

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

ENERCOP SAND SOLUTIONS INC.
Petitioner,

v.

SPECIALIZED DESANDERS INC.,
Patent Owner

Case IPR2018-01748
Patent No. 8,945,256

PETITION FOR INTER PARTES REVIEW

TABLE OF CONTENTS

I.	MANDATORY NOTICES (37 C.F.R. § 42.8)	1
A.	Real Parties-in-Interest.....	1
B.	Related Matters	1
C.	Counsel and Service Information.....	1
II.	COMPLIANCE WITH REQUIREMENTS FOR INTER PARTES PETITION PURSUANT TO 37 C.F.R. §§ 42.101 & 42.104(A)	2
III.	IDENTIFICATION OF CLAIMS BEING CHALLENGED AND RELIEF REQUESTED PURSUANT TO § 42.104(B)).....	2
IV.	TECHNOLOGICAL BACKGROUND	3
A.	General Phase Separation Principles and Equipment	3
B.	Separators in the Oil and Gas Industry	5
V.	U.S. PATENT NO. 8,945,256	10
A.	Priority Date	10
B.	Specification.....	11
1.	Background of the Invention	11
2.	The Claimed Invention	12
3.	Preferred Embodiments	13
C.	Prosecution History.....	15
D.	Claim Construction	18
VI.	PRECISE STATEMENT OF REASONS FOR THE RELIEF REQUESTED.....	20
A.	The Level of Ordinary Skill in the Art	20
B.	The Scope and Content of the Prior Art	21
1.	The Asserted Grounds are Not the Same or Substantially Similar to those Previously Presented to the Office	21
2.	The Prior Art is Analogous	23
3.	Asserted References	24
a.	Hemstock	24
b.	Davis	26

	c.	The Data Book.....	27	
	d.	Miller	28	
C.		Differences Between the Claimed Subject Matter and the Prior Art	29	
1.		The Prior Art References Teach All Elements of the Challenged Claims.....	30	
	a.	Claim 1	30	
	b.	Claim 9.....	38	
	c.	Dependent Claims.....	40	
2.		Explanation of Asserted Grounds and Rationales Supporting a Conclusion of Obviousness.....	47	
	a.	Grounds 1 and 2: The Base Claims are Obvious in View of Hemstock and Davis (Ground 1) and Hemstock and the Data Book (Ground 2)	47	
		i.	Ground 1: A POSITA would have been motivated to modify Hemstock based on Davis. 48	
		ii.	Ground 2: A POSITA would have been motivated to modify Hemstock based on the Data Book	49
		iii.	A POSITA would have had a reasonable expectation of success in modifying Hemstock as suggested by either Davis or the Data Book.....	51
		iv.	Grounds 1 and 2 Render the Base Claims Obvious	52
	b.	Grounds 2 and 3: The Inclination Angle Claims are Obvious in View of Hemstock and the Data Book (Ground 2) and Hemstock, Davis, and Miller (Ground 3)	52	
		i.	Ground 2: A POSITA would have been motivated to modify Hemstock as suggested by the Data Book.	53
		ii.	Ground 3: A POSITA would have been motivated to modify Hemstock and Davis based on Miller.....	54

iii.	A POSITA would have had a reasonable expectation of success in modifying Hemstock as suggested by the Data Book and by Davis and Miller.....	54
c.	Grounds 3 and 4: The Eccentric End Claims are Obvious in View of Hemstock, Miller, and either Davis or the Data Book.....	55
i.	A POSITA would have been motivated to modify Hemstock and Davis or Hemstock and the Data Book based on Miller's suggestion. .	56
ii.	A POSITA would have had a reasonable expectation of success in modifying Hemstock's vessel based on Miller's suggestion.....	57
d.	The Asserted Grounds Possess Every Element of the Claims.....	58
D.	Objective Indicia of Non-Obviousness.....	60
VII.	CONCLUSION.....	61

EXHIBIT LIST

Exhibit No.	Description
1001	U.S. Patent No. 8,945,256 B2 to Hemstock (the “’256 Patent”)
1002	Expert Declaration of David Simpson, P.E.
1003	Prosecution File History, U.S. Patent Application (U.S.13/372,291) (’256 Patent)
1004	U.S. Patent No. 6,983,852 to Hemstock et al. (“Hemstock”)
1005	Sedimentation of Noncolloidal Particles at Low Reynolds Numbers, Robert H. Davis and Andreas Acrivos, Annual Review of Fluid Mechanics, Vol. 17, 1985, published by Annual Reviews Inc., pages 91-118 (“Davis”)
1006	[Reserved]
1007	U.S. Patent No. 1,458,234 to Miller (“Miller”)
1008	Engineering Data Book, Gas Processors Suppliers Association, Revised Tenth Edition 1994 (the “Data Book”) (Sections 7 and 17)
1009	Declaration of Andre L. Davison
1010	Declaration of James H. Hall
1011	[Reserved]
1012	[Reserved]
1013	Canadian Patent 2,433,741

I. MANDATORY NOTICES (37 C.F.R. § 42.8)**A. Real Parties-in-Interest**

Petitioner Enercorp Sand Solutions Inc. is a real party-in-interest. The following are potentially real parties-in-interest, and should be considered so for purposes of this petition: Enercorp Sand Solutions Holdings Inc., Enercorp Sand Solutions & Technologies, LLC, and Enercorp Sand Solutions, LLC.

B. Related Matters

There are no other judicial or administrative matters that would affect, or be affected by, a decision in this proceeding.

C. Counsel and Service Information

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Service of any documents via mail or hand-delivery may be made on Petitioner at: Blank Rome LLP, 717 Texas Suite 1400, Houston, Texas 77002. The fax number for Petitioner's counsel is (713) 228-6605. Petitioner consents to electronic service by e-mail, provided that all counsel for Petitioners are copied at

the foregoing addresses.

II. COMPLIANCE WITH REQUIREMENTS FOR INTER PARTES PETITION PURSUANT TO 37 C.F.R. §§ 42.101 & 42.104(A)

Petitioner certifies that (1) the '256 Patent is available for *inter partes* review; and (2) Petitioner is not barred or estopped from requesting *inter partes* review of any of the challenged claims on the grounds identified herein.

The undersigned authorizes the Commissioner to charge the fee specified by 37 C.F.R. § 42.15(a) to Deposit Acct. No. 501922, referencing attorney docket number 152204-00601. In addition, the undersigned representative authorizes the Commissioner to charge any additional fees which may be required, or credit any overpayment, to Deposit Account No. 501922.

Concurrently, Petitioner is filing a Power of Attorney pursuant to 37 C.F.R. § 42.10(b). Proof of Service of this petition pursuant to §§ 42.6(e) and 42.105(a) is provided in the attached certificate of service.

III. IDENTIFICATION OF CLAIMS BEING CHALLENGED AND RELIEF REQUESTED PURSUANT TO § 42.104(B))

Petitioner requests institution of trial and cancellation of all claims (the “Challenged Claims”) of the '256 Patent. The specific grounds for each claim are set forth in detail herein and summarized as follows:

Ground 1: Claims 1, 2, 3, 4, 5, 6, 7, 9, 10, 11, 13, and 16 (the “Base Claims”) are obvious in view of the combination of Hemstock and Davis.

Ground 2: Claims 8 and 12 (the “Inclination Angle Claims”) and the Base Claims are obvious in view of the combination of Hemstock and the Data Book.

Ground 3: Claims 14 and 15 (the “Eccentric End Claims”) and the Inclination Angle Claims are obvious in view of the combination of Hemstock, Davis, and Miller.

Ground 4: The Eccentric End Claims are obvious in view of the combination of Hemstock, the Data Book, and Miller.

IV. TECHNOLOGICAL BACKGROUND

The ’256 Patent relates specifically to the control and separation of solids from the production streams from oil and gas wells. ’256 Patent, 1:5-8. Such streams often contain gases, liquids (hydrocarbon and/or water) and solids. Ex. 1002 ¶ 43. Water and sand must be removed in order to process the more valuable hydrocarbons for distribution and use. *Id.* These specific issues are a species of a broader genus, phase separation and related equipment. *Id.*

A. General Phase Separation Principles and Equipment

Various industries require the phase separation of multiphase (solid, liquid, and/or gas phases) streams, and to varying degrees. Such phase separation may be performed by various methods and types of equipment, all of which may generally be referred to as “separation equipment” or “separators.” Ex. 1002 ¶ 44. Separators have various different characteristics, but the term has no rigid definition. *Id.* An

apparatus used to separate sand from a production stream is commonly referred to as a “sand separator” and often, a “desander.” *Id.*

There are various types of separation equipment, which work in three primary ways: changes in momentum, acceleration (either through inducing angular velocity or through gravity settling), and coalescing. *Id.* ¶ 45. Separators work because the different fluid components have different densities and therefore react to the same acceleration with different responses. *Id.* Thus, denser liquids and solids will settle out of a gas, and solids will settle out of a liquid, when the forces acting on the liquid or solid particle (e.g., for gravity settling, the force of gravity) are greater than the drag force of the fluid flowing around it. *Id.* The drag force is a function of the particle’s terminal velocity in a particular fluid, which is dependent on the size of the particle and the relative density of the host fluid and the included fluid. *Id.*

Although there are no rigid definitions with regard to terminology, separators are often distinguished by reference to the phases or species separated. *Id.* ¶ 46. Thus, a “single phase” separator is generally understood as one having a single outlet during normal operation (i.e., one that does not require manual intervention). *Id.* Thus, while the unit may separate multiple species, at the outlet any species that is not retained in the vessel will be recombined. *Id.* A “two phase” separator will separate the phases of a multiple phase inlet stream into two separate (non-manual) outlet streams, while a “three phase” separator will separate an inlet stream into three

separate (non-manual) outlet streams. *Id.* Thus, the numerical indication (single, two, or three phase) refers to the number of unique outlet paths from the vessel during normal operation. *Id.* Of course, a separator may have other outlets that may be opened manually, outside of normal steady-state operation, but the presence of such outlets would not change whether a particular separator was considered a single, two, or three phase separator. *Id.*

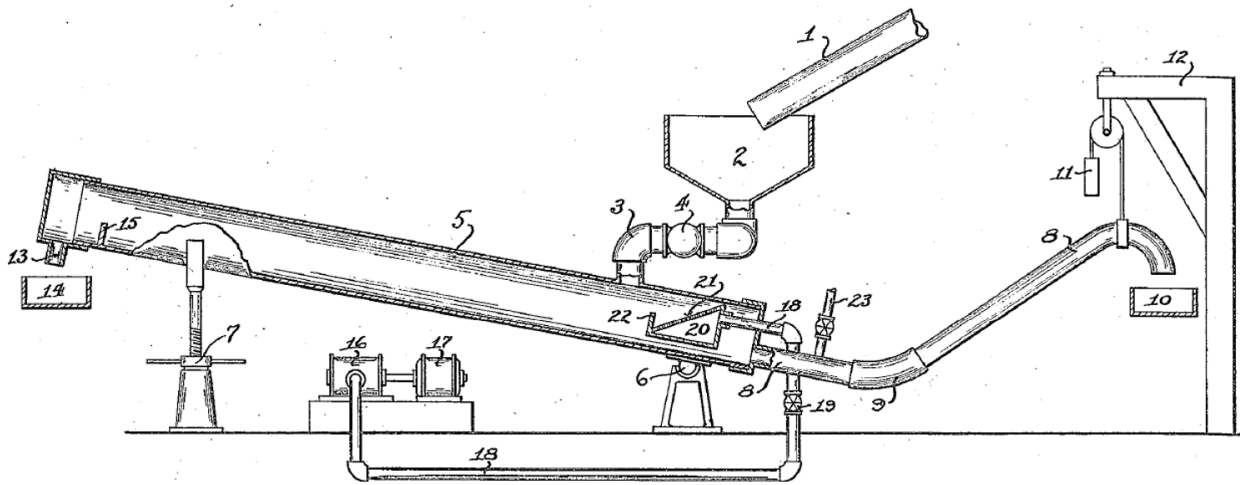
The sizing of separation equipment is largely based on empirical methods. *Id.*

