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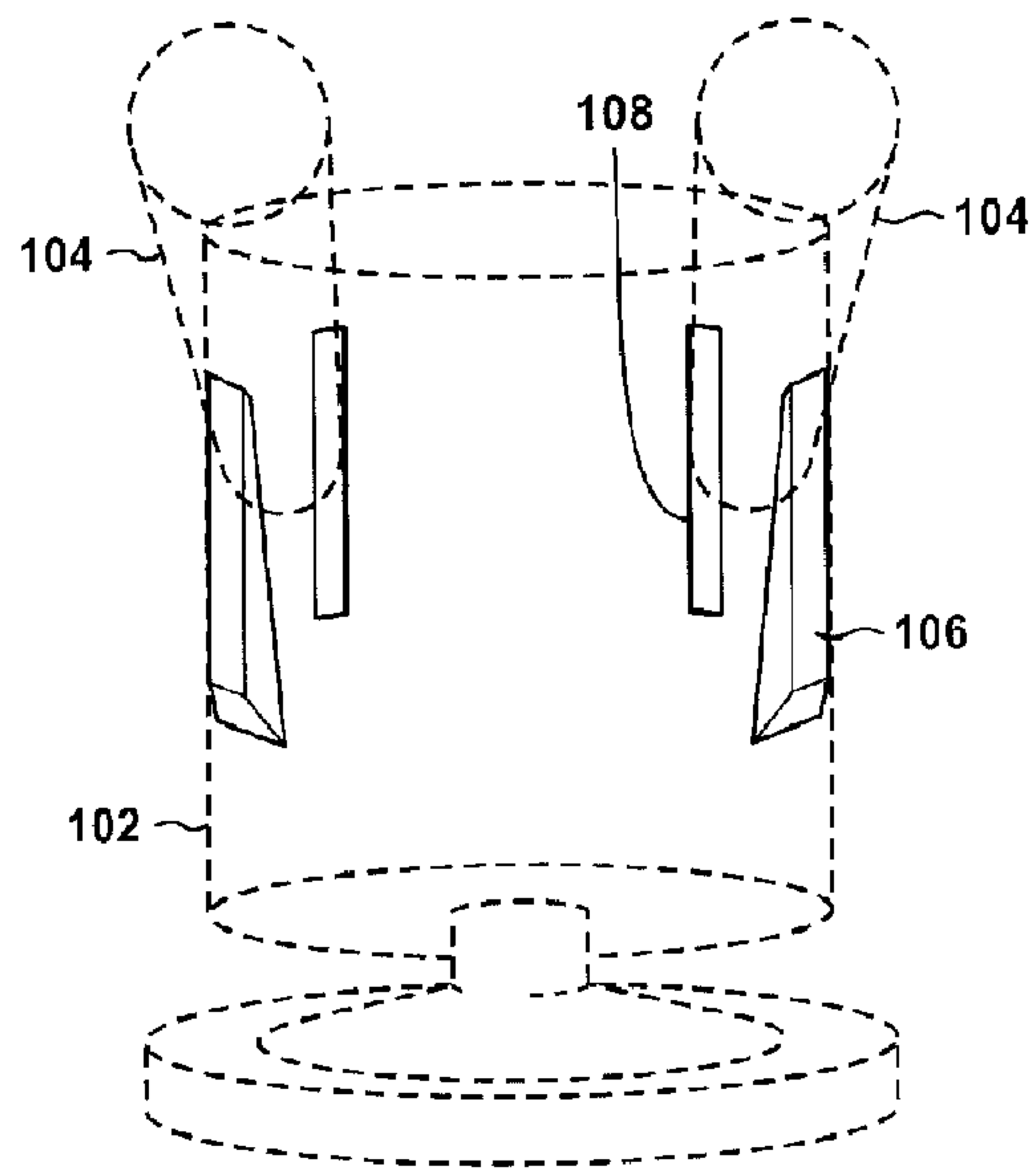
(54) Title: FEEDWELL SYSTEM FOR A SEPARATION VESSEL



(57) **Abrégé/Abstract**:
A feedwell system for delivering a slurry to a separation vessel, the system comprising: a feedwell barrel for containing and controlling the slurry; one or more inlet pipes leading into the feedwell barrel for tangentially introducing the slurry into the feedwell barrel to cause the slurry to swirl around the feedwell barrel; and a series of spaced-apart baffles disposed around an inner perimeter of the feedwell barrel for dissipating inflow energy and limiting an internal circulation field within the feedwell barrel, wherein the series of spaced- apart baffles comprises one or more inlet baffles configured to direct the slurry downwardly in the feedwell barrel and against a direction of introduction of the slurry; the feedwell barrel having a bottom with an outlet therein to allow discharge of the slurry.

ABSTRACT

A feedwell system for delivering a slurry to a separation vessel, the system comprising: a feedwell barrel for containing and controlling the slurry; one or more inlet pipes leading into the feedwell barrel for tangentially introducing the slurry into the feedwell barrel to cause the slurry to swirl around the feedwell barrel; and a series of spaced-apart baffles disposed around an inner perimeter of the feedwell barrel for dissipating inflow energy and limiting an internal circulation field within the feedwell barrel, wherein the series of spaced-apart baffles comprises one or more inlet baffles configured to direct the slurry downwardly in the feedwell barrel and against a direction of introduction of the slurry; the feedwell barrel having a bottom with an outlet therein to allow discharge of the slurry.

FEEDWELL SYSTEM FOR A SEPARATION VESSEL

BACKGROUND

FIELD OF DISCLOSURE

[0001] The present disclosure is in the field of separation vessels. More particularly, the present disclosure relates to feed delivery in separation vessels.

DESCRIPTION OF RELATED ART

[0002] This section is intended to introduce various aspects of the art, which may be associated with the present disclosure. This discussion is believed to assist in providing a framework to facilitate a better understanding of particular aspects of the present disclosure. Accordingly, it should be understood that this section should be read in this light, and not necessarily as admissions of prior art.

[0003] Separation vessels are used in various fields, for instance to separate solid particles from liquid particles in a slurry. One such field is bitumen extraction from mined oil sand.

[0004] Processes for extracting bitumen from mined oil sand commonly employ the steps of bitumen extraction, bitumen froth separation, and froth treatment. An example of such a process will now be provided, although different processes exist.

[0005] Oil sand is supplied from a mine, mixed with water to form a slurry, and separated from rocks and debris. The slurry is conditioned by adding air, and optionally chemical additives such as caustic (sodium hydroxide). Conditioning serves to liberate the bitumen from the oil sand and aerate the bitumen to produce buoyant bitumen droplets. The slurry is sent to a primary separation cell/vessel (PSV) where the aerated bitumen droplets separate from most of the solids to form bitumen froth. PSV's are typically large conical gravity separation vessels designed to provide a sufficient residence time in a low mixing energy environment to allow buoyancy forces to separate the bitumen froth from the slurry. The slurry is supplied to the PSV through a feed pipe at sufficient velocity to limit solids deposition and this flow enters a central feedwell where it is distributed radially into the vessel. Lighter bitumen droplets rise through the froth underwash layer and accumulate in the froth layer at the top of

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the vessel where it overflows a weir and is sent for further processing. A supplementary hot water underwash flow is supplied under the bitumen froth layer to assist with removal of fine solid particles and to increase froth temperature. The fine, near neutral buoyancy particles tend to be suspended in the middlings zone of the vessel and are either drawn with the middlings stream to flotation for additional processing or pumped away in an underflow stream.

[0006] The bitumen froth product stream from the PSV comprises bitumen, water and fine solids (also referred to as fine mineral solids). A typical composition of bitumen froth is about 60 wt% bitumen, 30 wt% water, and 10 wt% solids. This froth is then treated to separate out the bitumen from the water and solids. The tailings stream from the PSV comprises coarse solids, some fine solids, water, and residual bitumen.

[0007] Thus, PSVs typically employed in water-based mined oil sand separation systems are used to separate bitumen and solids in a three-phase separation process. Preferably, the PSV should provide high recovery of bitumen, clean bitumen froth (with low solids concentration), low wear leading to low maintenance, and good performance over the range of expected operating conditions. To meet these performance goals, the central feedwell should take the varying incoming feed stream and distribute it evenly in all azimuthal directions and minimize mixing motions that would disturb the PSV hydrodynamics.

