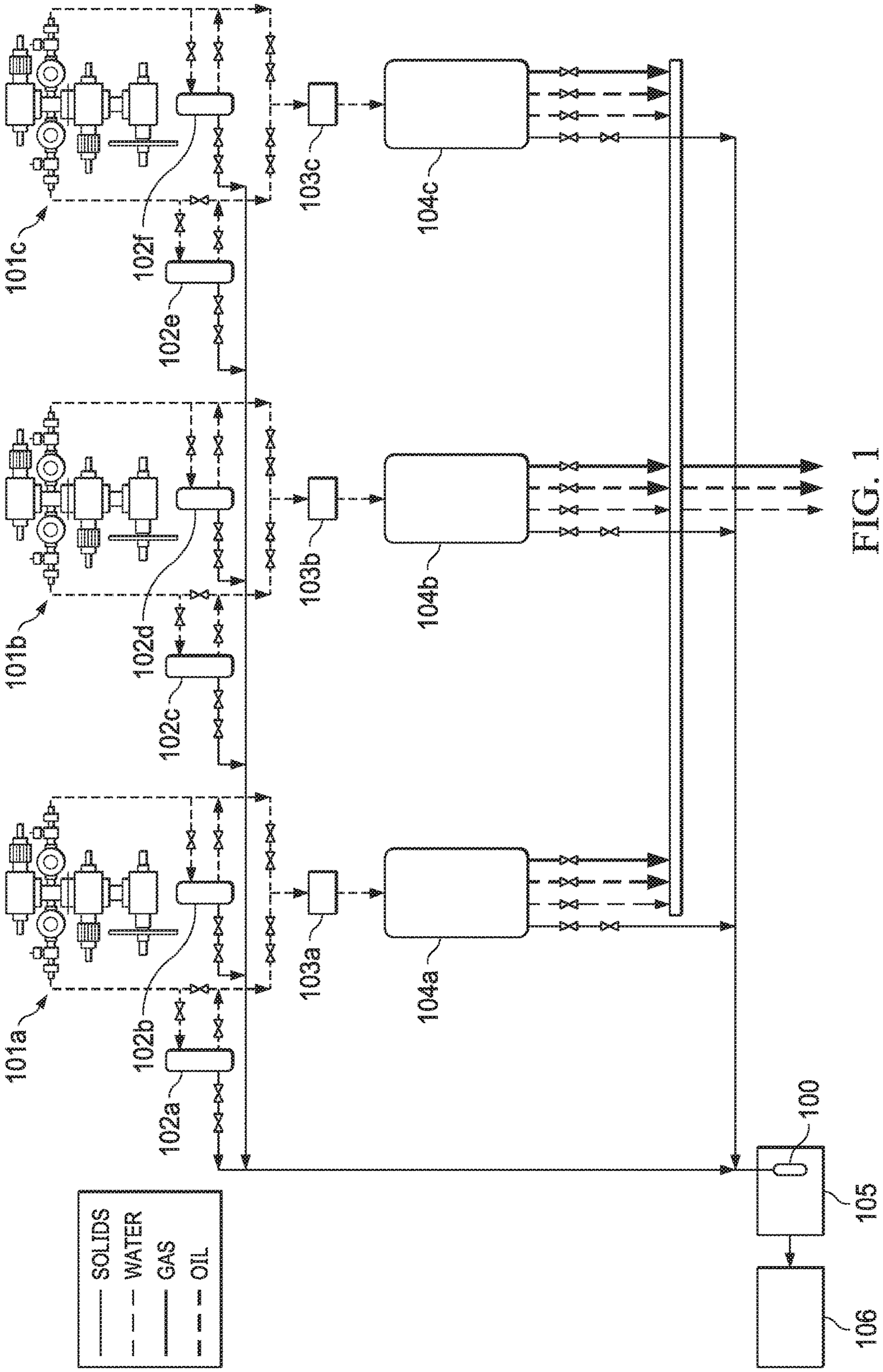
101a
101b
101c
102a
102b
102c
102d
102e
102f
103a
103b
103c
104a
104b
104c
100
105
106
SOLIDS
WATER
GAS
OIL