¶ 47. Three main factors are considered in separator sizing: 1) vapor capacity, 2) liquid capacity, and 3) operability. *Id.* The required vapor capacity (assuming the separator is intended to handle gas, versus separating liquids and solids) will determine the cross-sectional area necessary to reduce the velocity of the gas enough to permit liquid droplets and solid particles to fall into the bottom of the vessel at the design flow rate. *Id.* Liquid capacity is generally determined by the flow restrictions in the liquid-outlet flow line, assuming the separator is designed to separate vapor and liquid. *Id.* Operability issues include the separator's ability to deal with solids if present, unsteady flow/liquid slugs, changes in ambient conditions, etc. *Id.* Finally, the optimal design will usually result in a footprint or aspect ratio that satisfies these requirements in a vessel of reasonable cost. *Id.*

B. Separators in the Oil and Gas Industry

In the oil and gas industry, separation of solids, liquid, and gases arises in

multiple contexts. Ex. 1002 ¶ 48. For example, with regard to drilling operations, it is well-known that solids must be separated and removed from the mud used in drilling. *Id.* ¶ 49. Drilling mud is a fluid pumped down through the drill bit, which circulates into the bottom of the hole and carries drill cuttings and other particulates away from the bit and back to the surface. Miller, 2:24-34.¹ Thus, many apparatuses and methods have been devised to perform this function. As long ago as 1923, it was known to use an inclined settling vessel to separate drill cuttings and other particulates from the drilling mud, as shown in the figure from Miller below:



In Miller, drilling mud enters the drilling vessel (5) from a hopper (2), and compressed air is used to induce particulate settling. *Id.*, 2:51-61, 2:88-3:24. Miller's

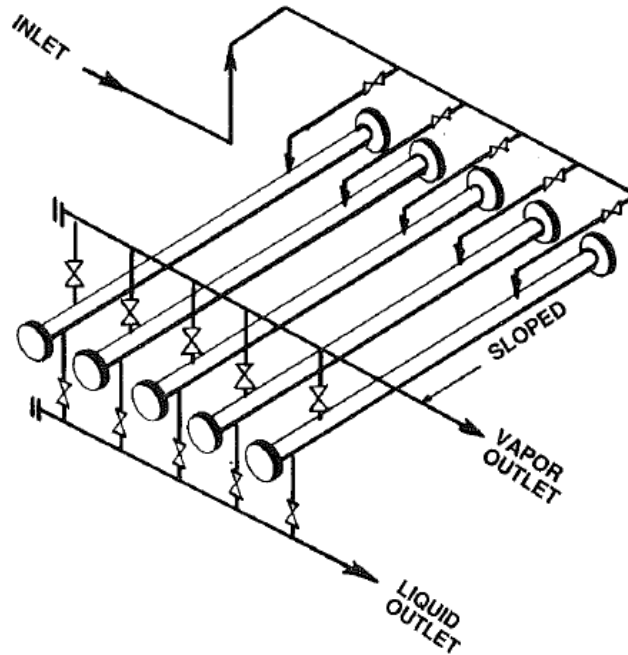
¹ References to Miller will cite the page number (of the exhibit) to the line number, e.g., [page]2:[line]100.

vessel is inclined from the vertical, and is supported by a jack (7) “by means of which the angle of the vessel may be varied and adjusted to suit.” *Id.*, 2:51-61. Miller explains that heavier particulates migrate toward the lower end of the vessel due to the force of gravity, while cleaned mud exits at the outlet (13). *Id.*, 3:14-21. Thus, the concentrated heavier particles pass out from the lower end of the vessel through pipe 8. *Id.*, 3:21-25. Pipe 8 has a smaller diameter than vessel 5, and is situated eccentrically toward the bottom of the vessel, so that solids migrating to the bottom might easily exit. *Id.* at 1 (Figure).

Miller’s device applies a particular type of separation: sedimentation. In sedimentation, particles fall under the action of gravity through a fluid in which they are suspended. Davis at 3. Sedimentation is commonly used in the chemical and petroleum industries as a way of separating particles from fluid. *Id.* By inclining his vessel, Miller took advantage of a now well-known phenomenon, by which sedimentation is enhanced in inclined channels. *Id.* at 17. An entire class of devices, known commercially as “supersettlers” or “lamella settlers,” consists of settling vessels having inclined walls, and in which retention times can be reduced by an order of magnitude or more. *Id.* “The enhancement in the sedimentation rate can be viewed as resulting from the fact that whereas particles can only settle onto the bottom in a channel with vertical walls, such particles can also settle onto the upward facing wall in a tilted channel” *Id.*

A different separation problem in the oil and gas industry is the removal of liquids from fluid streams containing at least two phases (i.e., at least gas and liquid). Data Book at 41. In two phase flow, several different flow regimes are possible, including bubble, stratified, annular mist, wave, and slug flow. *Id.* at 36. The slug flow regime is frequently encountered in certain situations and creates several problems. Ex. 1002 ¶ 52. To address this issue, devices called “slug catchers” are used. Data Book at 41. Slug catchers are separators which serve “both as a liquid-vapor disengaging device and as a surge vessel to absorb the fluctuating liquid flow rates caused by slugging.” *Id.* The normal principles of separator design apply to such devices. *Id.*

Slug catchers may be either vessels or constructed of pipe. *Id.* Slug catchers are frequently made of pipe to avoid the need for thick walled vessels, and are essentially “long, slender horizontal separators. The pipe is generally inclined from one to ten degrees and banks of these slightly inclined pipes are frequently manifolded together.” *Id.* Different pipe inclinations are favored by different designers. *Id.* An example of one such design (a multiple pipe or “harp”) is shown here:



Id. at 41 (Fig. 17-21). Generally, slug catchers such as these are considered single phase separators, as the liquid outlet valves are manual valves that are closed during normal operation. Ex. 1002 ¶ 53. Thus, when a liquid slug occurs, the slug catcher separates the liquid and vapor phases due to gravity settling, and provides a surge volume for the bulk of the liquid slug. *Id.* ¶ 53-55, 103; Data Book at 41. Because the liquid outlet is closed, this liquid (depending on volume) may be re-entrained into the vapor outlet. *Id.* ¶ 104.

Another application for settlers in the oil and gas industry is separating solids from production streams, which may involve many of the same issues previously discussed. Ex. 1002 ¶ 56. Production wells often produce solids of various types and sources with the produced hydrocarbons, which can cause problems in downstream piping and equipment, including mechanical erosion, blockage, and removal costs.

Id. ¶ 57; Hemstock, 1:34-50.

The ability of fluids to carry a solid is a function of solid particle size, fluid density, and dominant-species velocity. Ex. 1002 ¶ 56. A common approach to dealing with a stream that contains gas, liquid, and solids is to first separate the gas from the heavy species by significantly increasing the cross-sectional flow area, thereby dropping the velocity of the stream. *Id.* At the lower velocity, the heavy species will tend to fall out of the flow stream. *Id.* Vessels designed for significant solids will tend to have a larger liquid/solid reservoir and a larger liquid-handling capacity than one designed for streams that do not anticipate significant solids. *Id.* These vessels will also tend to have some method to remove accumulated solids from the vessel. *Id.*

V. U.S. PATENT NO. 8,945,256

The '256 Patent relates to “a system and apparatus for the removal of particulates, such as sand, from fluid streams produced from a well, while minimizing abrasion of the involved equipment.” '256 Patent, 1:5-8.

A. Priority Date

The patent is entitled “Desanding Apparatus and System” and issued on February 3, 2015 from an application filed on February 13, 2012. The earliest possible priority date of the '256 Patent is February 13, 2012.

B. Specification**1. Background of the Invention**

The specification explains that oil and gas produced from wells often contains particulates such as sand, which can cause abrasion and plugging of equipment. '256 Patent, 1:12-20. Erosion of high pressure production equipment caused by such particulates can cause catastrophic failures, posing a hazard to personnel and the environment. *Id.*, 1:25-35. Various “desanding” solutions have been used to remove particulates from production streams to prevent these problems. *Id.*, 1:40-2:22. These include a pressurized “P-Tank,” filters comprising filter bags inside pressure vessels, and a prior art solution by the inventor of the '256 Patent. *Id.*

The specification explains that Canadian Patents 2,433,741 and 2,407,554 disclose a desander having

an elongate, horizontal vessel having an inlet at one end and an outlet at the other end, the outlet separated from the inlet by a downcomer flow barrier, such as a weir, adjacent the vessel's outlet or exit. The weir forms, and maintains, an upper freeboard portion having a cross-sectional area which is greater than that of the field piping from whence the fluid stream emanates for encouraging water and particulates to fall out of the freeboard portion. Water and particulates accumulate along a belly portion. The accumulation of particulates is along a substantial length of the elongate vessel increasing the difficulty of periodic manual removal of such accumulating using scraper rods and the like.

Id., 2:8-21. The specification also references the prior art desander described in Hemstock (U.S. Patent No. 6,983,852). *Id.*, 6:38-40. Hemstock and Canadian Patent 2,433,741 (Ex. 1013) appear to have substantially similar disclosures. *Compare* Ex. 1004 *with* Ex. 1013. The specification further states that “[w]hile Applicant has substantially maintained their elongated horizontal design virtually unchanged over the past 8 years or so, there has been a desire to improve the ease with which the vessel can be cleaned and further improvement in separation efficiency.” ’256 Patent, 2:22-26.