[0008] One known PSV feedwell is the Syncrude Aurora feedwell design described in Tyler, J., Spence, J. Kiel, D., Schaan, J. Larson, G. (2009) "The Use of Physical Modeling in the Optimization of a Primary Separation Vessel Feedwell", The Canadian Journal of Chemical Engineering. A feed inlet enters tangentially into an open barrel which allows excess air to escape. The flow swirls through the barrel with eight radial baffles of increasing size in the direction of the swirl. The flow discharges from an orifice at the bottom of the barrel, and through a short downpipe onto a conical deflector plate.

[0009] Canadian Patent No. 2,734,811 (Sury et al.) describes a feedwell system for delivering a slurry to a separation vessel. The system includes a feedwell barrel with an inlet for receiving the slurry, internal baffles, and a bottom outlet. A downpipe extends from the bottom of the barrel directing the existing slurry onto a deflector plate deflecting the slurry radially and outwardly. A protector plate located between the downpipe and the deflector plate improves the underwash layer stability. Ventilation openings in the protector plate induce inflow which reduces the discharge velocity, limits the formation of an adverse pressure gradient and encourages circumferential distribution.

SUMMARY

[0010] Generally, the present invention provides, in one aspect, a feedwell system for delivering a slurry (for example a bituminous slurry) to a separation vessel (for example a primary separation vessel). The system includes a feedwell barrel and one or more inlet pipes for receiving the slurry, internal baffles, and a bottom outlet. The system includes at least one inlet baffle configured to direct the slurry downwardly in the feedwell barrel and against a direction of introduction of the slurry.

[0011] In one aspect, there is provided a feedwell system for delivering a slurry to a separation vessel, the system comprising: a feedwell barrel for containing and controlling the slurry; one or more inlet pipes leading into the feedwell barrel for tangentially introducing the slurry into the feedwell barrel to cause the slurry to swirl around the feedwell barrel; and a series of spaced-apart baffles disposed around an inner perimeter of the feedwell barrel for dissipating inflow energy and limiting an internal circulation field within the feedwell barrel, wherein the series of spaced-apart baffles comprises one or more inlet baffles configured to direct the slurry downwardly in the feedwell barrel and against a direction of introduction of the slurry; the feedwell barrel having a bottom with an outlet therein to allow discharge of the slurry.

[0012] The foregoing has broadly outlined the features of the present disclosure so that the detailed description that follows may be better understood. Additional features will also be described herein.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] These and other features, aspects and advantages of the disclosure will become apparent from the following description, appending claims and the accompanying drawings, which are briefly described below.

[0014] Fig. 1 is a schematic of a feedwell system described herein.

[0015] Fig. 2 is a schematic of a feedwell system described herein.

[0016] Fig. 3A is a schematic of a prior art feedwell system.

[0017] Fig. 3B is a schematic of a feedwell system described herein.

[0018] Fig. 4 is a graph of spatial non-uniformity of flow rate as calculated using computational fluid dynamics (CFD) for a prior art feedwell system.

[0019] Fig. 5 is a graph of CFD-calculated flow rate non-uniformity for a feedwell system described herein with dual-inlet operation.

[0020] Fig. 6 is a graph of CFD-calculated flow rate non-uniformity for a feedwell system described herein with single-inlet operation.

[0021] Fig. 7 is a graph of maldistribution as a function of ore rate.

[0022] It should be noted that the figures are merely examples and no limitations on the scope of the present disclosure are intended thereby. Further, the figures are generally not drawn to scale, but are drafted for purposes of convenience and clarity in illustrating various aspects of the disclosure.

DETAILED DESCRIPTION

[0023] For the purpose of promoting an understanding of the principles of the disclosure, reference will now be made to the features illustrated in the drawings and specific language will be used to describe the same. It will nevertheless be understood that no limitation of the scope of the disclosure is thereby intended. Any alterations and further modifications, and any further applications of the principles of the disclosure as described herein are contemplated as would normally occur to one skilled in the art to which the disclosure relates. It will be apparent to those skilled in the relevant art that some features that are not relevant to the present disclosure may not be shown in the drawings for the sake of clarity.

[0024] At the outset, for ease of reference, certain terms used in this application and their meaning as used in this context are set forth below. To the extent a term used herein is not defined below, it should be given the broadest definition persons in the pertinent art have given that term as reflected in at least one printed publication or issued patent. Further, the present processes are not limited by the usage of the terms shown below, as all equivalents, synonyms, new developments and terms or processes that serve the same or a similar purpose are considered to be within the scope of the present disclosure.

[0025] Throughout this disclosure, where a range is used, any number between or inclusive of the range is implied.

[0026] A "hydrocarbon" is an organic compound that primarily includes the elements of hydrogen and carbon, although nitrogen, sulfur, oxygen, metals, or any number of other elements may be present in small amounts. Hydrocarbons generally refer to components found in heavy oil or in oil sand. However, the techniques described are not limited to heavy oils but may also be used with any number of other reservoirs to improve gravity drainage of liquids. Hydrocarbon compounds may be aliphatic or aromatic, and may be straight chained, branched, or partially or fully cyclic.

[0027] "Bitumen" is a naturally occurring heavy oil material. Generally, it is the hydrocarbon component found in oil sand. Bitumen can vary in composition depending upon the degree of loss of more volatile components. It can vary from a very viscous, tar-like, semi-solid material to solid forms. The hydrocarbon types found in bitumen can include aliphatics, aromatics, resins, and asphaltenes. A typical bitumen might be composed of:

19 weight (wt.) % aliphatics (which can range from 5 wt. % - 30 wt. %, or higher);

19 wt. % asphaltenes (which can range from 5 wt. % - 30 wt. %, or higher);

30 wt. % aromatics (which can range from 15 wt. % - 50 wt. %, or higher);

32 wt. % resins (which can range from 15 wt. % - 50 wt. %, or higher); and

some amount of sulfur (which can range in excess of 7 wt. %), based on a weight of the bitumen.

In addition, bitumen can contain some water and nitrogen compounds ranging from less than 0.4 wt. % to in excess of 0.7 wt. %, based on a weight of the bitumen. The percentage of the hydrocarbon found in bitumen can vary. The term "heavy oil" includes bitumen as well as lighter materials that may be found in a sand or carbonate reservoir.

[0028] "Heavy oil" includes oils which are classified by the American Petroleum Institute ("API"), as heavy oils, extra heavy oils, or bitumens. The term "heavy oil" includes bitumen. Heavy oil may have a viscosity of about 1,000 centipoise (cP) or more, 10,000 cP or more, 100,000 cP or more, or 1,000,000 cP or more. In general, a heavy oil has an API gravity between 22.3° API (density of 920 kilograms per meter cubed (kg/m^3) or 0.920 grams per centimeter cubed (g/cm^3)) and 10.0° API (density of 1,000 kg/m^3 or 1 g/cm^3). An extra heavy oil, in general, has an API gravity of less than 10.0° API (density greater than 1,000 kg/m^3 or 1 g/cm^3). For example, a source of heavy oil includes oil sand or bituminous sand, which is a combination of clay, sand, water and bitumen.

[0029] "Fine particles" are generally defined as those solids having a size of less than 44 microns (μm), that is, material that passes through a 325 mesh (44 micron).

[0030] "Coarse particles" are generally defined as those solids having a size of greater than 44 microns (μm).

[0031] A "fine tailings stream" (also referred to herein as "fine sand tailings" or "FST") is defined herein as a stream derived from an oil sands extraction process wherein at least 75 % of the solids in the stream have a size of less than 44 microns (μm).

[0032] A "coarse tailings stream" (also referred to herein as "coarse sand tailings" or "CST") is defined herein as a stream derived from an oil sands extraction process wherein at least 75 % of the solids in the stream have a size of greater than 44 microns (μm).

[0033] The terms "approximately," "about," "substantially," and similar terms are intended to have a broad meaning in harmony with the common and accepted usage by those of ordinary skill in the art to which the subject matter of this disclosure pertains. It should be understood by those of skill in the art who review this disclosure that these terms are intended to allow a description of certain features described and claimed without restricting the scope of these features to the precise numeral ranges provided. Accordingly, these terms should be interpreted as indicating that insubstantial or inconsequential modifications or alterations of the subject matter described and are considered to be within the scope of the disclosure.