FIG. 1

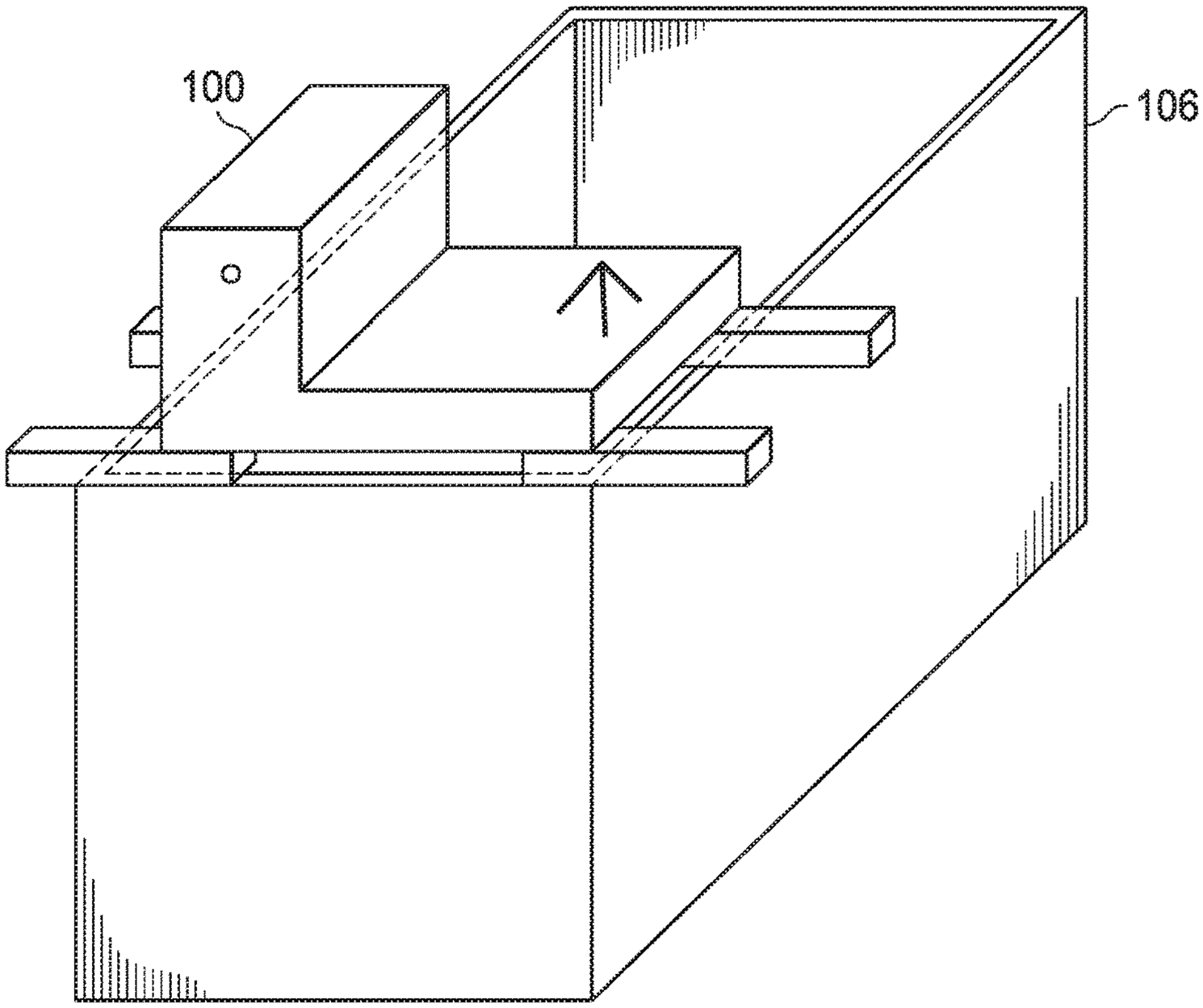

FIG. 2A

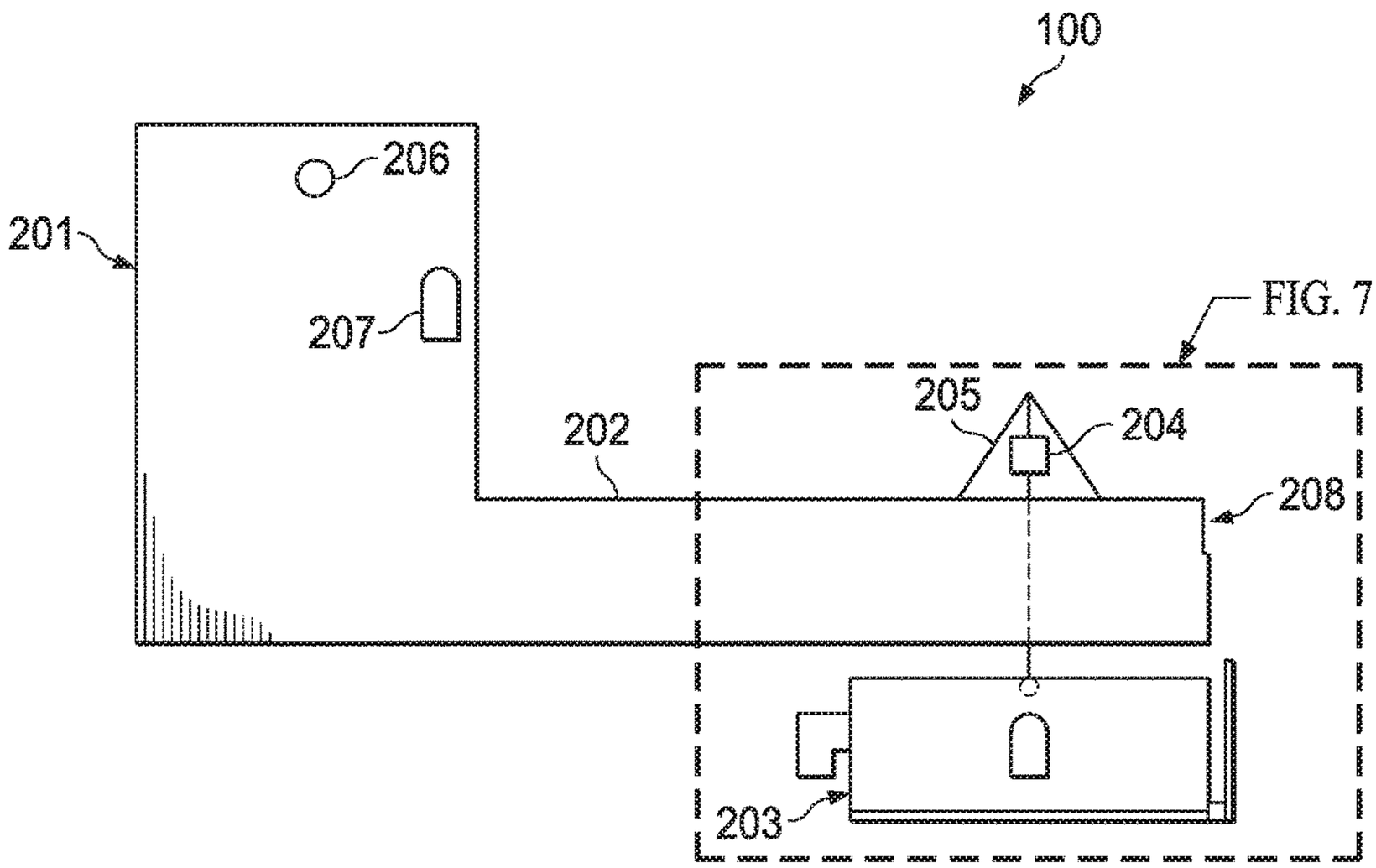

FIG. 2B

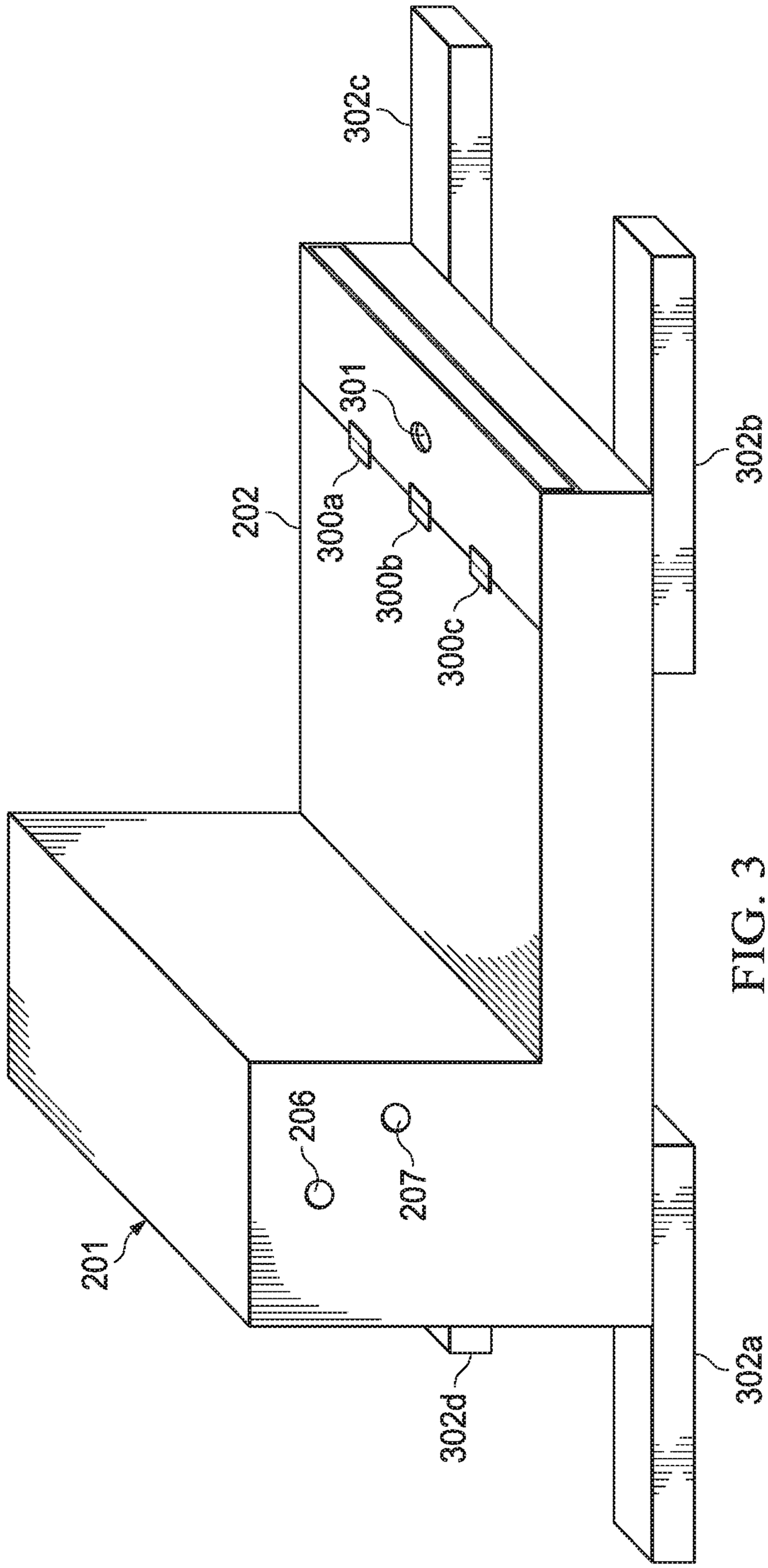

FIG. 3

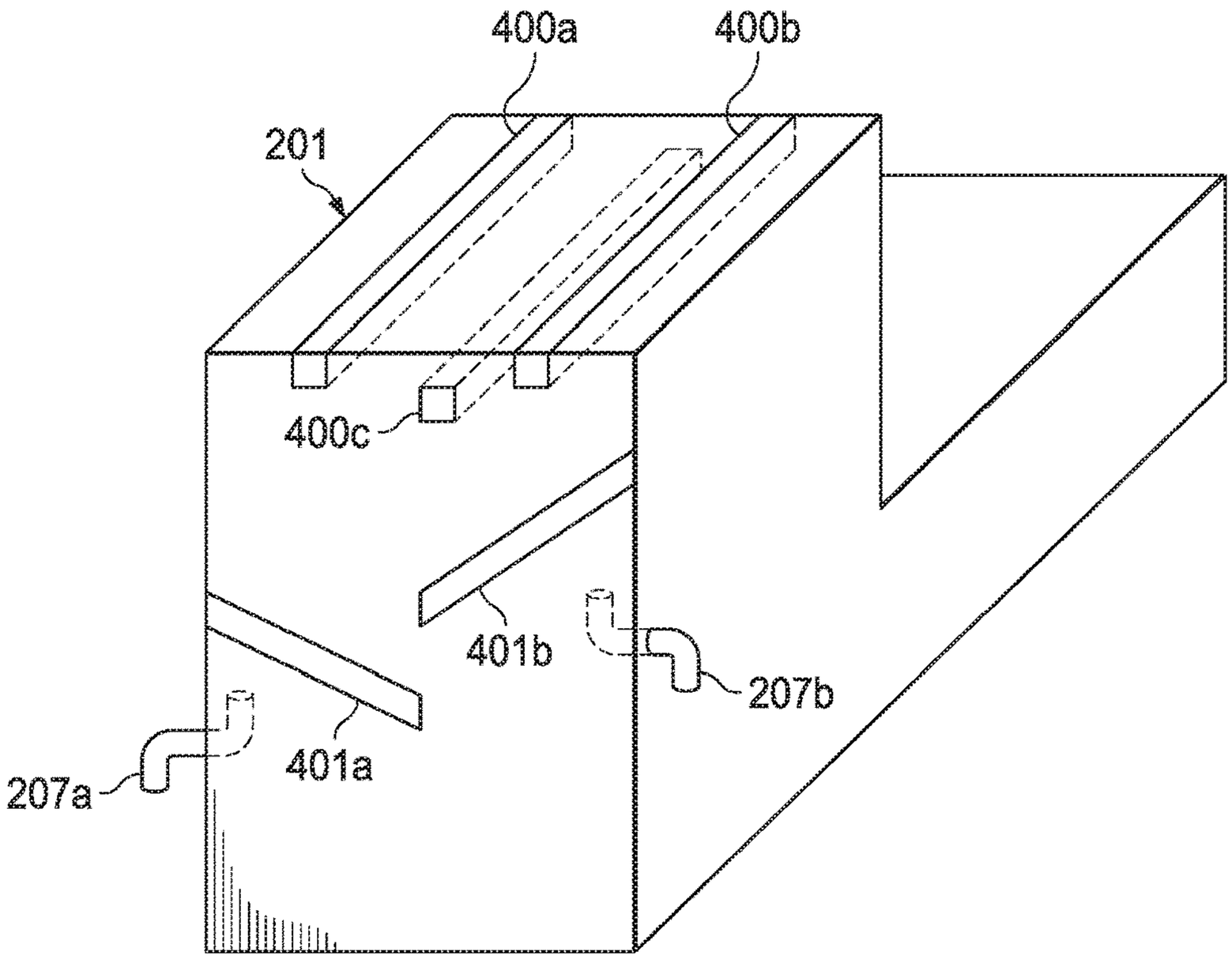