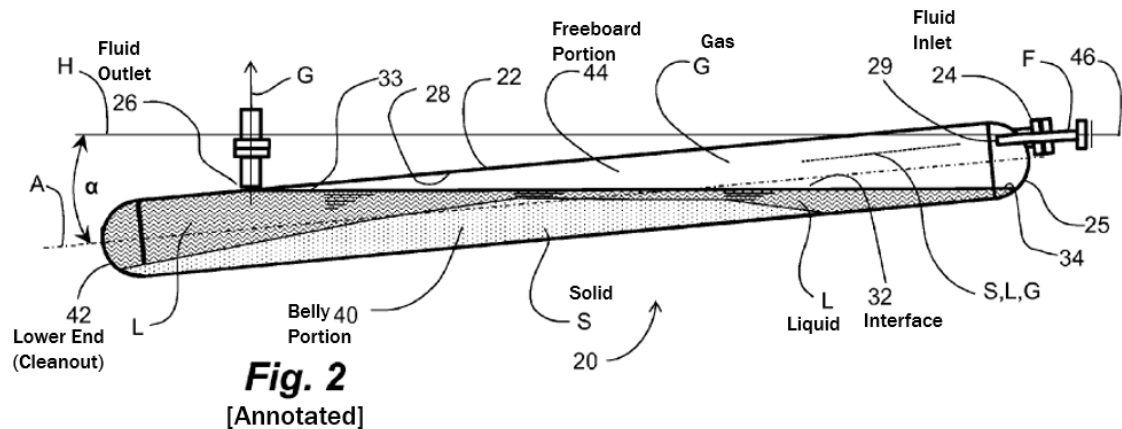
2. The Claimed Invention

The claimed invention is a desanding apparatus and corresponding method, consisting essentially of a vessel which is piped to receive a high velocity fluid (containing liquid, gas, and solid phases) from a wellhead. *Id.*, 2:33-40. The vessel has an “upper freeboard portion” having a greater cross-sectional area than the inlet piping, resulting in a reduced velocity such that entrained liquids and particulates fall out of the gas stream and collect in a belly storage portion. *Id.*, 2:56-67. The vessel has a fluid outlet, spaced along the longitudinal axis from the fluid inlet. *Id.*, 2:52-55. A desanded gas stream flows out of the freeboard portion and the fluid outlet, “being free of a substantial portion of the particulates.” *Id.*, 2:65-67. The specification admits that these aspects of the invention all appear in prior art patent by the same inventor. *Id.*, 2:7-21. The vessel of the claimed invention differs in that

it is inclined from the horizontal, and the angle is controlled to maintain the freeboard portion. *Id.*, 2:44-55.²

3. Preferred Embodiments

The invention is described with respect to the embodiment of Figure 2, which has been annotated here for reference.



Desander 20 is a vessel inclined at an angle α to the horizontal H. *Id.*, 4:30-31. Fluid containing gas and entrained liquids and solids enters the vessel 22 at fluid inlet 24. *Id.*, 4:32-38. Due to the increase in the cross sectional area in the freeboard portion 44 (compared to the inlet piping), the velocity drops sufficiently to allow the entrained liquids and particulate solids to fall out of the fluid stream and collect in

² The specification asserts that the claimed invention also lacks a flow barrier or weir (*id.*, 4:21-26), but the absence of such a barrier is not required by the claims. *Id.*, 7:46-9:13.

the belly portion 40. *Id.*, 5:24-30. A gas/liquid interface 32 forms horizontally from about the fluid outlet, and the belly portion is formed below the interface. *Id.*, 4:38-41. Gas, now substantially free of particulates, discharges at fluid outlet 26, along with liquids which are re-entrained with the gas. *Id.*, 4:67-5:5. The particulates are stored in the belly portion until the capacity is reached, at which time the vessel is shut in, depressurized, and cleaned out via a closure at lower end 42. *Id.*, 5:3-5, 7:14-19. In various embodiments, discharge nozzle 29 may be replaceable, may extend into the vessel, and may be oriented either parallel or at an angle to the vessel's longitudinal axis. *Id.*, 4:35-36, 6:9-31, 6:66-7:11. Claims 1, 2, 3, 4, 5, 6, 7, 9, 10, 11, 13, and 16 (the Base Claims) are directed towards these embodiments.

Claims 8 and 12 (the Inclination Angle Claims) are directed to specific embodiments having, respectively, a variable inclination angle and an angle between 2° and 20°. *Id.*, 5:58-6:8, 6:56.

Claims 14 and 15 (the Eccentric End Claims) are directed to specific embodiments where the vessel has a smaller diameter end downstream of the fluid outlet, and where that smaller diameter end is an eccentric end. *Id.*, 7:28-38, Fig. 7. Eccentric here refers to an end where the inside surface of the smaller diameter portion is flush with the inside surface of the larger diameter portion, and the centerlines are parallel. *See id.*; *see also* Ex. 1002 ¶ 194.

C. Prosecution History

In the first office action, the examiner rejected claims 1-3 and 8 for anticipation by U.S. Patent No. U.S. 4,073,734 to Lowrie (“Lowrie”). Ex. 1003 at 85-86. The examiner further rejected claims 4-7 as obvious in view of Lowrie and U.S. Publication 2004/0074838, which is the application publication of Hemstock. *Id.* at 87.

The § 103 rejection relied on Lowrie as disclosing all elements of Claim 1, and argued that Hemstock taught a replaceable nozzle and flanged connection as required by claims 4 and 5. *Id.* at 87-88. The rejection also relies on Hemstock to satisfy the claim 6 limitations requiring a gas stream emanating from a wellhead and a fluid inlet discharging the stream into the freeboard portion and parallel to the longitudinal axis. *Id.* at 88. The examiner stated that it would have been obvious to a person of ordinary skill in the art (“POSITA”) to modify Lowrie as suggested by Hemstock in order to enhance desanding performance. *Id.* With regard to claim 7, the examiner argued that Lowrie possessed all elements except: a conduit for conducting a fluid stream containing entrained particulates from a wellhead, having a desander end, where the fluid inlet comprises a discharge end directing the fluid into the freeboard portion parallel to the longitudinal axis and a receiving end oriented orthogonal to the desander end. *Id.* at 88-89. The examiner argued all of these were disclosed by Hemstock and the combination would have been obvious.

Id. at 89.

The examiner also rejected claim 9 over Hemstock in view of Lowrie. The examiner explained that Hemstock disclosed a “method for desanding a fluid stream emanating from a wellhead . . . the method comprising: providing an elongated vessel having a longitudinal axis, a fluid inlet adjacent an first end of the vessel.”

Id. at 89. However, the examiner did not rely on Hemstock’s other teachings due to the fact that it was not inclined, explaining that:

Hemstock does not disclose a fluid outlet spaced along the longitudinal axis from the fluid inlet inclining the vessel at angle from horizontal at a non-zero inclination angle so that the fluid outlet is lower than the fluid inlet for forming a freeboard above the fluid outlet; discharging the fluid stream from the fluid inlet, into the vessel and substantially parallel to the longitudinal axis for establishing a liquid interface in a belly portion of the vessel, the belly portion and being formed below the fluid outlet, and directing the liquid and particulates along a trajectory in the freeboard portion of the vessel to intercept a substantial portion of the particulates at the liquid interface for storage in the belly portion; and recovering a desanded gas stream at the fluid outlet which is substantially free of particulates.

Id. at 89-90 (emphasis in original). The examiner relied instead on Lowrie as teaching these limitations, and that it would have been obvious to combine the two in order to enhance desanding system performance. *Id.* at 90-91.

The applicant responded to the objection by requesting minor amendments to the specification and amending several claims. *Id.* at 56-78. Claim 1 was amended to add, *inter alia*, the requirement that the fluid inlet be spaced from the outlet, and that the fluid outlet be lower than the fluid inlet. *Id.* at 63. The applicant also added claims 10-16. *Id.* at 78.

In the response, the applicant noted first that Lowrie did not disclose a desanding system directed to receiving a gas stream with entrained liquid and particulates, but separation of heavy and light liquids in a marine installation, and was not capable of separating particulates. *Id.* at 70. Applicant also explained that Lowrie did not teach an inclined vessel, but rather a horizontal vessel addressed to the problem of liquid/liquid separation on a vessel subject to the pitch and roll of a marine installation. *Id.* at 70-71. Thus, Lowrie's disclosure of an inclined vessel merely showed the problem Lowrie was trying to solve. *Id.* Applicant also distinguished Lowrie as not teaching a combined gas/liquid fluid outlet as required by claim 1, the establishment of a gas/liquid interface, a diminishing freeboard portion, a fluid outlet lower than the fluid inlet during operation, a lowered freeboard velocity, or the accumulation of particulates. *Id.* at 71-74. Ultimately, the applicant explained that Lowrie would simply not function as a desanding device. *Id.* at 74-75. The applicant further explained that Lowrie, in combination with Hemstock, could not render the claims obvious due to the foregoing shortcomings. *Id.* at 76-77.

The applicant further noted that Hemstock does not teach an inclined vessel, and as such “it requires a weir to establish a freeboard portion,” and that the combination with Lowrie “would not arrive at Applicant’s claimed desanding system of a static, inclined vessel, absent a weir and forming a gas/liquid interface from the fluid outlet for particulate separation.” *Id.* at 77. However, the applicant never amended the claims to actually require the inclined vessel to not have a weir.

The examiner allowed the claims in response, after agreement to an examiner’s amendment requiring the vessel to be inclined at all times during operation. *Id.* at 35.

D. Claim Construction

In an inter partes review, an unexpired claim is, as of the time of this filing,³ given its “broadest reasonable construction in light of the specification of the patent in which it appears.” 37 C.F.R. § 42.100(b). Under this standard, “[t]he focus of the inquiry regarding the meaning of a claim should be what would be reasonable from the perspective of one of ordinary skill in the art.” MPEP § 2173.01 (*citing In re*

³ Petitioner is currently unaware of any reasons for differences in how the Challenged Claims should be construed under the BRI standard and the *Phillips* standard, but reserves the right to respond to any assertion that differences between the two standards affect Petitioner’s analysis herein.

Suitco Surface, Inc., 603 F.3d 1255, 1260 (Fed. Cir. 2010)).

One term appearing in all the claims, “freeboard portion,” is not a term used routinely in the art. Ex. 1002 ¶ 60. The specification, however, makes clear that “freeboard portion” refers to the substantially gas-filled portion of the desanding vessel above the gas/liquid interface. ’256 Patent, Abstract (“a freeboard portion formed adjacent an upper portion of the vessel above a gas/liquid interface”); 2:13-17 (“an upper freeboard portion ... for encouraging water and particulates to fall out of the freeboard portion”); 4:13-18 (“Particulates S and liquids L ... are periodically cleaned out ... to ensure that the maximum accumulated depth does not encroach on the freeboard portion 13.”). This is the interpretation a POSITA would give to “freeboard portion” in the ’256 Patent. Ex. 1002 ¶ 60.

Another term, “replaceable,” appears in claims 4 and 5. The term is used in the specification with regard to Figures 4 and 5, where it is explained that:

While the inlet 24 can be integrated with the vessel 22, one can also provide an inlet 24 or discharge 29 that is replaceable for ease of maintenance. Options include accepting eventual wear and shutdown of the desander 20 for replacement of an integrated inlet 24; modifying the material or configuration of the inlet 24 to prolong service life, or using replaceable discharge of nozzle for minimizing turnaround time.

’256 Patent, 6:9-18. A POSITA, in view of this disclosure and consistent with common usage in the art, would understand “replaceable” to refer to the capacity to

be removed without requiring welded modifications to the pressure vessel. Ex. 1002 ¶¶ 61-63.

Other than as set forth above, for purposes of this petition only, Petitioner submits that the claim terms of the '256 patent do not have any special meanings and are presumed to take on their broadest reasonable meaning consistent with the understanding of POSITA when read in light of the patent's specification. Ex. 1002 ¶ 64.

VI. PRECISE STATEMENT OF REASONS FOR THE RELIEF REQUESTED

A claim is obvious when “the differences between the claimed invention and the prior art are such that the claimed invention as a whole would have been obvious before the effective filing date of the claimed invention to a person having ordinary skill in the art to which the claimed invention pertains.” 35 U.S.C. § 103. The question of obviousness is resolved on the basis of underlying factual determinations including: (1) the level of ordinary skill in the art; (2) the scope and content of the prior art; (3) any differences between the claimed subject matter and the prior art; and (4) objective evidence of nonobviousness. *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007).