[0034] The articles "the", "a" and "an" are not necessarily limited to mean only one, but rather are inclusive and open ended so as to include, optionally, multiple such elements.

[0035] "At least one," in reference to a list of one or more entities should be understood to mean at least one entity selected from any one or more of the entity in the list of entities, but not necessarily including at least one of each and every entity specifically listed within the list of entities and not excluding any combinations of entities in the list of entities. This definition also allows that entities may optionally be present other than the entities specifically identified within the list of entities to which the phrase "at least one" refers, whether related or unrelated to those entities specifically identified. Thus, as a non-limiting example, "at least one of A and B" (or, equivalently, "at least one of A or B," or, equivalently "at least one of A and/or B") may refer, to at least one, optionally including more than one, A, with no B present (and optionally including entities other than B); to at least one, optionally including more than one, B, with no A present (and optionally including entities other than A); to at least one, optionally including more than one, A, and at least one, optionally including more than one, B (and optionally including other entities). In other words, the phrases "at least one," "one or more," and "and/or" are open-ended expressions that are both conjunctive and disjunctive in operation. For example, each of the expressions "at least one of A, B and C," "at least one of A, B, or C," "one or more of A, B, and C," "one or more of A, B, or C" and "A, B, and/or C" may mean A alone, B alone, C alone, A and B together, A and C together, B and C together, A, B and C together, and optionally any of the above in combination with at least one other entity.

[0036] While much of the discussion herein relates to the field of bitumen extraction, the feed delivery system disclosed herein may be used in other fields. For instance, the system may be used in gravity separation vessels which separate heavy and light particles from a continuous liquid phase.

[0037] The Primary Separation Vessel ("PSV") is an important part of an oil sand mining process. The PSV is where the bitumen froth is separated from the sand using water-based gravity separation. Oil sand slurry from a hydrotransport pipeline enters the PSV through a feedwell, which evenly distributes the slurry below the froth layer. The bitumen froth (bitumen attached to air bubbles) rises to the top of the PSV and the sand falls to the bottom. The feedwell design is important for achieving good separation in the PSV by ensuring even distribution of the slurry radially within the PSV and minimizing high velocity zones; a quiescent environment in the PSV is important for good separation performance and eliminating high erosion zones.

[0038] Generally, it is desirable to uniformly distribute the slurry radially in a PSV to optimize the use of the volume and cross-sectional area of the vessel while dissipating the incoming energy of the feed and maintaining the underwash layer, and limiting erosion by the incoming feed stream. It is also desirable to accommodate a range of feed flow rates and compositions while maintaining bitumen froth recovery and quality targets. Improving the feed delivery may also have a positive influence on the froth underwash and middlings withdrawal.

[0039] In one aspect, there is provided a feedwell system for delivering a slurry to a separation vessel, the system comprising: a feedwell barrel for containing and controlling the slurry; one or more inlet pipes leading into the feedwell barrel for tangentially introducing the slurry into the feedwell barrel to cause the slurry to swirl around the feedwell barrel; and a series of spaced-apart baffles disposed around an inner perimeter of the feedwell barrel for dissipating inflow energy and limiting an internal circulation field within the feedwell barrel, wherein the series of spaced-apart baffles comprises one or more inlet baffles configured to direct the slurry downwardly in the feedwell barrel and against a direction of introduction of the slurry; the feedwell barrel having a bottom with an outlet therein to allow discharge of the slurry.

[0040] In another aspect, there is provided a feedwell system for delivering a slurry to a separation vessel, the system comprising a feedwell barrel for containing and controlling the slurry; two inlet pipes leading into the feedwell barrel for tangentially introducing the slurry into the feedwell barrel to cause the slurry to swirl around the feedwell barrel; and a series of spaced-apart baffles disposed around an inner perimeter of the feedwell barrel for dissipating inflow energy and limiting an internal circulation field within the feedwell barrel; the feedwell barrel having a bottom with an outlet therein to allow discharge of the slurry.

[0041] The experimental section below shows how feedwell systems described herein may provide benefits over certain known designs.

[0042] A two inlet design may offer certain advantages. By using two inlets, a feed rate of the slurry per inlet may be reduced by half while supplying an equivalent total amount of slurry, thus reducing the feed velocity of the slurry into the feedwell barrel by a factor of two (2). Theoretically, the overall erosion rate in the area near the entrance to the feedwell barrel from each inlet pipe may be reduced by a factor of about four (4). A second inlet also allows for operation to continue on one inlet while maintenance is performed on the other inlet. The lower inlet velocity may also improve overall slurry distribution uniformity exiting the feedwell into the PSV.

[0043] While at least one known inlet diameter is 24 inches, the two inlets described herein may be larger, for instance having a diameter of 36 inches, or between 30 and 42 inches. This larger diameter also allows for a reduction in slurry velocity, providing the associated advantages described above.

[0044] While at least one known feedwell is 3.66 meters in diameter, using a larger diameter feedwell, for instance having 4.5 meters, or between 4.0 and 5.0 meters may improve flow distribution.

[0045] The series of spaced-apart baffles may comprise at least one inlet baffle configured to direct the slurry downwardly in the feedwell barrel and against a direction of introduction of the slurry. The inlet baffles may be the first baffles to come into contact with the slurry.

[0046] The inlet baffles may each comprise: a back wall portion depending inwardly from a feedwell barrel wall; a side wall portion depending from an inner edge of the back wall portion towards the direction of introduction of the slurry; and a bottom wall portion depending from a bottom edge of the back wall portion towards the direction of introduction of the slurry and downwardly. The back wall portion may depend inwardly from the feedwell barrel wall within 45 degrees of perpendicular to the feedwell barrel wall. The side wall portion may be oriented within 45 degrees of tangential to the feedwell barrel wall from which its baffle depends. The side wall portion may increase in depth from the back wall portion near the top of the side wall portion in a downward direction towards the near the bottom of the side wall portion (i.e., the sidewall portion may increase in depth moving in a downward direction along the vertical section of the baffle; see Fig. 2, element 106). The bottom wall portion may be oriented downwardly from horizontal at an angle between 30 and 60 degrees. The inlet baffles may comprise a concave contact area. The inlet baffles may comprise a concave area of contact with the slurry, i.e. a non-planar contact surface comprising at least two points of differing surface orientation that nevertheless face towards the slurry inlet. Such a configuration imparts some portion of the slurry stream with a significant velocity component directed back towards the slurry inlet. The series of spaced-apart baffles may further comprise vertical baffles depending inwardly from a feedwell barrel wall.

[0047] The inlet baffles may be configured to redirect a portion of an incoming slurry stream against its incoming flow direction, i.e. resulting in this portion of the stream flowing in a direction oriented greater than 90 degrees to its incoming flow direction.

[0048] The baffle design described herein may offer certain advantages. The baffle design described herein may reduce erosion inside the feedwell and improve overall distribution uniformity exiting the feedwell into the PSV.

[0049] The feedwell system described herein may improve froth recovery and/or quality performance of the PSV by improving the radial uniformity of the flow exiting the feedwell into the PSV over a wide operating envelope.

[0050] The separation vessel may be a gravity separation vessel. The separation vessel may be a primary separation vessel for separating a bitumen slurry into a froth system, a middlings stream, and a tailings stream. The slurry may be a bitumen slurry comprising bitumen, water, sand, and air. The feedwell barrel may have a circular side wall and an open top.

[0051] The slurry enters the feedwell through the inlet pipes and the kinetic energy of the in-flow stream is reduced by a series of vertical baffles located around the inner circumference of the feedwell barrel, and by a slurry pool contained within the feedwell.

[0052] A method may include feeding oil sand slurry through one or both of a two inlet system at a given time.

[0053] With reference to Figures 1, 2, and 3B, the feedwell system comprises a feedwell barrel (102) for containing and controlling the slurry; one or more inlet pipes (104) leading into the feedwell barrel (102) for tangentially introducing the slurry into the feedwell barrel (102) to cause the slurry to swirl around the feedwell barrel (102); and a series of spaced-apart baffles (106 and 108) disposed around an inner perimeter of the feedwell barrel (102) for dissipating inflow energy and limiting an internal circulation field within the feedwell barrel (102), wherein the series of spaced-apart baffles comprises one or more inlet baffles (106) configured to direct the slurry downwardly in the feedwell barrel (102) and against a direction of introduction of the slurry; the feedwell barrel (102) having a bottom with an outlet therein to allow discharge of the slurry.