400a
400b
201
400c
401b
207b
207a
401a

FIG. 4A

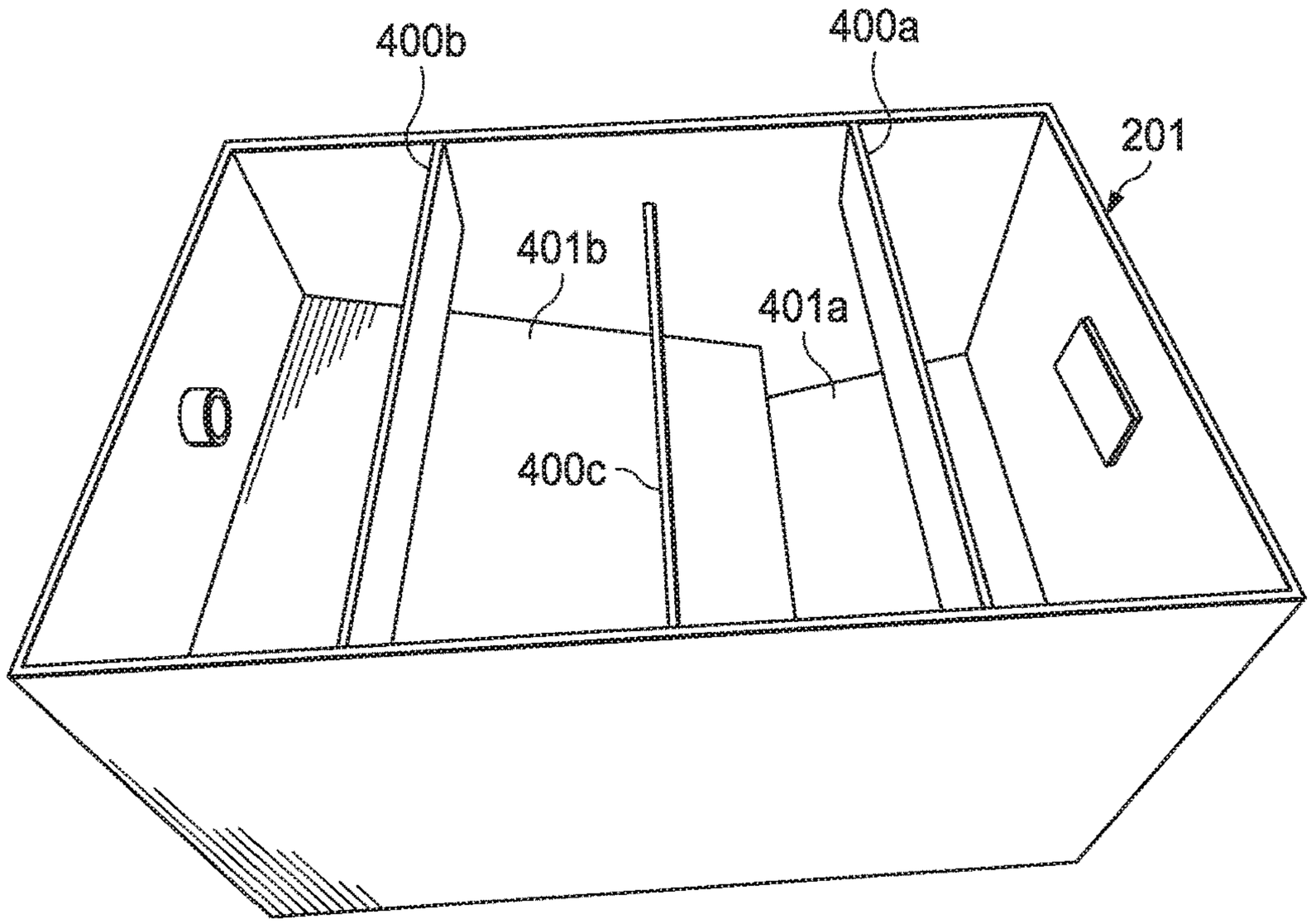
400b
400a
201
401b
401a
400c

FIG. 4B

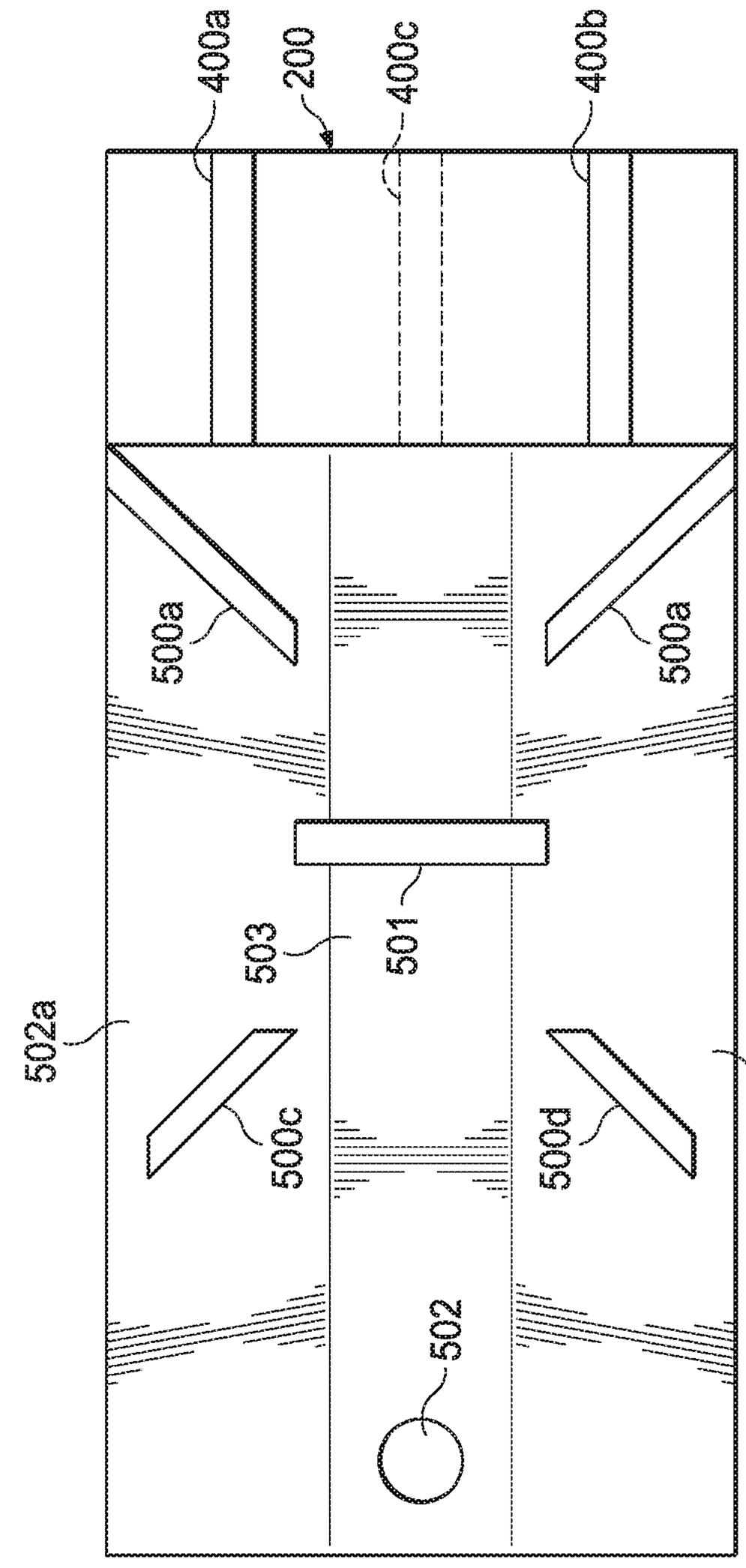

FIG. 5