A. The Level of Ordinary Skill in the Art

Based on the type of problems encountered in the field of oil and gas production and the design of separation vessels of all types, a POSITA would have

at least a bachelor's degree in petroleum, chemical, or mechanical engineering. Ex. 1002 ¶ 40. Alternatively, a POSITA could have a bachelor's degree in some other engineering or scientific discipline, and at least three years of experience working with separators, as might be acquired working with such equipment in oil and gas production, gas processing, petroleum refining, chemical processing, or similar fields. *Id.* This is the general educational background or experience level of active workers involved in designing separation systems. *Id.* The technology in this field is not subject to rapid innovation, and is not considered extremely sophisticated. *Id.*

The level of ordinary skill in the art is also reflected by the prior art of record. *See Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir. 2001).

B. The Scope and Content of the Prior Art

1. The Asserted Grounds are Not the Same or Substantially Similar to those Previously Presented to the Office

The grounds and arguments asserted in this Petition are not the same or substantially the same as the prior art or arguments previously presented to the Office, pursuant to 35 U.S.C. § 325(d). As discussed in section V.C., the examiner relied on Lowrie as teaching all claimed elements of the desander vessel, relying on Hemstock to supplement Lowrie's failure to teach a replaceable nozzle and those elements related to the fluid stream's emanation from a wellhead and subsequent discharge into the vessel. Ex. 1003 at 87-89. With respect to the claimed method, because Hemstock was not inclined, the examiner relied only on Hemstock for its

teachings of desanding, an elongated vessel with a longitudinal axis, and a fluid inlet at one end of the vessel. *Id.* at 89-90.

The applicant overcame the examiner's combinations by explaining that Lowrie does not disclose a desanding system, was not capable of separating particulates, and did not teach an inclined vessel. However, Davis, Miller, and the Data Book all teach separators and/or separation principles that use inclined vessels and are capable of separating solid particulates.

The applicant's only substantive arguments distinguishing Hemstock from the claimed invention related to Hemstock's failure to teach an inclined vessel, and its use of a weir, which was not required by the claimed invention. However, the absence of a weir is not required by the patent's claims.⁴ And, although Hemstock is not inclined, this is precisely what is suggested by Davis, Miller, and the Data Book.

Thus, the asserted grounds are not the same or substantially the same as the prior art or arguments previously considered by the Office.

⁴ It is also arguable that the '256 Patent does utilize a weir: Figure 7 of the '256 Patent shows that the gas outlet forms a flow barrier just as is described in Hemstock with regard to Figure 4c. Compare '256 Patent, Fig. 7 with Hemstock, Fig. 4c, 5:28-36. However, this was not addressed during examination.

2. The Prior Art is Analogous

In order for a reference to be prior art for obviousness purposes, it must be analogous, that is: (1) from the same field of endeavor as the claimed invention (even if addressing a different problem); and/or (2) reasonably pertinent to the problem faced by the inventor (even if from a different field of endeavor). *In re Bigio*, 381 F.3d 1320, 1325 (Fed. Cir. 2004). The '256 Patent states that it relates to a system and apparatus for the removal of particulates from fluid streams produced from a well. '256 Patent, 1:5-7. This is more specific than the patent's general field of endeavor. Based on the specification, a POSITA would understand the patent's general field of endeavor to be phase separation and related equipment. Ex. 1002 ¶ 79. This is because the basic principle on which the '256 Patent is designed—gravity settling—is a fundamental principle used to achieve physical separation of gas, liquids, and solids. *Id.* (citing Data Book at 3).

The particular problem faced by the inventor includes at least the more efficient separation of sand from a fluid containing both gas and liquids. '256 Patent, 1:5-8, 2:22-26; Ex. 1002 ¶ 80.

All of the references relied on herein are within the general field of endeavor and/or reasonably pertinent to the problem faced by the inventor, qualifying them as analogous prior art. Ex. 1002 ¶¶ 78-85. Hemstock is referenced in the specification itself, and the applicant admits the '256 is an improvement over its system. '256

Patent, 6:39-41; Ex. 1003 at 77. Miller is directed to the separation of solids from liquids, and is thus both from the same general field of endeavor and reasonably pertinent to the inventor's problem. Miller, 2:9-23. The Data Book is a reference work well-known to a POSITA, which provides basic instruction regarding the design of many types of separation vessels. Ex. 1002 ¶ 85. Thus, it is from the same general field of endeavor and reasonably pertinent to the problem faced by the inventor. *Id.* Finally, Davis is from the same general field of endeavor (phase separation), and explicitly discloses that the specific type—sedimentation—is one commonly used in the chemical and petroleum industries. Davis at 3. Davis is further reasonably pertinent to the problem faced by the inventor, as it teaches a method—the use of inclined channels—which can greatly reduce settling times for solids settling out of a liquid. *Id.* at 17; Ex. 1002 ¶ 83. Thus, all of the references relied on here are from the same general field of endeavor and/or reasonably pertinent to the problem faced by the inventor Ex. 1002 ¶ 78-85.

3. Asserted References

a. Hemstock

Hemstock, which shares one inventor with the '256 Patent, issued on January 10, 2006, making it pre-AIA § 102(b) prior art. Hemstock describes, essentially, the same desanding apparatus as that disclosed in the '256 Patent, except that it is not tilted or inclined. It is in fact the same apparatus disclosed in Canadian patent

2,433,741 discussed in the Background section of the '256 Patent's specification at 2:7-21. *Compare* Hemstock with Ex. 1013. Thus, the primary difference between Hemstock and the '256 Patent is the inclined angle of the desander in the '256 Patent.

Hemstock explains that its invention relates to the problem of sand and other particulates in production streams:

The present invention relates to a system and apparatus for the removal of particulates such as sand from fluid streams produced from a well while minimizing abrasion of the involved equipment. . . . Production from wells in the oil and gas industry often contain particulates such as sand. ... As the particulates are produced, problems occur due to abrasion, and plugging of production equipment.

Hemstock, 1:13-32. A modified version of Hemstock's Figure 3, which combines the right and left segments together, appears below:

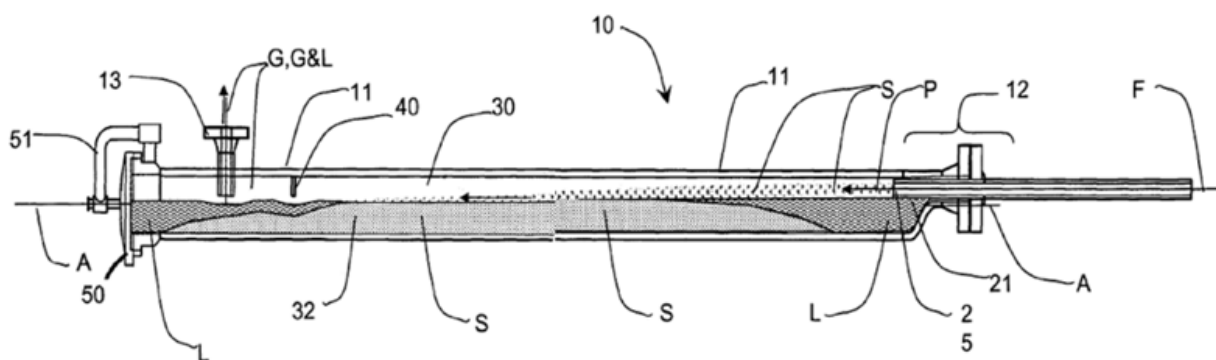


Fig. 3 (modified)

With reference to Figure 3, Hemstock teaches that its desander 10:

comprises a substantially horizontal, cylindrical pressure vessel 11 having a first fluid inlet end 12 adapted for connection to a fluid stream F such as from wellhead piping 9 and a fluid outlet 13 The fluid stream F typically comprises a variety of phases including gas G, some liquid L and entrained particulates such as sand S.

Id., 3:32-42. Hemstock's fluid outlet 13 discharges gas and liquids during normal operation. *Id.*, 1:34-42, 3:35-42, Fig. 3. Sand accumulates and is removed on a batch basis via cleanout 50. *Id.*, 3:35-42, 5:2-6, 5:44-47.

b. Davis

Davis is a paper entitled "Sedimentation of Noncolloidal Particles at Low Reynolds Numbers," published in 1985 in the Annual Review of Fluid Mechanics. Davis at 1-3. Davis was written by Robert H. Davis (Department of Chemical Engineering, University of Colorado, Boulder, Colorado) and Andreas Acrivos (Department of Chemical Engineering, Stanford University, Stanford, California). Ex. 1005 at 3. Davis was cited by others in the field as early as 1986, and was thus publicly accessible long before the priority date of the '256 Patent.⁵ Ex. 1009 ¶¶ 5-7. Davis is thus pre-AIA § 102(b) prior art.

Davis relates to sedimentation, "wherein particles fall under the action of

⁵ Davis also qualifies as an ancient document pursuant to FRE 803(16) due to its publication date.

gravity through a fluid in which they are suspended,” and which “is commonly used in the chemical and petroleum industries as a way of separating particles from fluid.” Davis at 3. Among other topics, the paper discusses then-recent developments in the area of enhanced sedimentation in inclined channels. *Id.* at 4.

Davis explains that because sedimentation is often very slow, “there exists a need for constructing simple devices that could accomplish this solid-liquid separation more rapidly.” *Id.* at 17. One type of device consists of settling vessels having inclined walls, composed of an inclined, narrow tube or channel. *Id.* Davis explains that “[t]he enhancement in the sedimentation rate [in an inclined channel] can be viewed as resulting from the fact that whereas particles can only settle on the bottom in a channel with vertical walls, such particles can also settle onto the upward-facing wall in a tilted channel.” *Id.* “These particles then form a thin sediment layer that rapidly slides down toward the bottom of the vessel under the action of gravity. Thus, one can interpret the increase in the settling rate as due to an increase in the surface area available for settling.” *Id.* at 17-18. Davis further explains that this effect had already been known for many years at the time. *Id.* at 18.

c. The Data Book

The Data Book is the Revised Tenth Edition of the Engineering Data Book, published by the Gas Processors Suppliers Association (GPSA) in 1994. The Data

Book is a well-known general reference publication to those of ordinary skill in the art, was publicly sold, and was publically accessible well before the priority date of the '256 Patent. Ex. 1002 ¶¶ 74-75; Ex. 1010 ¶¶ 3-4. The Data Book is thus pre-AIA § 102(b) prior art.

Section 7 of the Data Book is entitled “Separators and Filters.” Data Book at 3. The section explains the design of vessels used in the separation of gases, liquids, and solids. *Id.* The Data Book explains the principles related to gravity settling, which apply to the '256 Patent. *Id.* at 4-5; Ex. 1002 ¶ 76. It also discusses the various parts and types of separator vessels, including horizontal vessels (such as those discussed in Hemstock). Data Book at 5-8.

Section 17 of the Data Book relates to fluid flow and piping. This section includes a discussion of two phase (liquid and gas) flow, including the problem of liquid slugging (large liquid volumes occurring at irregular intervals) and the design of “slug catchers.” *Id.* at 31-37, 41. The Data Book explains that slug catchers are devices used to absorb the fluctuating liquid inlet flow rates, and may be “inclined one to ten degrees,” and that different inclinations are favored by different designers. *Id.* at 41.

d. Miller

Miller issued on June 12, 1923, making it pre-AIA § 102(b) prior art. Miller’s invention “relates to the separating art, and ... is especially adapted for the separation

of solid matter from liquids, and is particularly intended for the separation of sand, minerals and other heavy particles and cuttings from mud-laden water, slimes and other liquids, especially from the mud-laden water used in drilling wells.” Miller, 2:9-20.