[0054] Figure 3A illustrates a prior art feedwell comprising a feedwell barrel (202), an inlet pipe (204) and a series of flat baffles (208). The arrows in Figures 3A and 3B illustrate the slurry flow. In contrast to the slurry flow caused by the feedwell of Figure 3A, the slurry flow caused by the feedwell of Figure 3B, and particularly the inlet baffles (106), directs the slurry downwardly in the feedwell barrel (102) and also directs the slurry against a direction of introduction of the slurry inlet into the feedwell barrel.

[0055] <u>Experimental</u>

[0056] The dual inlet design and baffle design have been evaluated using Computational Fluid Dynamics (CFD) simulations. The CFD simulation was run with a volume-to-fluid (VOF) method with a slurry feed rate corresponding to 10,000 ton/hr of ore and slurry material properties (e.g. density and viscosity) corresponding approximately to those of a PSV feed. Figs. 4 to 6 are polar plots (as looking in plan view at the top of the feedwell barrel) of the CFD-predicted deviation (in %) from the mean flow rate in 8 subsections of the feedwell outlet distributor, with arrows indicating the feed inlet flow direction(s). Fig. 4 corresponds to a prior art feedwell system having one inlet baffle and vertical baffles and generally as described in Canadian Patent No. 2,734,811 (Sury et al.); Fig. 5 corresponds to a feedwell system described herein with dual-inlet operation; and Fig. 6 corresponds to the same feedwell system in Fig. 5 with single-inlet operation. Figs. 4 to 6 show that the 2-inlet design achieves equal or better flow distribution in both operating modes than the prior-art, single-inlet design. Fig. 7 illustrates overall values of the maldistribution within the feedwell barrel as a function of ore rate. The three scenarios in Fig. 7 are "Prior art" meaning a single inlet system with only flat vertical baffles; "Improved – Single Inlet Operation" meaning a single slurry inlet design with an inlet baffle as described herein: "Improved – Dual Inlet Operation" meaning a dual slurry inlet design with two inlet baffles as described herein. Improvement in maldistribution is evident in Fig. 7 in both of the "Improved" cases over the "Prior art" case.

[0057] References

[0058] The following references are mentioned: CA Patent No. 2,734,811 (Sury et al.); U.S. Patent No. 5,147,556 (Taylor); U.S. Patent No. 6,966,985 (Schoenbrunn et al.); U.S. Patent No. 5,015,392 (Taylor); U.S. Patent No. 2,528,094 (Walker); U.S. 5,944,995 (Sethi et al.); U.S. Patent No. 2,630,691 (Egan); CA Patent No. 2,449,443 (Nyman et al.); CA Patent No. 2,449,657 (Nyman et al.); CA Patent No. 2,665,780 (Triglavcanin et al.); CA Patent No. 2,678,307 (Triglavcanin); and U.S. Patent No. 4,082,671 (Kelly). Mastbergen, D.R.; Kesteren, W.G.M.; Loman, G.J.A., Controlled submerged deposition of fine grained dredged sediment with various diffuser types, WODCON XVII, 27 Sept. - 1 October 2004, Hamburg, Germany, 2004.

[0059] In the preceding description, for purposes of explanation, numerous details are set forth in order to provide a thorough understanding of the embodiments of the invention. However, it will be apparent to one skilled in the art that these specific details are not required in order to practice the invention.

[0060] The above-described embodiments of the invention are intended to be examples only. Alterations, modifications and variations can be effected to the particular embodiments by those of skill in the art without departing from the scope of the invention, which is defined solely by the claims appended hereto.

CLAIMS:

1. A feedwell system for delivering a slurry to a separation vessel, the system comprising:

a feedwell barrel for containing and controlling the slurry;

one or more inlet pipes leading into the feedwell barrel for tangentially introducing the slurry into the feedwell barrel to cause the slurry to swirl around the feedwell barrel; and

a series of spaced-apart baffles disposed around an inner perimeter of the feedwell barrel for dissipating inflow energy and limiting an internal circulation field within the feedwell barrel, wherein the series of spaced-apart baffles comprises one or more inlet baffles configured to direct the slurry downwardly in the feedwell barrel and against a direction of introduction of the slurry, wherein the one or more inlet baffles each comprise:

a back wall portion depending inwardly from a feedwell barrel wall;

a side wall portion depending from an inner edge of the back wall portion towards the direction of introduction of the slurry; and

a bottom wall portion depending from a bottom edge of the back wall portion towards the direction of introduction of the slurry and downwardly; and

the feedwell barrel having a bottom with an outlet therein to allow discharge of the slurry.

2. The system of claim 1, wherein the one or more inlet baffles each comprise a concave contact area.

3. The system of claim 1 or 2, wherein the back wall portion depends inwardly from the feedwell barrel wall within 45 degrees of perpendicular to the feedwell barrel wall.

4. The system of claim 3, wherein the side wall portion is oriented within 45 degrees of tangential to the feedwell barrel wall from which its baffle depends.

5. The system of any one of claims 1 to 4, wherein the side wall portion increases in depth from the back wall portion near the top of the side wall portion in a downward direction towards the near the bottom of the side wall portion.

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6. The system of any one of claims 1 to 5, wherein the bottom wall portion is oriented downwardly from horizontal at an angle between 30 and 60 degrees.

7. The system of any one of claims 1 to 6, wherein the system comprises two inlet pipes leading into the feedwell barrel for tangentially introducing the slurry into the feedwell barrel to cause the slurry to swirl around the feedwell barrel.

8. The system of any one of claims 1 to 7, wherein the one or more inlet baffles are first to come into contact with the slurry.

9. The system of claim 8, wherein the series of spaced-apart baffles further comprises vertical baffles depending inwardly from the feedwell barrel wall.

10. The system of any one of claims 1 to 9, wherein the separation vessel is a gravity separation vessel.

11. The system of any one of claims 1 to 10, wherein the separation vessel is a primary separation vessel for separating a bitumen slurry into a froth system, a middlings stream, and a tailings stream.

12. The system of any one of claims 1 to 11, wherein the slurry is a bitumen slurry comprising bitumen, water, sand, and air.