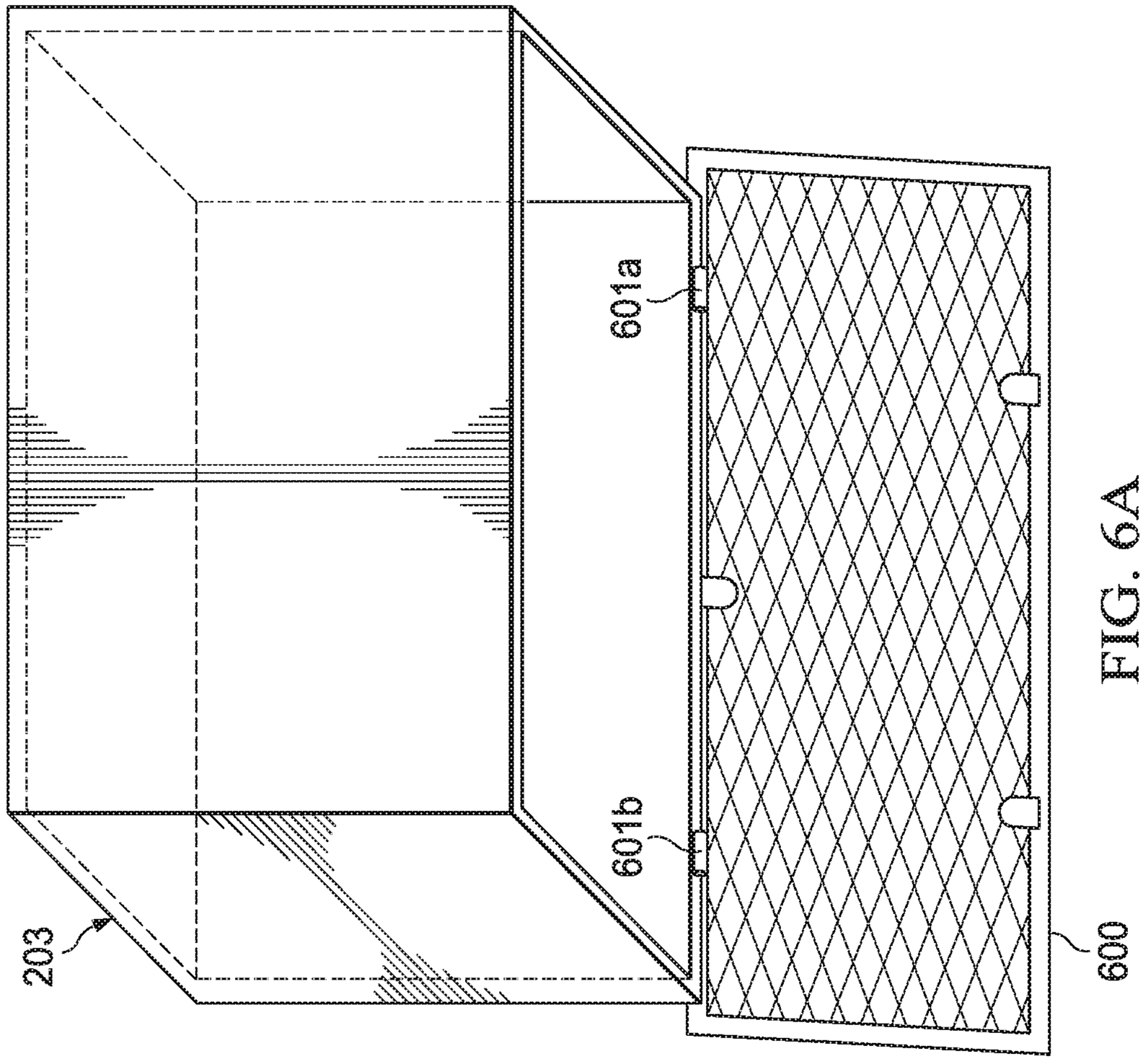

FIG. 6A

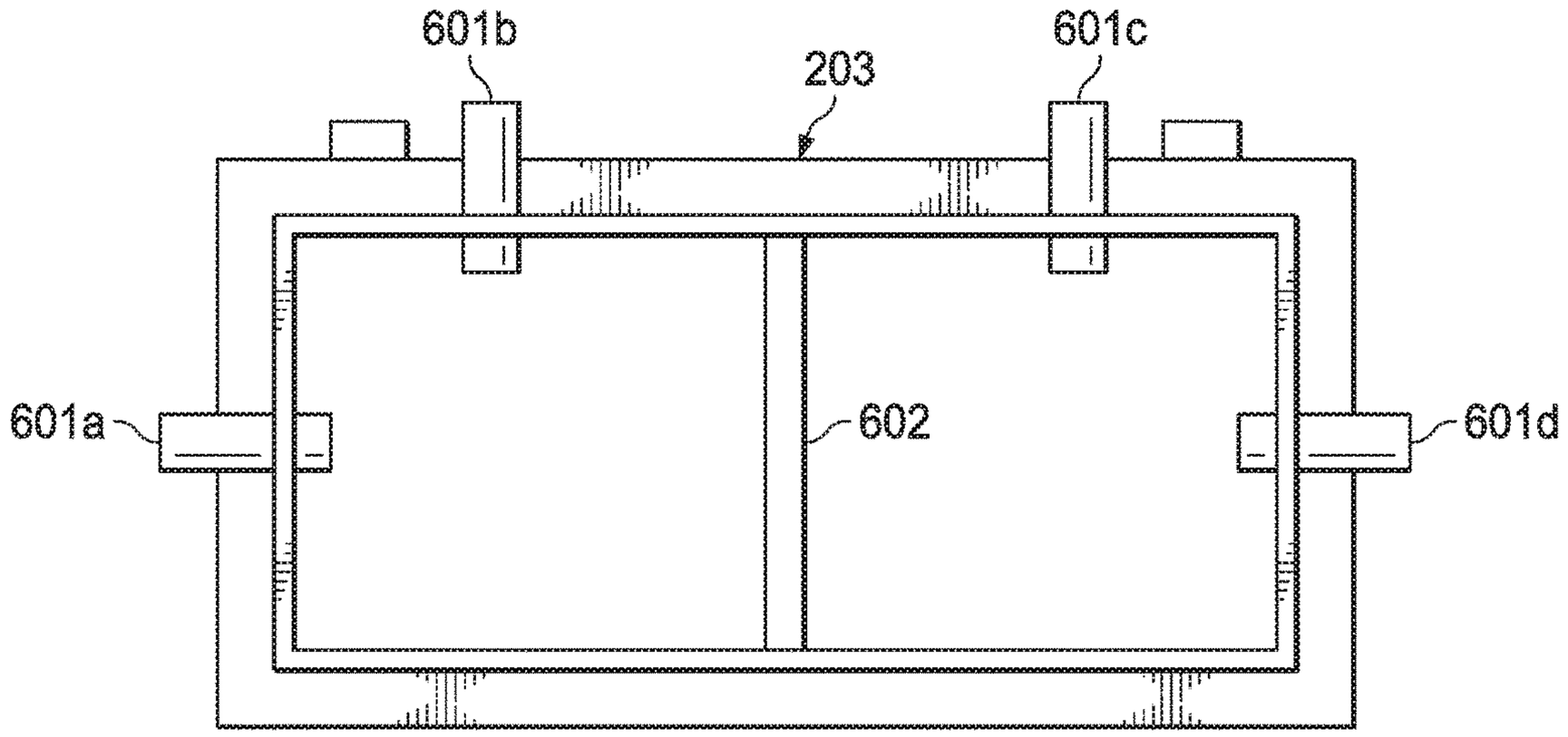

FIG. 6B

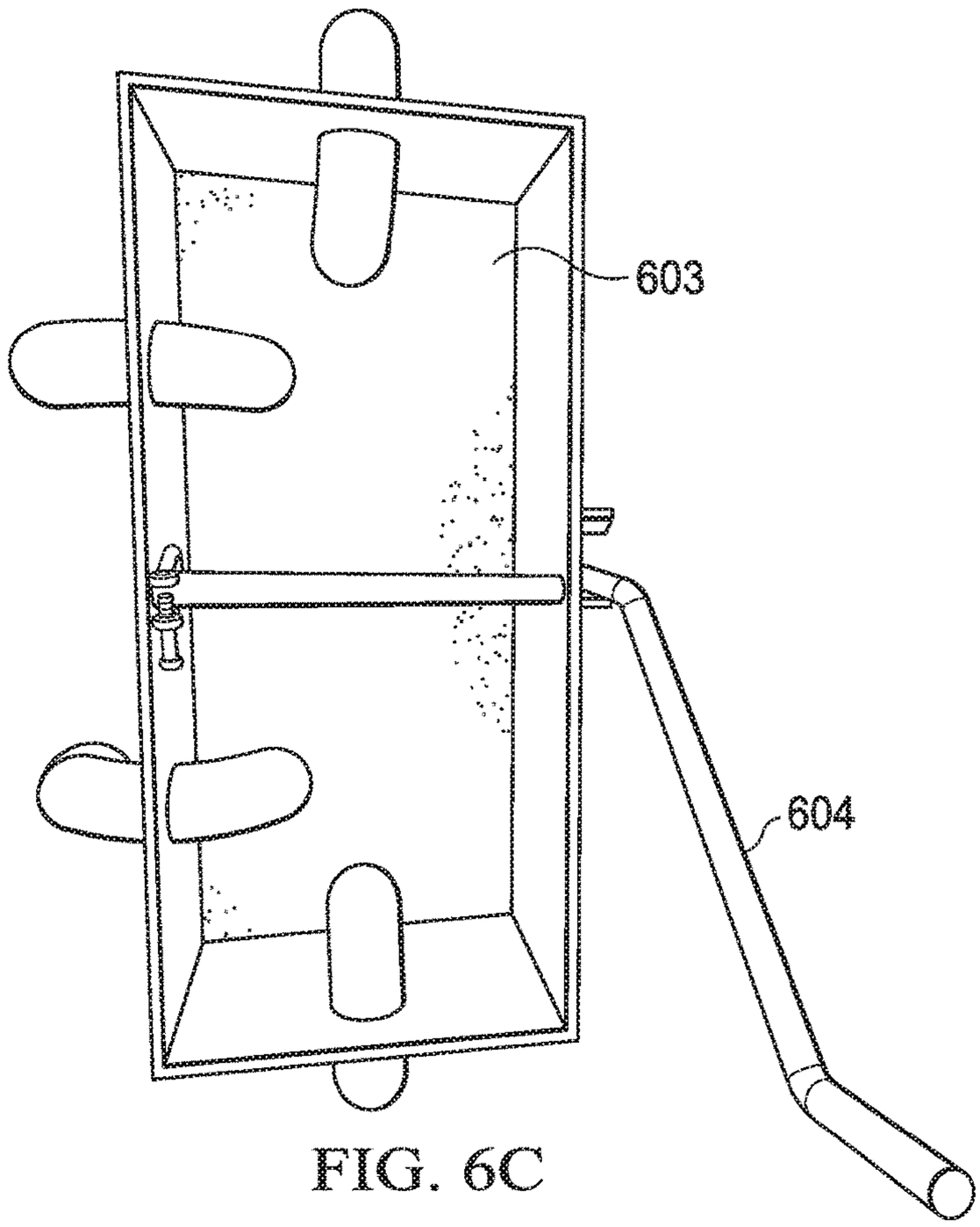

FIG. 6C

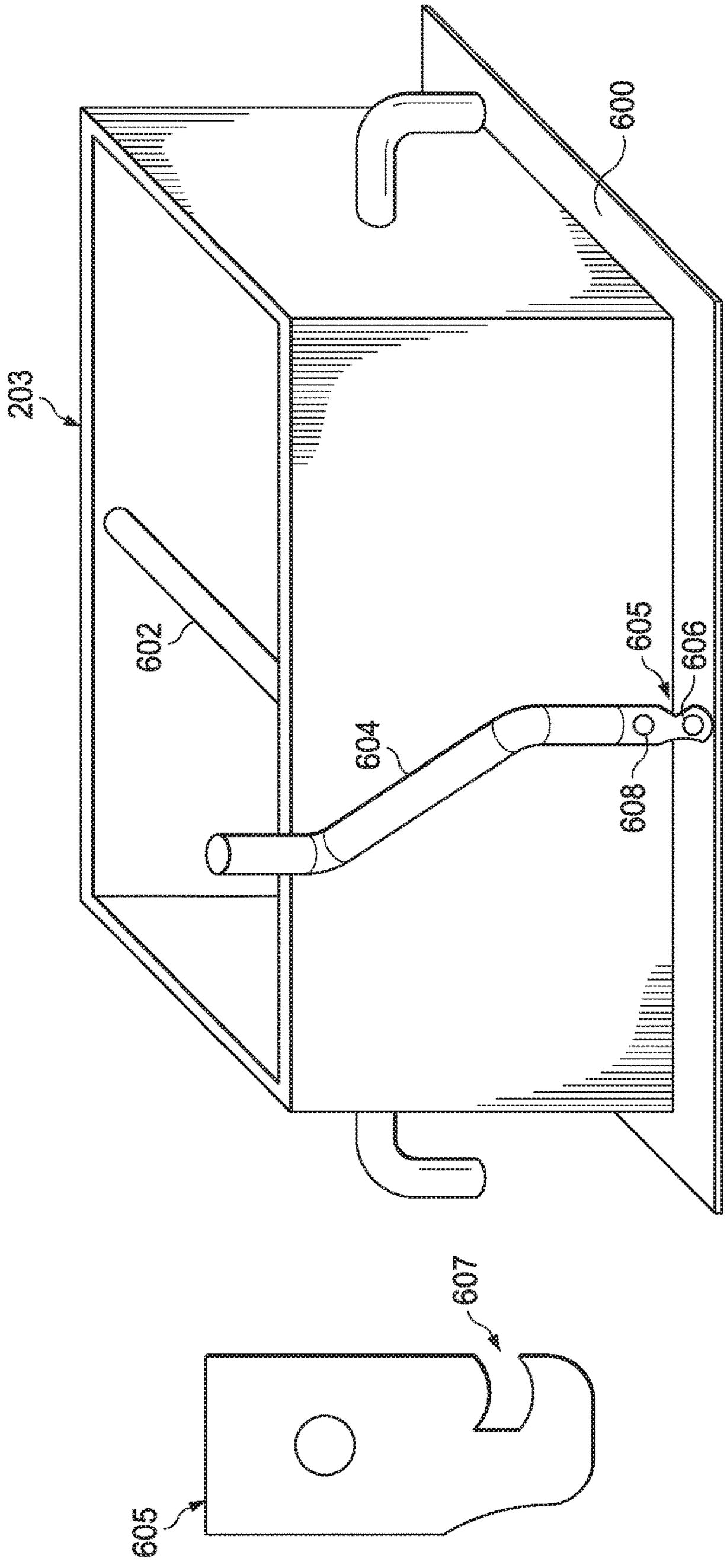