Miller discloses an inclined separation vessel, mounted on a jack, whereby the angle of the vessel may be varied. *Id.* at 2:51-61. Mud, containing particulates, is separated using the action of both gravity and the bubbling of compressed air through the mud. *Id.* at 2:51-61, 2:88-3:24, 3:14-21. Solids migrate toward the lower end of the vessel, to which a smaller diameter outlet pipe is attached eccentrically, and pass out through the outlet pipe. *Id.* at 1 (Figure); 3:14-25.

C. Differences Between the Claimed Subject Matter and the Prior Art

Ascertaining the differences between the prior art and the claimed subject matter entails determining “whether there was an apparent reason to combine the known [prior art] elements in the fashion claimed by the patent at issue.” *KSR Int’l Co.*, 550 U.S. at 417-18. Accordingly, the teachings of each prior art reference in relation to each element of the Challenged Claims are first provided below. Then, the asserted grounds are explained including the rationales supporting the conclusion that the Challenged Claims are obvious.

1. The Prior Art References Teach All Elements of the Challenged Claims.

The teachings of the prior art references are mapped to each element of the Challenged Claims below. To the extent a prior art reference discloses the claim element or has features similar (but not necessarily identical) to the claim element, they are discussed below.

a. Claim 1

1.0 A desanding system for receiving a gas stream containing entrained liquid and particulates comprising:

Hemstock teaches a desanding apparatus for intercepting a fluid stream from a wellhead, which contains liquid, gas, and solids. Hemstock, 2:25-30. Hemstock explicitly states that the solids are entrained. *Id.*, 3:37-39. Hemstock also explains that such multiphase flow in oil and gas operations is unstable, and can contain both entrained liquids in a gas mist (if the flow is primarily gas phase) or gas flow punctuated by large slugs of liquid. *Id.*, 2:7-9. Hemstock also explains that liquid in the vessel is “**re-entrained** for discharge with fluids exiting the outlet 13.” *Id.*, 4:55-57 (emphasis added). In order for the liquids to be re-entrained, they of course had to first be entrained. Thus, Hemstock’s desanding system receives a stream from a wellhead, containing gas, entrained liquid and particulates.

The Data Book discloses separator vessels for receiving gas streams containing entrained liquids and solids. Data Book at 3, 5-7.

1.1 a vessel elongated along a longitudinal axis and having a fluid inlet adjacent a first end of the vessel and a fluid outlet spaced along the longitudinal axis from the fluid inlet towards a second end of the vessel,

Hemstock discloses a cylindrical pressure vessel which is elongated along its central longitudinal axis as shown below in Figures 1b and 3⁶, which has a first fluid inlet end 12 adapted for connection to a fluid stream from the wellhead, and a fluid outlet 13 spaced along the longitudinal axis towards the second end of the vessel. Hemstock, Fig. 1b, Fig 3, 3:32-37.

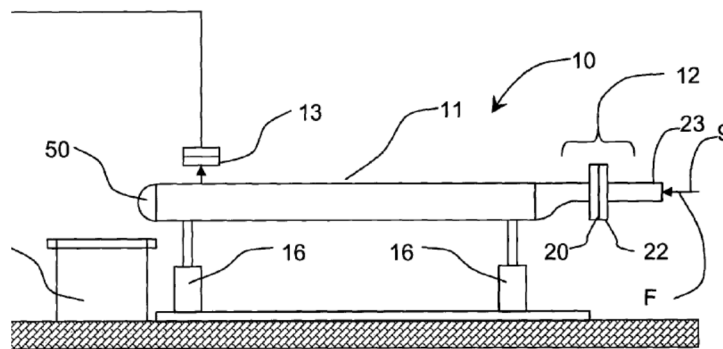


Fig. 1b

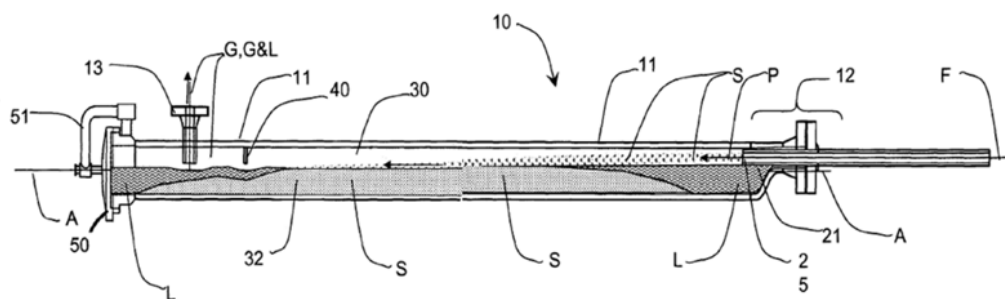


Fig. 3 (modified)

⁶ Fig. 3 has been modified here for ease of comparison by combining the top and bottom images.

Miller teaches an elongated vessel 5 having a fluid inlet from hopper outlet 3 near the lower end of the vessel, and an outlet 13 spaced along the longitudinal axis from the inlet towards the second end of the vessel. Miller, 1, 2:51-75.

The Data Book discloses several different separator vessels elongated along a longitudinal axis, having a fluid inlet at a first end and a fluid outlet spaced along the longitudinal axis toward the second end. Data Book at 7, 41.

1.2 said vessel being inclined from a horizontal at a non-zero inclination angle at all times during operation such that the fluid outlet is lower than the fluid inlet,

Hemstock teaches a horizontal (non-inclined) vessel, which has a freeboard both above and immediately below the fluid outlet. Hemstock, Fig. 3, 4:15-21 (discussing the substantially gas-phase volume of freeboard portion 30 in Figure 3 and illustrating that it exists both below and above the fluid outlet 13). A POSITA would understand that Hemstock's fluid outlet is lower than its fluid inlet based on its principles of operation and as shown in Figures 3, 4a, and 4c. Ex. 1002 ¶ 94. However, even if this were not the case, if Hemstock were inclined its fluid outlet would necessarily be lower than its fluid inlet. *Id.*

Davis teaches that sedimentation is commonly used in the chemical and petroleum industries as a way to separate particles from fluid. Davis at 3. Davis explains that because sedimentation is often very slow, "there exists a need for constructing simple devices that could accomplish this solid-liquid separation more

rapidly.” *Id.* at 17. Davis explains that a simple device that can accomplish solid-liquid separation more rapidly is a settling vessel comprising an inclined, narrow tube or channel. *Id.*

The Data Book discloses that a slug catcher may be a single vessel or constructed of pipe and that such devices are “generally inclined from one to ten degrees” and that “[d]ifferent pipe inclinations ... are favored by different designers.” Data Book at 3, 41. Figure 17-21 shows an example of a “multiple pipe (harp) slug catcher” that is inclined, having separate vapor (gas) and liquid outlets. *Id.* at 41. Both of these outlets are lower than the fluid inlet. Ex. 1002 ¶ 96.⁷

1.3 the fluid inlet discharging the gas stream into the vessel at an inlet velocity,

Hemstock discloses a vessel with a “fluid inlet adjacent a first end of the

⁷ Although not explicit in the Data Book, a POSITA would understand that the harp style slug catcher shown in Figure 17-21 normally operates with manual liquid outlet valves that are closed. Ex. 1002 ¶¶ 103-04. Thus, both liquids and vapor normally leave the slug catcher through the vapor outlet. *Id.* Further, it is normal for such slug catchers to accumulate some solids that must be flushed out the liquid outlet, although this is not their primary function. *Id.* Although this is how a POSITA would understand such a slug catcher to work, Petitioner does not rely on this understanding as a part of the Data Book’s disclosure in any of the asserted grounds.

vessel and adapted for receiving the fluid stream, the fluid inlet discharging the fluid stream at an inlet velocity.” Hemstock, 2:40-46.

The Data Book discloses a number of vessels having fluid inlets which discharge a fluid stream into the vessel. Data Book at 7, 41. A POSITA would understand that any fluid inlet stream discharged into any vessel, pipe, or other space necessarily has an inlet velocity. Ex. 1002 ¶ 99.

1.4 the gas stream travelling down the inclined vessel to the fluid outlet

Hemstock: The inlet stream travels from a first end of the vessel at the fluid inlet 12 to the other end, where the fluid outlet 13 is spaced horizontally from the inlet. Hemstock, 2:40-50, 3:32-37, Fig. 3.

The Data Book teaches that the inlet stream into the harp slug catcher travels down the inclined or sloped vessel to both the vapor and liquid outlets. Data Book at 41.

1.5 the vessel having: a gas/liquid interface formed at the fluid outlet having a belly storage portion formed therebelow and a freeboard portion formed adjacent an upper portion of the vessel above the interface,

Hemstock discloses that its vessel comprises an upper freeboard portion and a lower belly portion, where the “freeboard portion” is maintained using a depending flow barrier adjacent the vessel’s outlet.” Hemstock, Abstract, 4:44-47. The upper freeboard portion 30, which is substantially gas phase, and the belly

portion 32 formed below the freeboard portion, which stores liquids and sand, necessarily form together a gas/liquid interface where they meet. *Id.*, 4:15-21, 4:37-43, Fig.3. Freeboard portion 30 is formed adjacent an upper portion of the vessel above the interface as shown in Figures 1b and 3.

The Data Book discloses a sloped harp slug catcher having both vapor and liquid outlets. Data Book at 41. The Data Book explains that such devices must have sufficient volume for liquid level fluctuation and serve as a “liquid-vapor disengaging device.” *Id.* A POSITA would understand from these disclosures that such devices necessarily have a gas/liquid interface, which is formed at the vapor outlet and extends horizontally from the vapor outlet in the same manner as disclosed, for example, in Figure 7 of the ’256 Patent. Ex. 1002 ¶¶ 103-04. Thus, the gas-liquid interface forms a belly storage portion storing liquid (and any entrained solids) below the interface and a freeboard (substantially gas phase) portion above the interface, adjacent the upper wall. *Id.*

1.6 the freeboard portion having a freeboard cross-sectional area which diminishes along the inclined vessel from the fluid inlet to the fluid outlet; and

Hemstock teaches that flow barrier 40 “depends downwardly from the top of the vessel 11,” and is preferably spaced from inlet 11. Hemstock, 5:9-15. Figure 3 shows that the cross-sectional area of freeboard portion 30 is reduced at the point where flow barrier 40 is installed, as compared to the cross-sectional area of the

freeboard portion between flow barrier 40 and inlet 12. *Id.*, Fig. 3. Thus, Hemstock's freeboard portion has a smaller cross-sectional area at at least one point between the fluid inlet and the fluid outlet, although Hemstock is not inclined. If Hemstock were inclined, the cross-sectional area of the freeboard portion would necessarily diminish along the vessel from the inlet to the outlet. Ex. 1002 ¶ 105.