13. A method of using the system of any one of claims 1 to 12, wherein the slurry is fed through a single inlet pipe.

14. A method of using the system of any one of claims 1 to 12, wherein the slurry is fed through two inlet pipes.

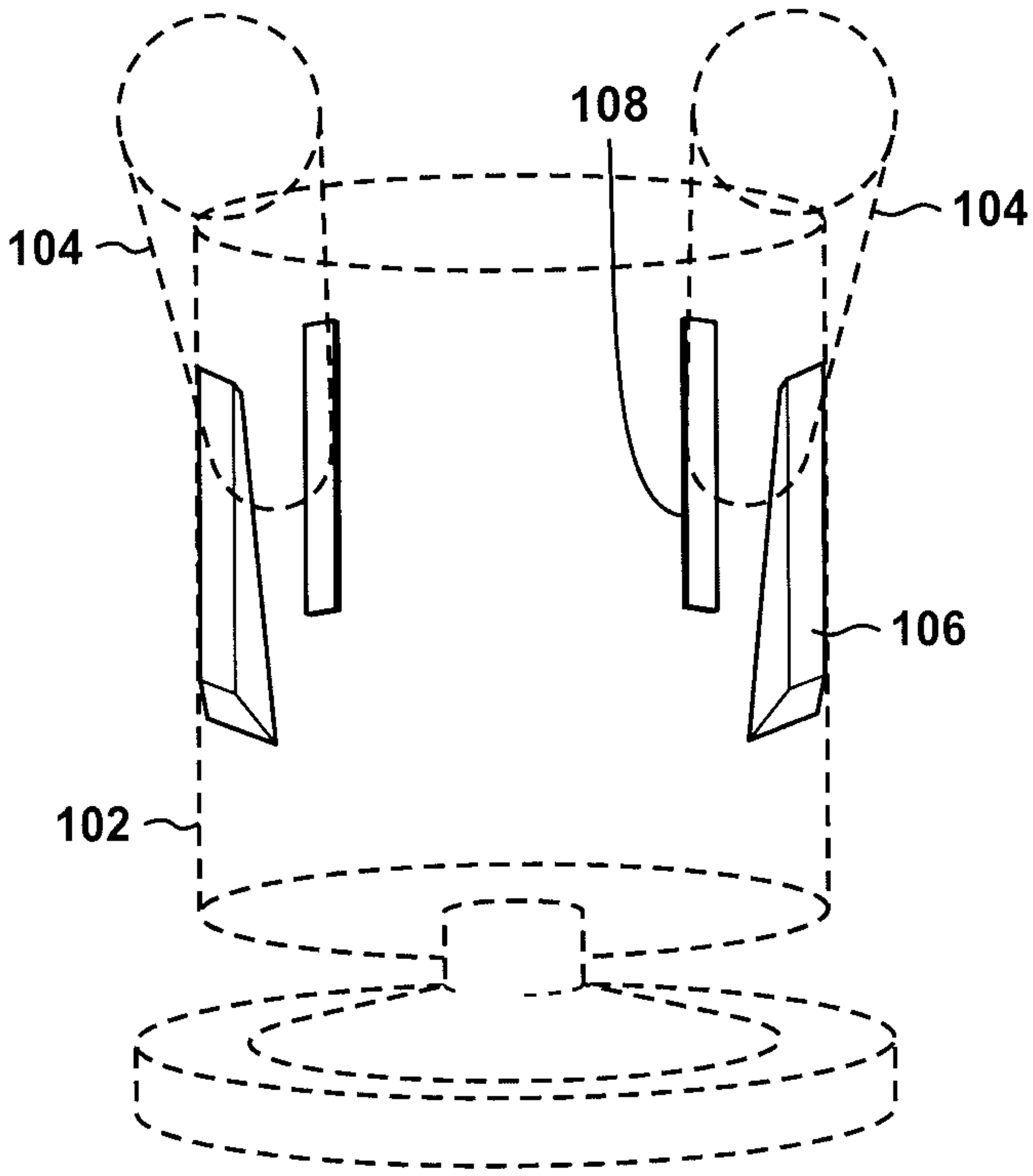


FIG. 1

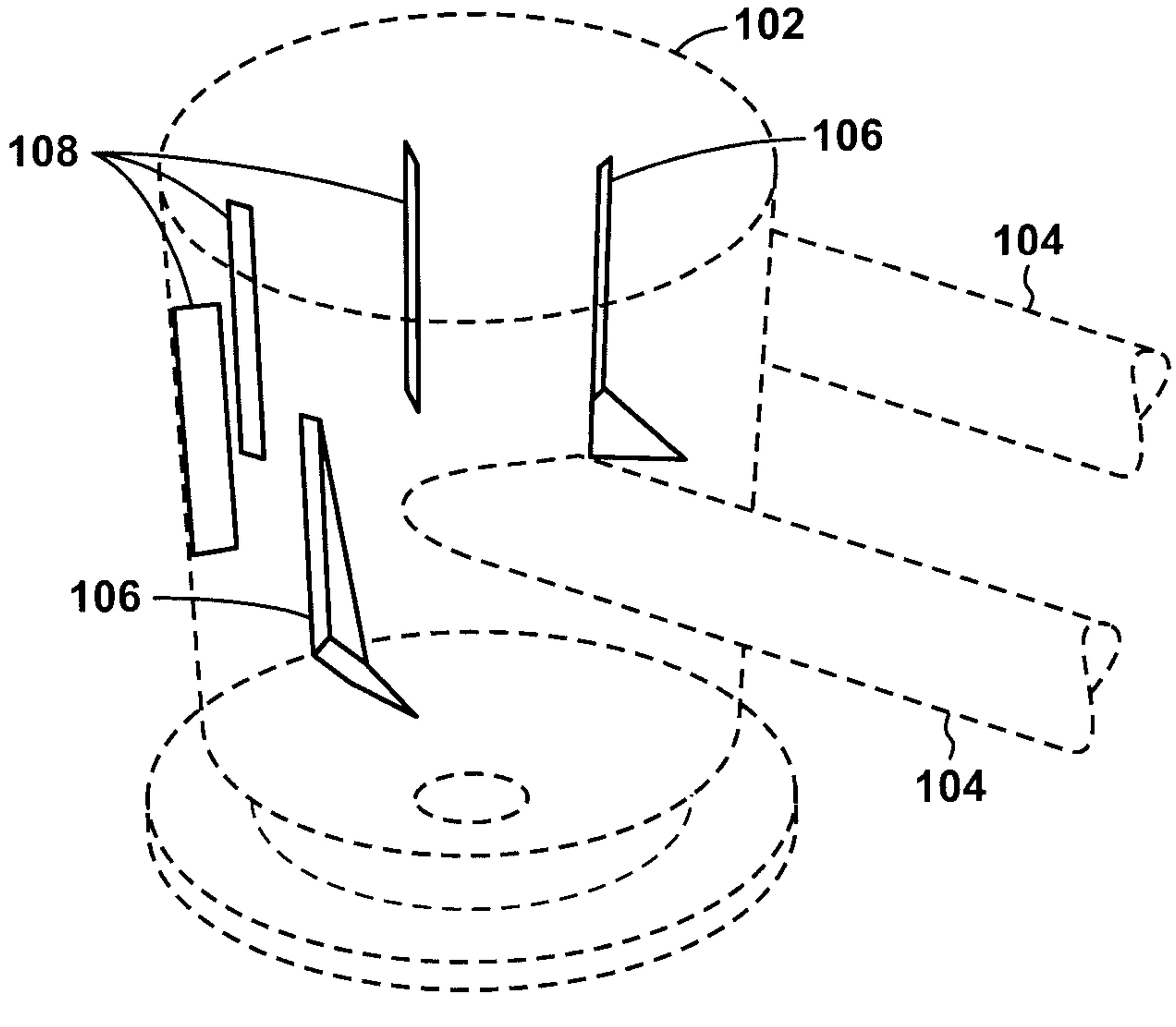


FIG. 2

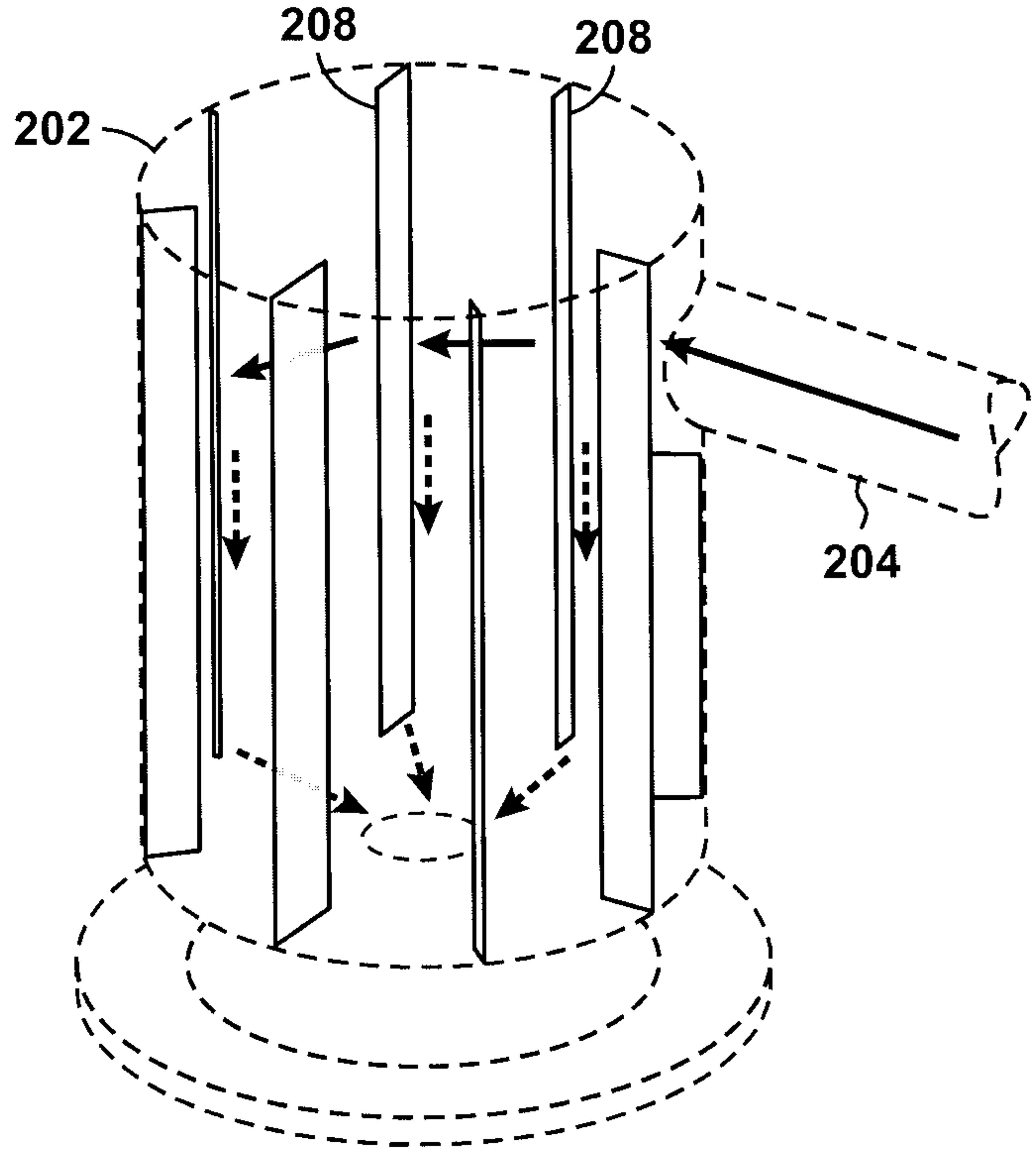


FIG. 3A
(Prior Art)