FIG. 6D

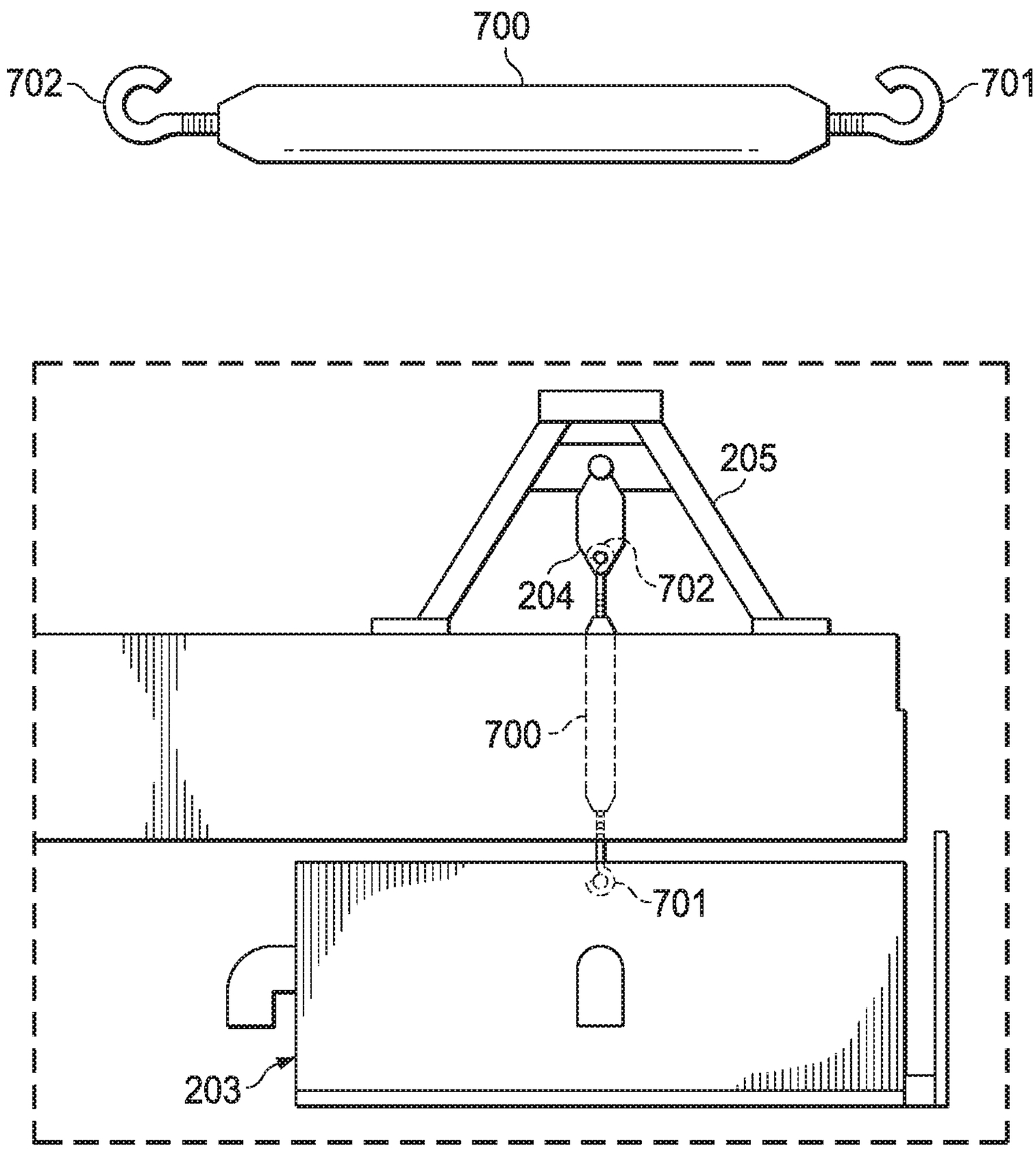

FIG. 7

DIFFUSER AND SOLIDS COLLECTION AND MEASUREMENT SYSTEM FOR USE IN CONJUNCTION WITH OIL AND GAS WELLS

CROSS-REFERENCE TO RELATED APPLICATION

The present application claims the benefit of U.S. Provisional Patent Application Ser. No. 62/680,995, filed Jun. 5, 2018, which is incorporated herein in its entirety for all purposes.