1.7 the freeboard portion at the fluid inlet causing the gas stream to have a freeboard velocity adjacent the fluid inlet which is less than the velocity of the fluid in the inlet, wherein the freeboard velocity is such that the entrained liquids and particulates fall out of the gas stream and collect in the belly storage portion, and

Hemstock teaches that the fluid stream F enters through inlet 12, and is received by a larger cross-sectional area and substantially gas-phase volume of freeboard portion 30, and “[a]ccordingly, the velocity of the fluid stream F slows to a point below the entrainment or elutriation velocity of at least a portion of the particulates S in the fluid stream.” *Id.*, 4:18-24. Further, Hemstock explains that liquids L from the fluid stream, along with particulates S, also collect in the vessel's belly portion 32. *Id.*, 4:37-43. These liquids accumulate there because they “dropout” of the fluid stream. *Id.*, 4:59-63. A POSITA would understand from these disclosures that liquids entrained in Hemstock's fluid stream F would, like the particulates, settle out of the fluid stream due to the velocity in freeboard portion 30 dropping low enough to allow gravity to overcome the drag force on the entrained liquid particles exerted by the gas flowing around it. Ex. 1002 ¶ 108. Thus, both the

liquid droplets and solid particles fall out of the fluid stream into the belly storage portion, which begins at the gas/liquid interface as discussed with regard to Claim 1.5. Hemstock, 4:37-43.

The Data Book discloses that standard horizontal separator design includes a “gravity” section “B” (corresponding to the claimed freeboard portion) which consists of a “portion of the vessel through which the gas moves at a relatively low velocity,” which enhances separation of entrained droplets. Data Book at 5-7 (Fig. 7-5). Separated droplets (which a POSITA would understand would also include entrained solid particulates, if present) gather in the sump section “D” (“belly storage portion”) which “acts as a receiver for all liquid removed from the gas.” *Id.*; Ex. 1002 ¶ 109.

1.8 wherein a desanded gas/liquid stream flows out of the freeboard portion and out the fluid outlet, being free of a substantial portion of the particulates, and

Hemstock teaches that “[t]ypically, liquid L out of the fluid stream F accumulates in the belly portion 32 to a steady state level and then is re-entrained for discharge with fluids exiting the outlet 13.” Hemstock, 4:55-59. Further, this fluid stream is “substantially free of particulates.” *Id.*, 2:59-61.

The Data Book explains that for a standard horizontal separator (including a slug catcher) the lighter phase (gas) stream flows out of the gravity section and out the gas or vapor outlet, free of a substantial portion of entrained droplets (droplets

including solid particulates, which behave in the same manner with regard to separation principles). Data Book at 5-7, 41; Ex. 1002 ¶ 112.

1.9 particulates accumulate in the belly portion for flowing downvessel towards said second end.

Hemstock explains that belly portion 32 receives and temporarily stores both liquids L and sand S which separate from the fluid stream F. Hemstock, 4:15-19, Fig. 3. The particulates have a fall trajectory from the fluid inlet such that they accumulate prior to the flow barrier. *Id.*, 2:50-61. Thus, the particulates entrained in fluid stream F at inlet 12 flow towards outlet 13, falling into the belly portion 32 for accumulation.

The Data Book discloses inclined slug catchers. Data Book at 41. A POSITA would understand that particulates in the inlet stream would necessarily accumulate with any liquid, if the liquid outlet valve was closed. Ex. 1002 ¶ 114.

b. Claim 9

9.0 A method for desanding a fluid stream emanating from a wellhead, the fluid stream containing gas, entrained liquid and particulates, the method comprising:

Hemstock: With regard to teaching a method, the normal use and operation of Hemstock's system would necessarily and naturally result in receiving a fluid stream from a wellhead containing gas, entrained liquid, and particulates. Ex. 1002 ¶¶ 115-16.

9.1 providing an elongated vessel having a longitudinal axis, a fluid inlet adjacent a first end of the vessel and a fluid outlet spaced along the longitudinal axis from the fluid inlet;

See Claim 1.1 above. The normal use and operation of Hemstock's desander would necessarily and naturally result in the performance of this step. Ex. 1002 ¶¶ 117-18.

9.2 inclining the vessel at angle from horizontal at a non-zero inclination angle so that the fluid outlet is lower than the fluid inlet for forming a freeboard above the fluid outlet;

See Claims 1.2, 1.5, above and Claim 10, below. Although Hemstock's desander is not inclined, the combination of the weir and/or the extended nozzle create a freeboard section.

If it were inclined (as suggested by the asserted grounds), the inclined desander would necessarily and naturally result in the performance of this step. Ex. 1002 ¶¶ 119-120.

9.3 discharging the fluid stream from the fluid inlet, into the inclined vessel and substantially parallel to the longitudinal axis for

See Claims 1.3 above and 3 below. 122. The normal use and operation of Hemstock's desander would necessarily and naturally result in the performance of this step. Ex. 1002 ¶¶ 121-22.

9.4 establishing a liquid interface in a belly portion of the vessel, the belly portion being formed below the fluid outlet, and

See Claims 1.5 above and 10 below. The normal use and operation of

Hemstock's desander would necessarily and naturally result in the performance of this step. Ex. 1002 ¶ 123-24.

9.5 directing the liquid and particulates along a trajectory in the freeboard portion of the vessel to intercept a substantial portion of the particulates at the liquid interface for storage in the belly portion; and

See Claim 1.7 above. The normal use and operation of Hemstock's desander would necessarily and naturally result in the performance of this step. Ex. 1002 ¶¶ 125-26.

9.6 recovering a desanded gas stream at the fluid outlet which is substantially free of particulates.

See Claim 1.8 above. The normal use and operation of Hemstock's desander would necessarily and naturally result in the performance of this step. Ex. 1002 ¶ 127-28.

c. Dependent Claims

2. The desanding system of claim 1 wherein fluid inlet has a discharge end, the discharge end oriented for discharging the gas stream into the freeboard portion.

Hemstock discloses that fluid inlet 12 has a discharge end, namely the protruding discharge portion 25 of nozzle 21, which extends into upper freeboard portion 30. Hemstock, 3:43-4:14, Figs. 2a, 2b, 3.

The Data Book teaches that the fluid inlet of a standard horizontal separator has a discharge end oriented for discharging the gas stream into the freeboard or

gravity phase portion. Data Book at 5, 7 (Fig. 7-5).

3. The desanding system of claim 1 wherein discharge end of the fluid inlet directs the gas stream into the freeboard portion and parallel to the longitudinal axis.

Hemstock: Nozzle 21 (including its discharge portion 25) directs the incoming fluid stream (containing gas, liquid, and solid particulates) into the freeboard portion along the nozzle's axis in a path (P) substantially parallel to the vessel's longitudinal axis (A). *Id.*, 4:5-14, Figs. 2a, 2b, 3.

The Data Book discloses that the discharge end of the fluid inlet into the horizontal separator shown in Figure 7-5 directs the inlet stream into the freeboard portion (gravity portion B) and parallel to the vessel's longitudinal axis. Data Book at 7.

4. The desanding system of claim 1 wherein the fluid inlet further comprises a replaceable nozzle having a discharge end oriented for discharging the gas stream into the freeboard portion.

Hemstock discloses that fluid inlet 12 has a nozzle 21, with discharge end 25, having a threaded inlet 23 for connection with coupling 24 on wellhead piping 9. Hemstock, 3:48-60, Figs. 1, 2a, 2b. Thus, the vessel is positioned over the nozzle. *Id.*, Figs. 2a, 2b. The nozzle inlet 23 is "typically formed of heavy-wall piping to extend its operational life Further, the nozzle's discharge 25 protrudes into the vessel 11 sufficiently to extend beyond the inlet 12 and into the freeboard portion 30, thereby aiding in minimizing localized wear on the *less easily replaced* inlet 12,

or eccentric fitting 31, of vessel 11.” *Id.*, 4:5-14 (emphasis added). A POSITA would understand from Hemstock’s description of the nozzle that it is a separate element from the vessel and does not require any welded modifications to the vessel to be removed, and is thus “replaceable.” Ex. 1002 ¶¶ 133-34.

5. The desanding system of claim 4 wherein the replaceable nozzle is connected to the fluid inlet at a flange.

Hemstock: Replaceable nozzle 21 is connected to fluid inlet 12 at flange 20.

Hemstock, 3:48-60, Figs. 2a, 2b. *See also* Claim 4, above.

6. The desanding system of claim 1 wherein the gas stream emanates from a wellhead and the fluid inlet further comprises: a discharge end for directing the gas stream into the freeboard portion and parallel to the longitudinal axis; a receiving end for receiving the gas stream and orthogonal to the wellhead.

Hemstock’s fluid stream emanates from a wellhead via piping 9. Hemstock, 3:32-39, Fig. 1a. As discussed for claims 2 and 3, the fluid inlet 12 includes nozzle 21 with discharge end 25 which directs the gas stream into the freeboard portion and parallel to the longitudinal axis. The fluid inlet 12 also has a receiving end, nozzle inlet 23, for receiving the inlet stream from the well. *Id.*, 3:55-60. Nozzle inlet 23 is “adapted for threaded connection to an existing coupling 24 from the wellhead piping 9.” *Id.*

As stated in the ’256 Patent, connective piping between a wellhead and downstream equipment is “typically in rectilinear or orthogonal arrangements.” ’256 Patent, 5:6-8. That is, it is either straight or at a 90° angle (perpendicular). Ex. 1002

¶¶ 136-37. These, and other less common piping angles, have been long known. *Id.* (see, e.g., Data Book at 41 depicting an inclined slug catcher positioned “orthogonal” to its inlet piping). A POSITA would understand from Hemstock’s discussion of the piping connections between inlet 23 and coupling 24 that the inlet piping could inherently be modified to include any required angle, turn, or lack thereof, to orient the desanding vessel or nozzle as necessary with relation to the wellhead and inlet piping, depending on existing piping configurations and space limitations at the wellsite. *Id.* Thus, a POSITA would have understood based on Hemstock’s disclosure that its receiving end could necessarily be adapted to be oriented either “rectilinear” or “orthogonal” to the wellhead or the wellhead piping. *Id.*

7. The desanding system of claim 1 further comprising:

a conduit for conducting a fluid stream containing entrained particulates from a wellhead, the conduit having a desander end; and

wherein the fluid inlet further comprises a discharge end for directing the fluid stream into the freeboard portion and oriented parallel to the longitudinal axis, and a receiving end for receiving the gas stream and oriented orthogonal to the desander end.

Hemstock discloses a conduit, wellhead piping 9, which carries fluid stream F, containing entrained particulates, from a wellhead, which connects to inlet end 12 of desander 10 (thus disclosing a “desander end”). Hemstock, 3:32-39. The remaining limitations, related to the fluid inlet discharge and receiving end, are discussed with respect to claims 2, 3, and 6 above.

8. The desanding system of claim 1 wherein the inclination angle is variable for varying fluid stream conditions.

Miller discloses an elongated solid/liquid separator vessel mounted at an angle to the horizontal, supported by means of a jack, “by means of which the angle of said vessel may be varied and adjusted to suit.” Miller, 2:6-8, 2:51-59. Miller does not explicitly state a preferred angle of inclination but the angle disclosed in Miller’s figure appears to be approximately 10°-15° from the horizontal, and is definitely less than 20°. Ex. 1002 ¶ 140.

The Data Book teaches that slug catchers are generally inclined from “one to ten degrees” and that “[d]ifferent pipe inclinations ... are favored by different designers.” Data Book at 41.

A POSITA would understand from these disclosures that the inclination angle to be used for a given fluid stream must be determined based on experience or experimentation with regard to the particular characteristics of the fluid stream in question, such as velocity and viscosity, as well as the amount of entrained particulates. Ex. 1002 ¶ 142.