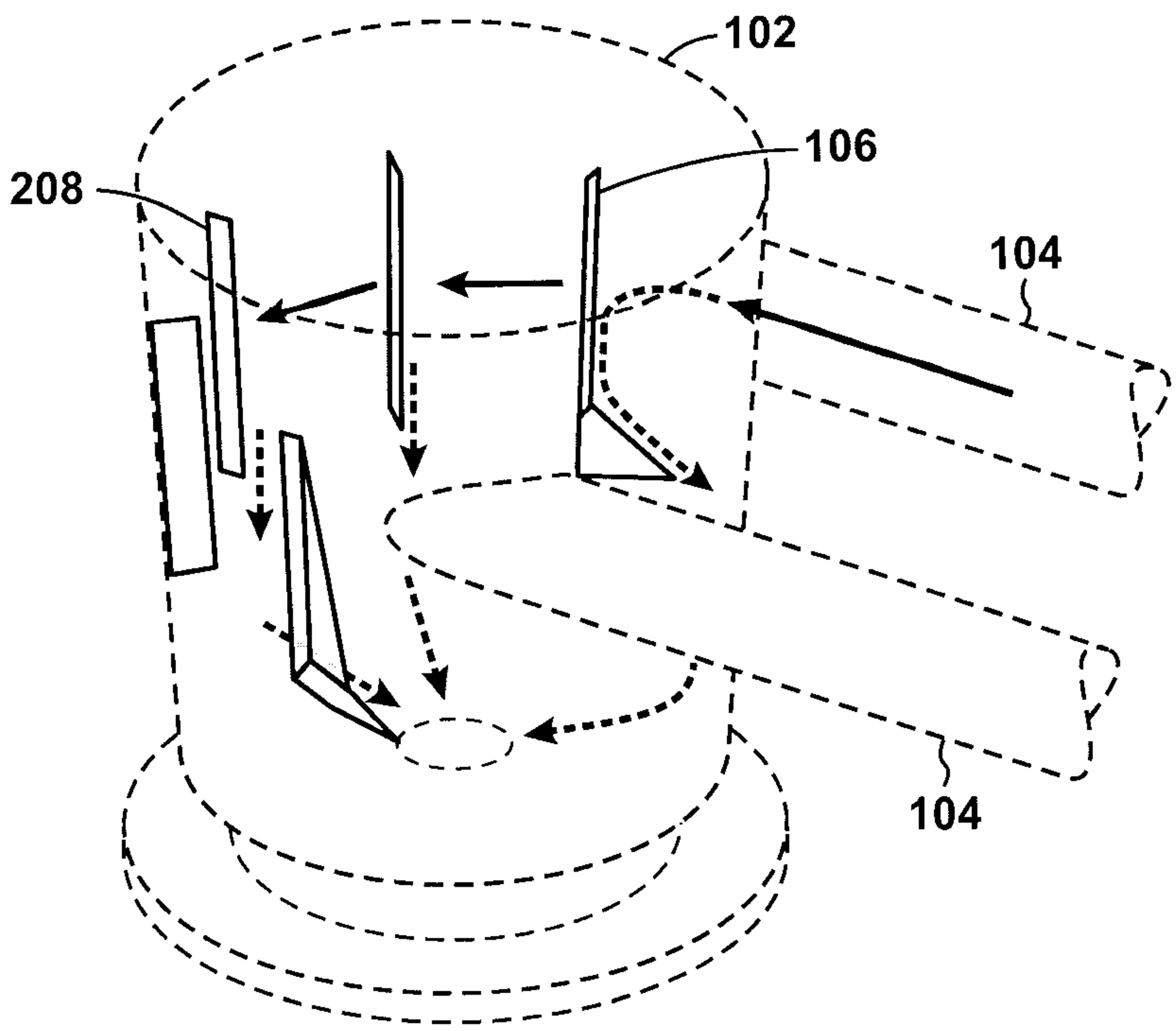


FIG. 3B

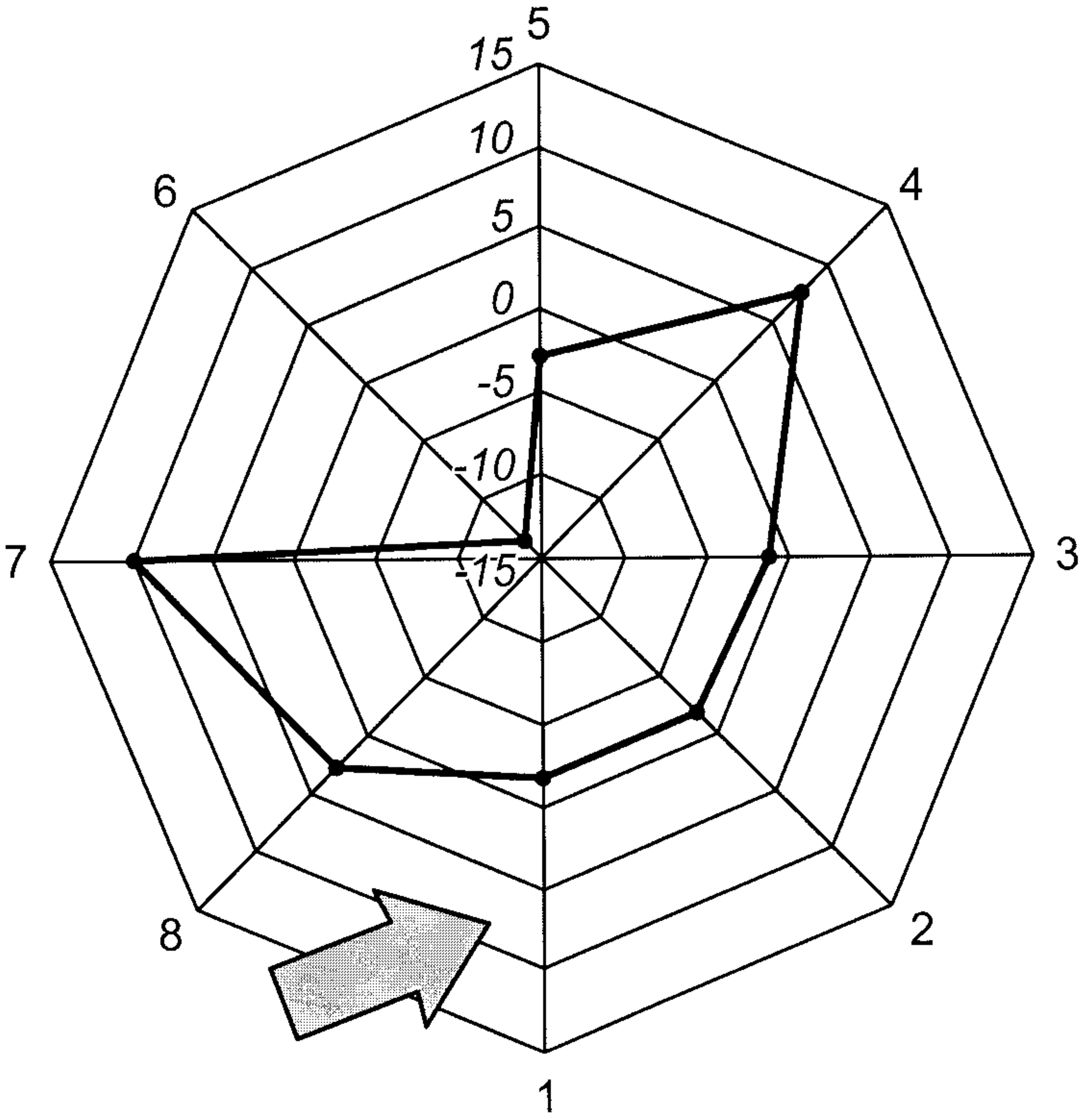


FIG. 4