FIELD OF INVENTION

The present invention relates in general to oil and gas operations and in particular to a diffuser and solids collection and measurement system for use in conjunction with oil and gas wells.

BACKGROUND OF INVENTION

In a typical oil well, the oil, gas, water, and solids are produced at the wellhead and then separated. The oil, gas, and usable amounts of water are sent for sale or reuse. The solids, which may include solids such as fracing proppants (e.g., frac sand), are sent to a solids tank for recovery.

In many instances, the amount of solids being output from a given well or group of wells must be monitored. Current methods are based on rough estimates made by personnel observing the output being discharged into the tank. And while it would be advantageous to provide a more accurate and efficient method of determining the amount of solids being produced by a well, the nature of wellhead operations presents some significant challenges for achieving that goal. For example, the solids-bearing water is typically produced under pressure and is therefore discharged it at a high velocity.

SUMMARY OF INVENTION

The principles of the present invention are embodied in a diffuser and solids collector system that provides for the collection of solids discharged from a wellhead and the accurate measurement (e.g., weighing) of the collected solids.

One particular embodiment of these principles is a diffuser and solids collection system, which includes a first baffle section having an input for receiving from a petroleum well a fluid carrying solids and a first set of internal baffles for reducing a velocity of the fluid. A second baffle section in fluid communication with the first baffle section has a second set of internal baffles for further reducing the velocity of the fluid. A solids collection container separates the solids from the fluid received from the second baffle section. A weighing system, supported by the second baffle section and supporting the solids collection container, weighs the solids collected in the solids collection container.

Advantageously, the principles of the present invention allow for an accurate measurement of the solids flowing out of a petroleum well under pressure.

BRIEF DESCRIPTION OF DRAWINGS

For a more complete understanding of the present invention, and the advantages thereof, reference is now made to

the following descriptions taken in conjunction with the accompanying drawings, in which:

FIG. **1** depicts a representative petroleum well serviced by a diffuser and solids collector system according to the principles of the present invention;

FIG. **2**A is a perspective view of an exemplary embodiment of the diffuser and solids collector system FIG. **1**, embodying the principles of the present invention, and as installed over the solids collection tank of FIG. **1**;

FIG. **2**B is a side elevational view of the diffuser and solids collector system of FIG. **2**A;

FIG. **3** is a perspective view of the diffuser and solids collector system of FIG. **2**A;

FIG. **4**A is partial cutaway end view of the diffuser and solids collector system of FIG. **2**A showing the internal baffles of the vertical baffle section;

FIG. **4**B is a cutaway top view of the diffuser and solids collector system of FIG. **2**A showing the internal baffles of the vertical baffle section;

FIG. **5** is a cutaway top view of the diffuser and solids collector system of FIG. **2**A showing the internal baffles of the horizontal baffle section;

FIG. **6**A is a side view of the solids collection box of the diffuser and solids collector system of FIG. **2**A;

FIG. **6**B is a top view of the solids collection box of the diffuser and solids collector system of FIG. **2**A without the bottom release handle in place;

FIG. **6**C is a top view of the solids collection box of the diffuser and solids collector system of FIG. **2**A with the bottom release handle in place;

FIG. **6**D is a top perspective view of the solids collection box of diffuser and solids collector system of FIG. **2**A showing the bottom release mechanism; and

FIG. **7** is a side view of the diffuser and solids collector system of FIG. **2**A showing the weighing system in further detail.

DETAILED DESCRIPTION OF THE INVENTION

The principles of the present invention and their advantages are best understood by referring to the illustrated embodiment depicted in FIGS. **1-7** of the drawings, in which like numbers designate like parts.

FIG. **1** is a diagram of an exemplary petroleum well system including a diffuser and solids collector system **100** embodying the present of the present invention. FIG. **1** shows three (3) petroleum production wells **101***a*-**101***c*, corresponding water/solids separators **102***a*-**102***f*, valve manual manifolds **103***a*-**103***c*, four-phase separators **104***a*-**104***c*, solids tank **105**, and open top tank **106**. In other systems, the manifolds may be choke manifolds and the separators 2- or 3-phase separators.

Solids-bearing water from water/solids separators **102***a*-**102***f* and four phase separators **104***a*-**104***c* are passed to diffuser and solids collector system **100**. As discussed in further detail below, the water bearing solids, such as frac sand, are delivered diffusor and solids collection system **100**, which reduces the fluid velocity, collects the solids, and allows the solids to be weighed. Once a desired amount of solids have been collected an weighed, they are discharged from diffuser and solids collector system **100** into solids tank **105**.

FIG. **2**A partially shows a preferred embodiment of diffuser and solids collection system **100** mounted on the solids tank **106** of FIG. **1**. FIG. **2**B shows the exterior of diffuser and solids collector system **100** in further detail. The illus-

trated embodiment includes a vertical baffle section **201**, a horizontal baffle section **202**, and a particulate (solids) collection box **203**, which is supported by a scale **204** and pyramid support structure **205**.

High-velocity solids-bearing water is received through an inlet **206** near the top a vertical baffle section **201** and passes through a series of internal baffles, discussed in further detail below. Additional baffles within contiguous horizontal baffle section **202** further reduce the fluid velocity.

After the reduction in fluid velocity, the solids-bearing water is discharged through an aperture in the base of horizontal baffle section **202** and into particulate collection box **203**. Particulate collection box **203** includes filter material supported by a hinged screen on the base. The hinged screen is associated with a handle and release mechanism, which allow a lateral edge of the hinged screen to be released and the collected solids to be dumped into solids tank **105** below, once those solids have been weighed by scale **204**.

FIG. **3** provides an alternate view of diffuser and solids collector system **100**. Vertical baffle section **201** includes vents **207** on opposing sides for discharging gases accumulated during the diffusion process. The upper surface of the horizontal baffle section **202** includes an aperture through which a turnbuckle extends, as discussed below, to couple scale **204** with particulate collection box **203**. Supports **302** at the four corners are provided for supporting diffuser and solids collector system **100** on the walls of solids tank **105** during use. Hinges **300***a*-**300***c* allow a portion of the upper surface of horizontal baffle section **202** to swing open for internal access.

FIGS. **4**A-**4**B show the preferred vertical baffle section **201** in further detail. As shown in FIGS. **4**A and **4**B, three (3) elongated internal rectangular baffles **400***a*-**400***c* are provided near the top of vertical baffle section **201**, along with two (2) slanted planar baffles **401***a*-**401***b* extending from opposing sidewalls. (The principles of the present invention are not limited to this configuration, and in alternate embodiments, the number of rectangular and/or slanted baffles, as well as their positioning, may vary. In addition, the number and location of vents **207** and fluid inlet **206** may also vary in alternate embodiments.)