10. The desanding system of claim 1 wherein said gas/liquid interface is formed during operation, the gas/liquid interface extending horizontally from about the fluid outlet.

Hemstock’s gas liquid interface is at the meeting of the upper freeboard portion 30 and the lower belly portion 32, as discussed with regard to Claim 1.5. The “freeboard portion is maintained using a depending flow barrier adjacent the

vessel's outlet." Hemstock, Abstract, 4:44-47. Hemstock further discloses that the flow barrier 40c can be formed by outlet 13 itself. *Id.*, 5:16-20, Fig. 4c. The flow barrier maintains the freeboard portion (gas) above the lower edge and forms the belly storage portion (liquid, solid) below the lower edge. *Id.*, 2:50-55, 4:44-47. A POSITA would understand from these disclosures, as shown in Figures 4a-4c, that the gas/liquid interface is formed around the location of the flow barrier. Ex. 1002 ¶ 143. Thus, as shown in Figure 4c, Hemstock discloses that the gas/liquid interface (30/32) extends horizontally from near, or about, the location of fluid outlet 13 and barrier 40c.

The Data Book: See Claim 1.5, above.

11. The desanding system of claim 1 wherein said the cross-section [sic] area of the freeboard portion is at its greatest adjacent the fluid inlet.

Hemstock: See Claim 1.6, above. Further, the cross-sectional area of freeboard portion 30 is lower at the point where flow barrier 40 is installed, as compared to the cross-sectional area of the freeboard portion between flow barrier 40 and inlet 12. Hemstock, 5:9-15, Fig. 3. Further, due to the accumulation of liquid and solids in the belly storage portion as they fall out of the inlet stream, the cross-sectional area of Hemstock's freeboard portion would be at its greatest adjacent the fluid inlet. Ex. 1002 ¶ 145; Hemstock, Fig. 3. Also, if Hemstock were inclined, the cross-sectional area of the freeboard portion would be at its greatest adjacent the

fluid inlet. Ex. 1002 ¶ 145.

12. The desanding system of claim 1 wherein said inclination angle is between about 2 degrees and about 20 degrees.

See Claim 8, above.

13. The desanding system of claim 1 further comprising: an access closure at said second end for removal of accumulated particulates.

Hemstock discloses a quick release pressure-vessel compatible cleanout 50 for access to vessel 11 for cleanout of the accumulated particles. Hemstock, 5:44-46, Fig. 3. The cleanout is performed manually on a batch basis. *Id.*, 5:46-58.

14. The desanding system of claim 1 wherein said vessel has a smaller diameter downstream of the fluid outlet than the diameter of other portion of the vessel.

Miller discloses for a solid/liquid settling vessel the use of an eccentrically located, smaller diameter outlet pipe 8. Miller, 1, 2:51-64, 3:21-24. A POSITA would understand from this disclosure that the smaller diameter pipe could be included as part of the pressure vessel itself, as such pressure vessels have long been well-known in the art. Ex. 1002 ¶¶ 148, 192-98.

15. The desanding system of claim 14 wherein second end of the vessel is an eccentric end.

See Claim 14, above.

16. The method of claim 9 further comprising: accumulating particulates in said belly portion; and periodically removing accumulated particulates.

See Claim 13.

2. Explanation of Asserted Grounds and Rationales Supporting a Conclusion of Obviousness

There are a number of rationales which can support a conclusion of obviousness, including a teaching, suggestion, or motivation in the prior art to modify or combine. *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 416-21 (2007); *DyStar Textilfarben GmbH & Co. Deutschland KG v. C.H. Patrick Co.*, 464 F.3d 1356, 1360 (Fed. Cir. 2006). MPEP § 2143.

a. Grounds 1 and 2: The Base Claims are Obvious in View of Hemstock and Davis (Ground 1) and Hemstock and the Data Book (Ground 2)

The first two grounds are the combination of Hemstock and either Davis (Ground 1) or the Data Book (Ground 2). The differences between Claims 1-7, 9, 10-11, 13, and 16 and either combination is such that the subject matter of each of these claims would have been obvious to a POSITA. Ex. 1002 ¶ 163.

As shown in section VI.C.1., Hemstock and Davis, or Hemstock and the Data Book, collectively possess every single element of the Base Claims. *See also* Ex. 1002 ¶¶ 151-56.

Hemstock discloses a horizontal desanding vessel and system which receives a multiphase (gas, liquid, and solid) fluid stream, and which substantially removes

the particulates from the stream by lowering the fluid velocity in the vessel to the point where the particulates fall out and accumulate in the vessel, along with liquid in the inlet stream. *See also* Hemstock, 2:25-61. This is the same desanding vessel and system claimed in the '256 Patent, with the exception being that the '256 Patent teaches inclining the vessel from the horizontal. This is required by elements 1.2 and 9.2. Thus, Hemstock discloses every element of the Base Claims except for the inclination of the vessel required by elements 1.2 and 9.2. *See* § VI.C.1.

i. Ground 1: A POSITA would have been motivated to modify Hemstock based on Davis.

Davis teaches that it was well known that an inclined channel improved solid-liquid separation times, and that a settling vessel comprising an inclined tube or channel was known and effective. Davis at 17.

A POSITA would have been motivated to modify Hemstock by inclining the desander, based on Davis's teaching that an inclined tube or channel would achieve more rapid separation between the solid and liquid phases. Ex. 1002 ¶ 167. A POSITA, using the invention taught in Hemstock, would have desired more rapid sand settling in the liquid in order to prevent, to the maximum extent possible, re-entrainment of the solid particulates with the liquid stream leaving via outlet 13. *Id.* ¶ 168; *see also* Hemstock, 4:55-59 (explaining that liquids are re-entrained with the gas leaving the vessel during typical operation). This is because the retention of particulates "contaminates both surface equipment and the produced fluids and

impairs the normal operation of the oil and gas gathering systems and process facilities.” Ex. 1002 ¶ 168; Hemstock, 1:47-50.

Furthermore, simply improving particulate settling efficiency in the prior art desander is sufficient as an implicit motivation to modify Hemstock. *DyStar Textilfarben*, 464 F.3d at 1368 (“[A]n implicit motivation to combine exists ... when the ‘improvement’ is technology-independent and the combination of references results in a product or process that is more desirable, for example because it is stronger, cheaper, cleaner, faster, lighter, smaller, more durable, or more efficient. ... [T]here exists in these situations a motivation to combine prior art references even absent any hint of suggestion in the references themselves. In such situations, the proper question is whether the ordinary artisan possesses knowledge and skills rendering him capable of combining the prior art references.”). The ’256 Patent itself cites this motivation as one of the reasons to improve Hemstock.’256 Patent, 2:22-26.

ii. Ground 2: A POSITA would have been motivated to modify Hemstock based on the Data Book

The Data Book teaches that it was well known to use an inclined or sloped slug catcher to absorb the fluctuating liquid slugs in process and transmission piping. Data Book at 41. The Data Book explains that such devices are generally inclined from one to ten degrees, based on design choices. *Id.*

A POSITA would have been motivated to modify Hemstock by inclining the

desander, based on the Data Book's teaching that an inclined device is desirable for absorbing the fluctuating liquid inlet flow rates through liquid level fluctuation. Ex. 1002 ¶ 171.

A POSITA, using Hemstock's claimed invention, would have wanted to maximize the device's ability to handle liquid slugs based on Hemstock's disclosure that the expected multiphase flow is unstable, and that "[l]arge slugs of fluid followed by a gas mist is [sic] common." Hemstock, 2:8-9; Ex. 1002 ¶ 171. Furthermore, a POSITA would have recognized that an inclined horizontal separator as taught in the Data Book would necessarily have a horizontal gas/liquid interface, with the highest volume of liquid at the lower end of the separator. Ex. 1002 ¶ 172. Because of this, when compared to a non-inclined horizontal separator, an inclined device would have improved liquid/vapor separation efficiency, due to the increased cross-sectional area in the gravity or freeboard section. *Id.* Improving such efficiency is an independent motivation to modify Hemstock. *See also DyStar Textilfarben*, 464 F.3d at 1368.

Finally, a POSITA would have understood that slug catchers such as the inclined harp slug catcher in the Data Book function as a single phase separator. Ex. 1002 ¶ 173. Because Hemstock's desander functions in the same way, accumulating solids in the vessel but re-entraining liquid in the fluid outlet, a POSITA would have recognized that the Data Book's inclined design would be effective and useful for

Hemstock's single phase desanding vessel. *Id.*

iii. A POSITA would have had a reasonable expectation of success in modifying Hemstock as suggested by either Davis or the Data Book

A POSITA would have had a reasonable expectation of success in modifying Hemstock by inclining the vessel. Ex. 1002 ¶ 174. Inclining vessels, or portions of vessels was a well-known technique used to improve settling of solids from liquids. *Id.* With these teachings as a background, and based on either Davis or the Data Book, a POSITA would have expected that inclining Hemstock's vessel would improve solid-liquid settling time (based on Davis), improve the vessel's ability to handle slug flow (based on the Data Book), and promote more efficient separation between solids and liquids (Davis) and vapor and liquid (Data Book). *Id.* Moreover, a POSITA would not have expected inclining Hemstock's vessel to have any negative impact on its operation. *Id.* ¶ 175. This is because a POSITA would have been well aware of the changes that inclining the vessel would have—primarily, the creation of a gas-liquid interface now at an angle to the vessel's axis—and would have understood how to adequately size such a vessel in order to achieve appropriate gas, liquid, and solid separation. *Id.*

Further, inclining the vessel was within the knowledge and ability of a POSITA. Ex. 1002 ¶ 176. Inclining Hemstock would of course have required tilting the vessel by providing a higher support on one end, but it also may have required

modifying the angle of the connection to the inlet and/or outlet piping. *Id.* Such changes were not required (*see* '256 Patent, 6:66-7:2), but even if they were they were within the skill of a POSITA, as they would require nothing more than the use of well-known angled pipe fittings or bending the pipe. *Id.*

iv. Grounds 1 and 2 Render the Base Claims Obvious

Based on the foregoing, a POSITA would have reasonably expected that inclining Hemstock's desander based on either the suggestions in Davis or the Data Book would be successful in improving the separation efficiency by improving liquid/solid settling times and vapor/liquid disengagement, improve the ability to handle two phase slug flow, and would not have been expected to impede or harm the system's functionality. Ex. 1002 ¶ 177. Accordingly, a POSITA would have found the subject matter of all of the Base Claims obvious in view of Hemstock as modified by either the suggestion in Davis or the Data Book. *Id.*

b. Grounds 2 and 3: The Inclination Angle Claims are Obvious in View of Hemstock and the Data Book (Ground 2) and Hemstock, Davis, and Miller (Ground 3)

The differences between Claims 8 and 12 (the Inclination Angle Claims) and either the combination of Ground 2, discussed above, or Ground 3 (Hemstock, Davis, and Miller) are such that the subject matter of each of these claims would have been obvious to a POSITA. Ex. 1002 ¶ 178.

As discussed for Grounds 1 and 2, the combinations of Hemstock and Davis

or Hemstock and the Data Book render obvious every element of Claim 1 from which these claims depend. Claims 8 and 12 respectively require that the desander's inclination angle be variable for varying fluid stream conditions, and that the inclination angle be between "about" 2°-20°.

i. Ground 2: A POSITA would have been motivated to modify Hemstock as suggested by the Data Book.