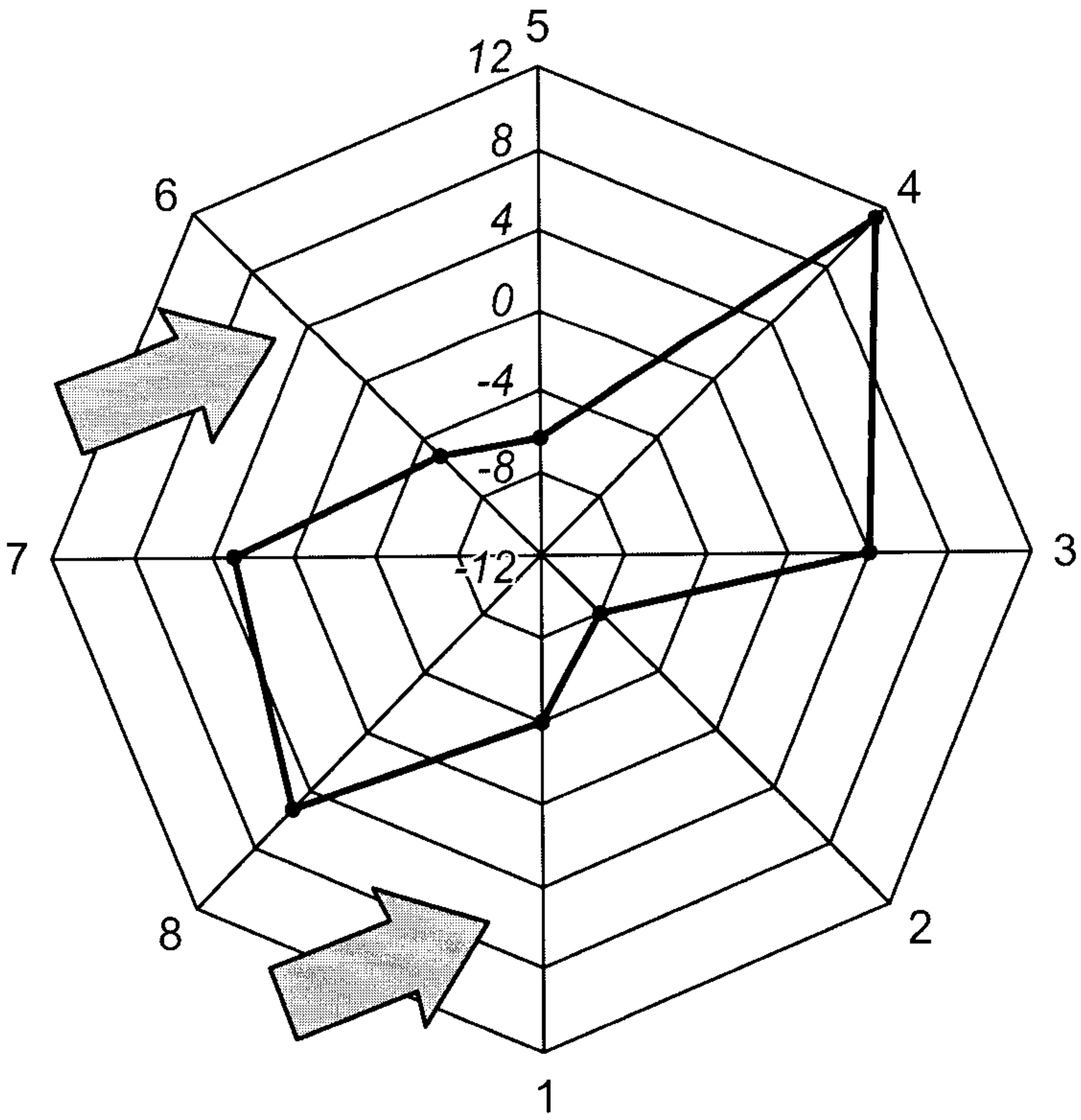
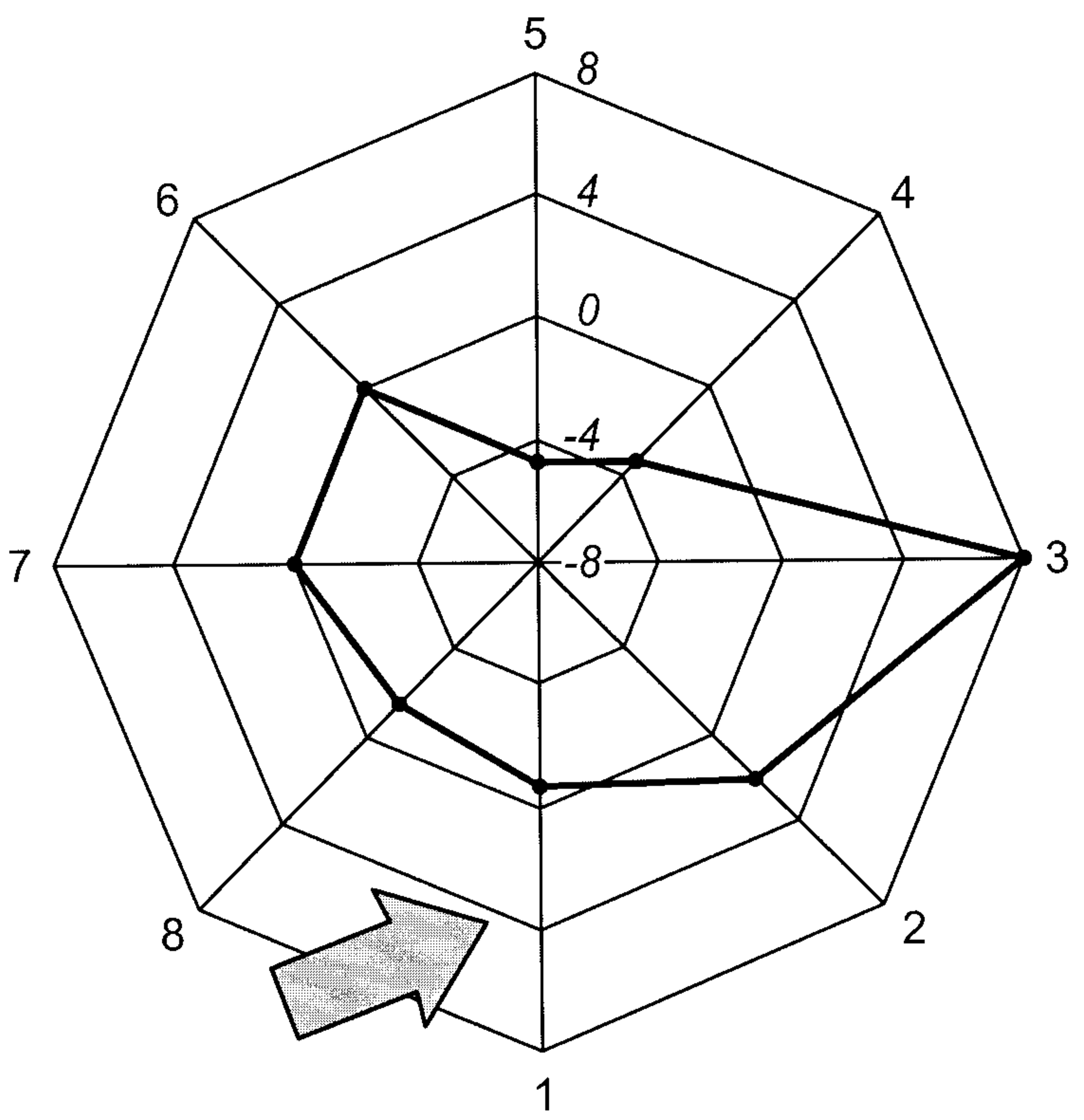
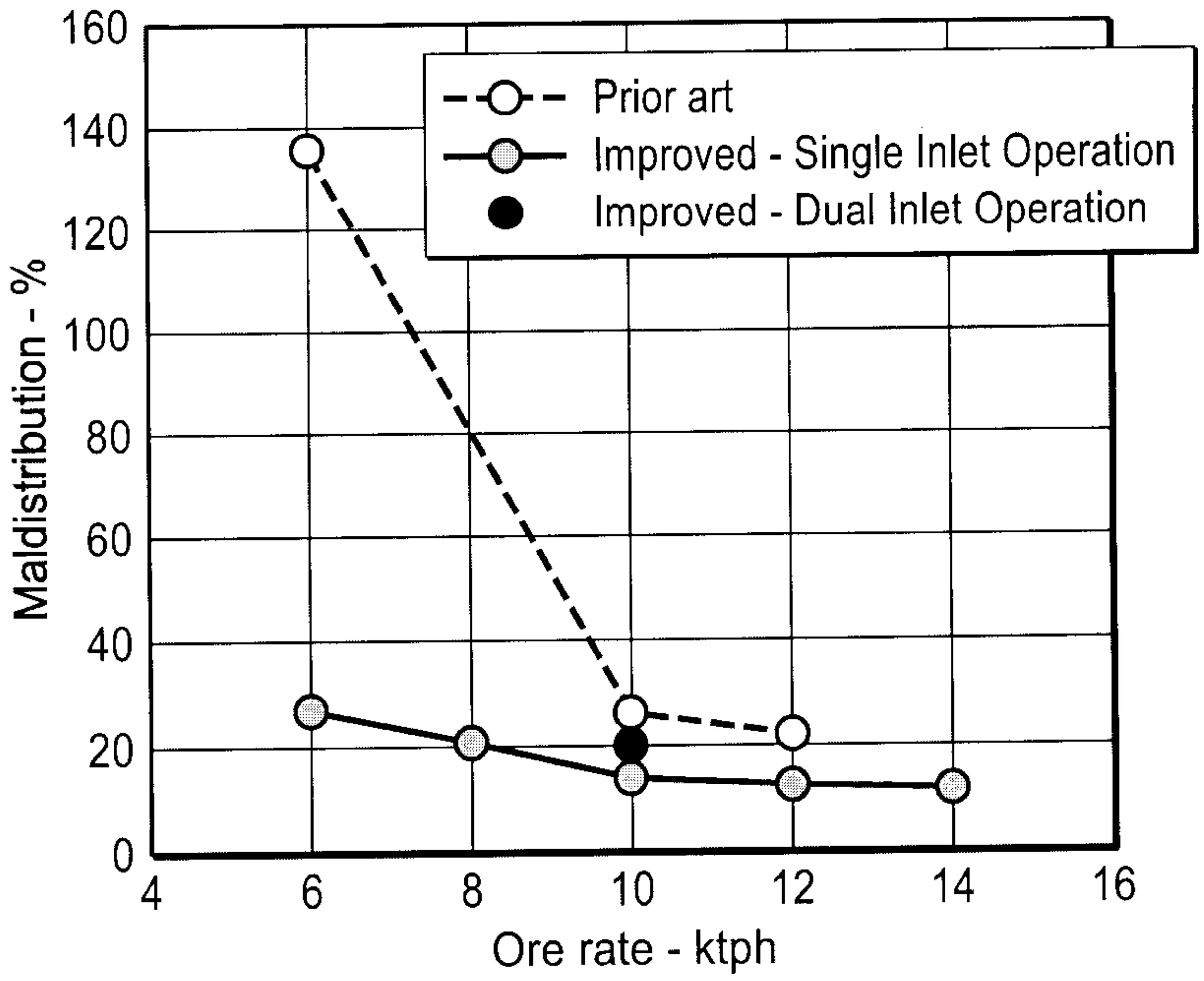