A preferred configuration of horizontal baffle section **202** is shown in FIG. **5**. In the embodiment, four (4) baffles **500***a*-**500***d* extend upward from the angled side-sections **502***a*-**502***b* of the floor and at an angle to the horizontal baffle section **202** lateral sidewalls. A rectangular baffle **501** extends upward from the flat portion **503** of the floor and perpendicular to the lateral sidewalls. In alternate embodiments, the number and configuration of the baffles of the horizontal baffle section **202** may vary. Aperture **502** through the floor allows a turn buckle to extend through the interior of horizontal baffle section **202** for coupling particulate collection box **203** with scale **204**, as well as to allow solid-bearing water to discharge into particulate collection box **203**.

FIGS. **6**A-**6**D illustrate the preferred configuration of particulate collection box **203**. The bottom of the solids collection box is a hinged screen **600** as shown in FIG. **6**A. A crossbar **602**, as shown in FIG. **6**B, provides structural support, as well as a grasping point for the turnbuckle hook. Four (4) vents **601***a*-**601***d* are provided for discharging gas (FIG. **6**B).

As shown in FIG. **6**C, filter material **603** is disposed across hinged screen **600** for capturing solids as water is discharged through the bottom of particulate collection box **203** into solids tank **105**. Once the solids have been collected and weighed, hinged screen **600** is released using the release mechanism of FIG. **6**D.

The release mechanism includes a release handle **604** and a rotating latch **605**, which includes a slot **607** for engaging a pin **606** extending from the free (non-hinged) side of hinged screen **600**. Rotation of the latch around pivot point **608** is controlled by handle **604**. When hinged screen **600** is the closed position, pin **606** on hinged screen **600** slides into slot **607** of rotating latch **605**. To release hinged screen **600**, and allow the free edge to fall, handle **604** is rotated such that latch **605** rotates away from pin **606** and pin **606** exits slot **607** in the latch **605**.

The weighing system is shown in FIG. **7** for the preferred embodiment of diffuser and solids collector system **100**. A pyramid support is disposed on the upper side of the horizontal baffle section. As discussed above, pyramid support **205** supports a scale **204**. A turnbuckle **700**, which is coupled to scale **704** by a hook **702**, extends through aperture **301** on the upper surface of horizontal baffle section **202** and aperture **502** through the floor of horizontal baffle section **202**. An opposing hook **701** couples to crossbar **602** of particle collection box **203**. The solids captured by particulate collection box **203** and particulate collection box **203** itself are weighed together and the tare taken to determine the weight of the solids alone.

The primary components of diffuser and solids collector system **100** including vertical baffle section **201** and internal baffles **400** and **402**, horizontal baffle section **202** and internal baffles **500** and **501**, and particulate (solids) collection box **203**, are preferably fabricated from steel. In alternate embodiments, other materials capable of withstanding the stresses from use of diffuser and solids collector system **100** in the petroleum fields may be used.

Although the invention has been described with reference to specific embodiments, these descriptions are not meant to be construed in a limiting sense. Various modifications of the disclosed embodiments, as well as alternative embodiments of the invention, will become apparent to persons skilled in the art upon reference to the description of the invention. It should be appreciated by those skilled in the art that the conception and the specific embodiment disclosed might be readily utilized as a basis for modifying or designing other structures for carrying out the same purposes of the present invention. It should also be realized by those skilled in the art that such equivalent constructions do not depart from the spirit and scope of the invention as set forth in the appended claims.

It is therefore contemplated that the claims will cover any such modifications or embodiments that fall within the true scope of the invention.

What is claimed is:

1. A diffuser and solids collection system comprising:

a first baffle section having an input for receiving from a petroleum well a fluid carrying solids and a first set of internal baffles for reducing a velocity of the fluid;

a second baffle section in fluid communication with the first baffle section and having a second set of internal baffles for reducing the velocity of the fluid;

a solids collection container in fluid communication with the second baffle section for separating the solids from the fluid received from the second baffle section; and

a weighing system supported by the second baffle section and supporting the solids collection container for weighing the solids collected in the solids collection container.

2. The system of claim 1, wherein the first set of baffles of the first baffle section comprises a plurality of vertically spaced-apart baffles supported by sidewalls of the first baffle section.

3. The system of claim 2, wherein plurality of vertically spaced-apart baffles of the first baffle section comprise a first angled baffle extending downward from a first sidewall and a second angled baffle extending downward from a second opposing sidewall.

4. The system of claim 2, wherein the plurality of vertically spaced-apart baffles of the first baffle section comprise a plurality of laterally spaced apart vertically aligned baffles extending between first and second opposing sidewalls of first baffle section.

5. The system of claim 1, wherein the second set of baffles of the second baffle section comprises a plurality of laterally spaced baffles extending upward from a floor of the second baffle section.

6. The system of claim 5, wherein the plurality of laterally spaced baffles extending upward from a floor of the second baffle section comprise at least one baffle extending inward at an angle to a sidewall of the second baffle section.

7. The system of claim 5, wherein the plurality of laterally spaced baffles extending upward from a floor of the second baffle section comprise at least one baffle disposed substantially perpendicular to a sidewall of the second baffle section.

8. The system of claim 1, wherein the solids collection container comprises:

a hinged screen forming a bottom of the solids collection container; and

a latching mechanism for latching the hinged screen in a closed position during the collection of the solids and releasing the hinged screen to discharge the collected solids from the solids collection container.

9. The system of claim 1, wherein the weighing system comprises:

a support structure supported by an upper surface of the second baffle section;

a scale supported by the support structure; and

a coupling mechanism coupled to the scale and extending through apertures through upper and lower walls of the second baffle section to couple with the solids collections container.

10. A solids measurement system for measuring solids discharged from a petroleum well comprising:

a vertical baffle section having an input for receiving from a petroleum well a fluid carrying solids and a set of vertically spaced internal baffles for reducing a velocity of the fluid;

a horizontal baffle section having a set of horizontally spaced internal baffles for reducing the velocity of the fluid discharged from the vertical baffle section;

a solids collection container for separating the solids from the fluid discharged from the horizontal baffle section; and

a weighing system for weighing the solids collected in the solids collection container.

11. The system of claim 10, wherein the solids collection container comprises:

a hinged screen forming a bottom of the solids collection container; and

a latching mechanism for latching the hinged screen in a closed position during the collection of the solids and releasing the hinged screen to discharge the collected solids from the solids collection container.

12. The system of claim 11, further comprising a filter material disposed across the hinged screen for separating the solids from the fluid.

13. The system of claim 10, wherein the weighing system comprises:

a support structure supported by an upper surface of the horizontal baffle section;

a scale supported by the support structure; and

a coupling mechanism coupled to the scale and extending through apertures through upper and lower walls of the horizontal baffle section to couple with the solids collections container.

14. The system of claim 13, wherein the coupling mechanism comprises a turnbuckle.

15. The system of claim 10, wherein the set of vertically spaced internal baffles of the vertical baffle section comprise at least one angled baffle extending downward from a sidewall of the vertical baffle section.

16. The system of claim 10, wherein the set of horizontally spaced internal baffles of the horizontal baffle section extend upward from a floor of the horizontal baffle section.

17. The system of claim 10, wherein at least part of the vertical baffle section is fabricated from steel.

18. The system of claim 10, wherein at least part of the horizontal baffle section is fabricated from steel.

19. The system of claim 10, wherein at least part of the solids collection container is fabricated from steel.

20. A method of measuring solids discharged from a petroleum well comprising:

receiving from a petroleum well a fluid carrying solids;

reducing a velocity of the fluid with a vertical baffle section having a set of vertically spaced internal baffles;

reducing the velocity of the fluid discharged from the vertical baffle section with a horizontal baffle section having a set of horizontally spaced internal baffles;

separating the solids from the fluid discharged from the horizontal baffle section with a solids collection container supported by the horizontal baffle section; and

weighing the solids collected in the solids collection container with a weighing system supported by the horizontal baffle section.

* * * * *