The Data Book discloses that angles of between one to ten degrees were used in slug catchers and that this angle was a design choice. Ex. 1002 ¶ 180; Data Book at 41.

In addition to the motivation to modify Hemstock as discussed with regard to the Base Claims, a POSITA would have been motivated to make the inclination angle variable to suit varying stream conditions, as suggested by the Data Book's disclosure that the appropriate angle is a design choice. Ex. 1002 ¶ 181. A POSITA would have been motivated to make the angle variable as a design choice because it was well known that different fluid streams have different properties and therefore different angles might be more or less suited to maximize gas/liquid separation efficiency for a particular stream. *Id.* A POSITA would also have been motivated to select an angle between about 2° and 20°, as the Data Book explicitly suggests such angles (those between 2° and 10°). *Id.*

ii. Ground 3: A POSITA would have been motivated to modify Hemstock and Davis based on Miller.

Miller teaches that it was known to vary and adjust the inclination angle of a solid/liquid separator “to suit.” Miller, 2:51-59. A POSITA would have been motivated to modify the teachings of Hemstock to incline the desander based on the teachings of Davis, as discussed for Ground 1, and to further make the inclination angle variable so as to suit varying stream conditions, as suggested by Miller. Ex. 1002 ¶¶ 184-85. This is because a POSITA using Hemstock’s desander would have understood that different fluid streams have different properties, and therefore different angles might be more or less suited to maximize solid/liquid separation efficiency for a particular stream. *Id.* Further, although Miller does not explicitly state an angle, a POSITA reviewing Miller would have understood that it discloses an angle of between 2 and 20 degrees, and thus would have been motivated to use or try such an angle. *Id.* ¶ 185.

iii. A POSITA would have had a reasonable expectation of success in modifying Hemstock as suggested by the Data Book and by Davis and Miller.

A POSITA would have had a reasonable expectation of success in making the inclination angle variable and further in selecting an angle between about 2 and 20 degrees. *Id.* ¶ 186. This is, first, because it was an obvious matter for a mechanic to make the angle of inclination variable by use of a device such as Miller’s jack, or by using replaceable base supports of varying heights. Ex. 1002 ¶ 186. Doing so would

have necessitated changes to the angle of pipe fittings for the inlet and outlet nozzles and any other connective piping, but this would have required only the mechanical skills of a pipe fitter. *Id.* There was also a reasonable expectation of success in making such modifications because each of Miller and the Data Book suggests that different angles might be necessary dependent on stream conditions and show that different inclination angles have been successful in similar applications. *Id.* ¶ 187.

Thus, a POSITA would have reasonably expected that making the inclination angle of Hemstock's desander variable and between 2 and 20 degrees would be successful in improving the separation efficiency between gas, liquid, and solid particulates, dependent on the particular characteristics or conditions of the inlet stream. Ex. 1002 ¶ 188. Accordingly, a POSITA would have found the subject matter of claims 8 and 12 obvious in view of Hemstock and the Data Book (Ground 2) and Hemstock, Davis, and Miller (Ground 3) *Id.*

c. Grounds 3 and 4: The Eccentric End Claims are Obvious in View of Hemstock, Miller, and either Davis or the Data Book

The differences between Claims 14 and 15 (the Eccentric End Claims) and either the combination of Ground 3, discussed above, or Ground 4 (Hemstock, the Data Book, and Miller) are such that the subject matter of each of these claims would have been obvious to a POSITA. Ex. 1002 ¶ 189.

As discussed for Grounds 1 and 2, the combinations of Hemstock and Davis

or Hemstock and the Data Book render obvious every element of Claim 1 from which these claims depend. Claims 14 and 15 respectively require that the vessel have a smaller diameter downstream of the fluid outlet, and that that end be an eccentric end.

i. A POSITA would have been motivated to modify Hemstock and Davis or Hemstock and the Data Book based on Miller's suggestion.

Miller suggests that a solid/liquid settling vessel use an eccentrically located, smaller diameter end on the lower end where solids will be removed from the vessel. Ex. 1002 ¶ 191. Miller explicitly discloses using an outlet pipe rather than a different diameter vessel. Miller, 1, 2:51-64, 3:21-24. However, a POSITA would understand from this disclosure that instead of a smaller diameter pipe, a smaller diameter section of the pressure vessel itself was also suggested, as similar pressure vessels were well-known in the art prior to the priority date of the '256 Patent. Ex. 1002 ¶¶ 191-96.

In addition to the motivation to modify Hemstock discussed with regard to Grounds 1, 2, and 3, a POSITA using Hemstock's desander would have been motivated to use, as suggested by Miller, a smaller diameter for an end containing a quick release pressure-vessel compatible cleanout (*see* Hemstock, 5:43-58), because such closures on pressure vessels are increasingly expensive as the closure size increases, and it is common to try to reduce this cost by reducing the vessel size at

the closure. Ex. 1002 ¶ 196. Moreover, the desander's freeboard portion must be sized, based on the mass flow rate of gas, liquid, and solids, to achieve a velocity resulting in adequate separation. *Id.* ¶ 197. This is obviously variable depending on the properties of the inlet stream. *Id.* Thus, a POSITA would have understood that having a standardized and smaller cleanout would allow for fabrication and material costs to be optimized (and thus lowered). *Id.* These motivations to reduce costs are also implicit motivations to make the modification suggested by Miller. *See DyStar Textilfarben*, 464 F.3d at 1368.

A POSITA would have been motivated to make this smaller diameter end an eccentric end situated on the lower end of the inclined vessel, as taught in Miller, because this is naturally where solids will accumulate—the lowest part of the vessel. Ex. 1002 ¶ 198. Using a non-eccentric end would create a dead space in the desander vessel from which it would be difficult to remove accumulated solids. *Id.*

ii. A POSITA would have had a reasonable expectation of success in modifying Hemstock's vessel based on Miller's suggestion.

A POSITA would further have had a reasonable expectation of success in adding a smaller diameter eccentric end, as suggested by Miller, to Hemstock's modified (inclined) vessel discussed in Grounds 1 and 2. Ex. 1002 ¶ 199. Such a modification was well within the knowledge and skill of a POSITA, and would merely require sizing the smaller diameter end sufficiently to ensure that cleanout

could be performed efficiently and safely. *Id.*

A POSITA would have had a reasonable expectation of success in making such a modification because similar vessels were well known in the art. *Id.* ¶ 200. This modification would not have impacted the functionality of the desander, because downstream of the fluid outlet, liquids and solids have disengaged from the gas phase, and the belly area has a very low mass flow rate, making the vessel diameter there inconsequential. *Id.*

Thus, a POSITA would have reasonably expected that making the cleanout end of Hemstock's desander a smaller diameter eccentric end would be successful in standardizing the design of cleanout components while lowering fabrication and material costs. Ex. 1002 ¶ 201. Accordingly, a POSITA would have found the subject matter of all claims of the '256 Patent obvious in view of either Hemstock, Davis, and Miller (Ground 3) and Hemstock, the Data Book and Miller (Ground 4). *Id.* ¶ 202.

d. The Asserted Grounds Possess Every Element of the Claims

Hemstock, as modified by Davis or the Data Book (Grounds 1 and 2), possesses every element of the Base Claims, arranged in the same way as claimed. Ex. 1002 ¶¶ 151-56. For Claims 1 and 9, inclining Hemstock would have resulted in lowering the fluid outlet below or further below the inlet than the original design (1.2, 9.2), causing the fluid stream to travel down the inclined vessel to the outlet

(1.4). *Id.* ¶ 152. It would necessarily cause the gas/liquid interface to form (or more precisely, remain) at the fluid outlet (1.5, 9.2, 9.4). *Id.* Inclining the separator would force the gas-liquid interface to be at an angle to the vessel's axis, which would necessarily cause the cross-sectional area of the freeboard portion (gas phase) to diminish along the vessel from the fluid inlet to the fluid outlet, as illustrated in Figs. 3A and 3B (1.6). *Id.*; '256 Patent Figs. 3A, 3B. The incline would direct the trajectory of the liquid and solid particulates into the gas/liquid interface, similar to Figure 7 from the '256 Patent, where a substantial portion of the particulates would be intercepted (9.5). Ex. 1002 ¶ 152.

Inclining Hemstock's vessel would not have changed Hemstock's fulfillment of the limitations of dependent claims 2-7, 11, 13, or 16. *Id.* ¶ 153. For claim 10, as with elements 1.5, 9.2, and 9.4, inclining the vessel would necessarily cause the gas/liquid interface to form (or more precisely, remain) at the fluid outlet. *Id.*

The proposed combinations do not affect Hemstock's fulfillment of the remaining limitations of the Base Claims. *Id.* ¶ 156.

With specific regard to claim 9, a POSITA would understand that the normal use and operation of the combination—which is Hemstock's vessel, but inclined or sloped as suggested by Davis and the Data Book—would necessarily and naturally result in the performance of every step of the claimed method. *Id.* ¶ 155. This is because Hemstock already performed every step of Claim 9 except those related to

it being an inclined vessel. *Id.*

The modified (inclined) Hemstock desander, as modified by the Data Book (Ground 2) or Davis and Miller (Ground 3) would also possess every element of the Inclination Angle Claims, arranged in the same way as claimed. Ex. 1002 ¶¶ 157-59. This is clearly shown in the discussion with regard to those grounds and claims, above.

The modified (inclined) Hemstock desander, as modified by Davis and Miller (Ground 3) or the Data Book and Miller (Ground 4), would also possess every element of the Eccentric End Claims, arranged in the same way as claimed. Ex. 1002 ¶¶ 160-61. This is clearly shown in the discussion with regard to those grounds and claims, above.

D. Objective Indicia of Non-Obviousness

Petitioner is unaware of any evidence of objective indicia of non-obviousness at this time. Should Patent Owner introduce any such evidence, Petitioner respectfully requests the opportunity to respond. However, Petitioner has presented strong prima showing of obviousness based on the primary considerations. *Wyers v. Master Lock Co.*, 616 F.3d 1231, 1246 (Fed. Cir. 2010). As shown in section VI.C., the purported invention represents no more than the modification of the Patent Owner's own prior art based on well-known principles and prior art teachings. The primary modification of a prior art vessel such as Hemstock by simply inclining it,

as taught extensively in the prior art, is simply not inventive. Ex. 1002 ¶ 204.

VII. CONCLUSION

For the foregoing reasons, Petitioner respectfully requests that trial be instituted and that all Challenged Claims of the '256 Patent be cancelled.

Dated: September 17, 2018

Respectfully submitted,

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CERTIFICATE OF SERVICE

I hereby certify that on this 17th day of September, 2018, a copy of this Petition for Inter Partes Review, Petitioner's Exhibits 1001–1005, 1007-1010, and 1013, were served by Federal Express on the following correspondence address of record for patent owner, pursuant to 37 C.F.R. § 42.105(a):

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James H. Hall

CERTIFICATE OF COMPLIANCE

Pursuant to 37 C.F.R. § 42.24 *et seq.*, the undersigned certifies that this document complies with the type-volume limitations. This document, excluding the table of contents, appendix of exhibits, mandatory notice under 37 C.F.R. § 42.8, and certificates of service and word count, contains 13,788 words as calculated by the “Word Count” feature of Microsoft Word 2013, the program used in creating it.

/James H. Hall/

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