FIG. 5



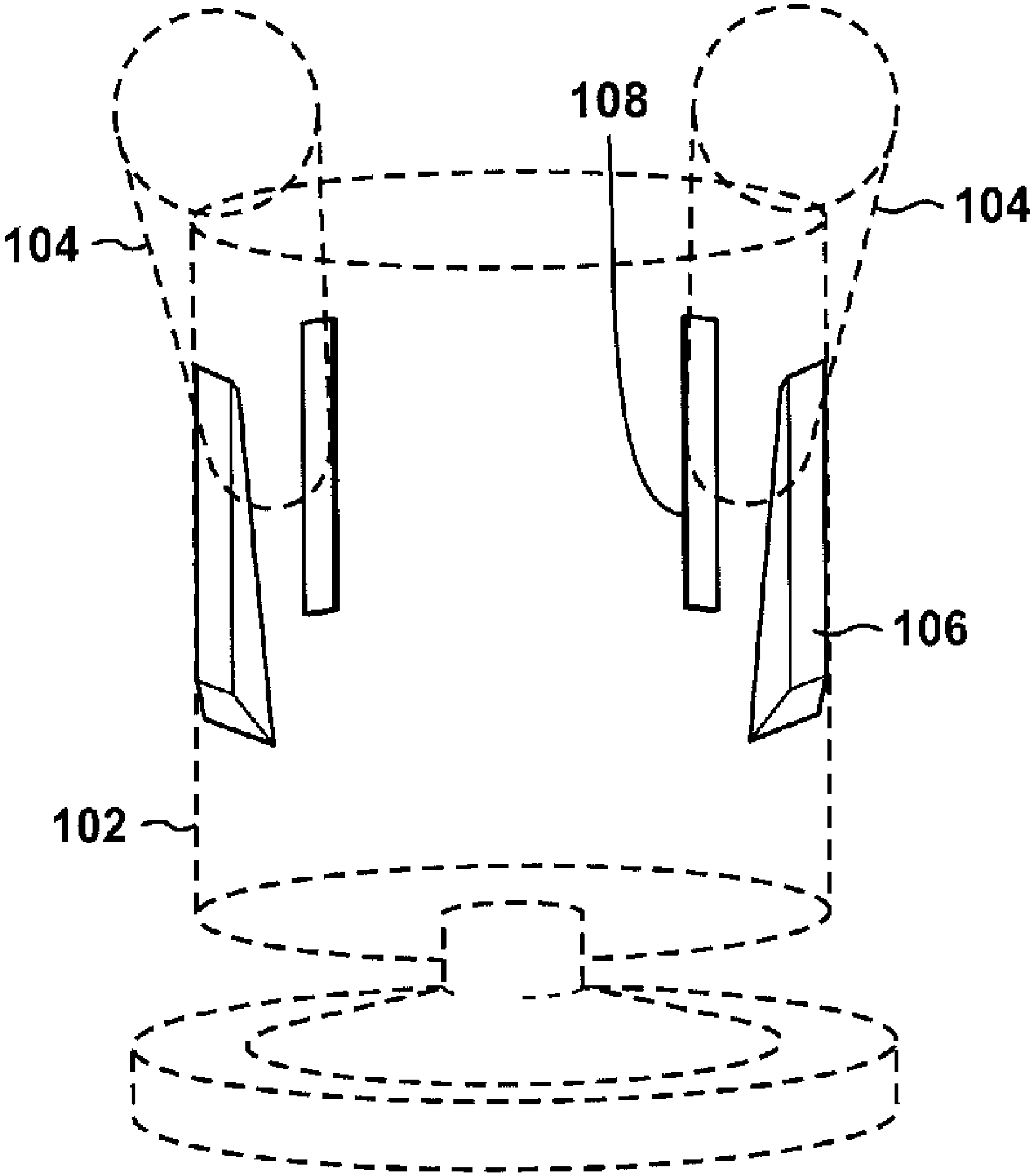
5
8
4
4
0
6
-4
7
-8
3
8
2
1

FIG. 6



Prior art
Improved - Single Inlet Operation
Improved - Dual Inlet Operation
Maldistribution - %
160
140
120
100
80
60
40
20
0
4
6
8
10
12
14
16
Ore rate - ktph

FIG. 7



108
104
104
106
102