UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

UNION ELECTRIC COMPANY,
Petitioner,

v.

BIRCHTECH CORPORATION,
Patent Owner.

Case: IPR2025-01323
Patent 10,589,225

PETITION FOR *INTER PARTES* REVIEW OF U.S. PATENT NO. 10,589,225

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LISTING OF EXHIBITS

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1002	Declaration of Dr. Radisav Vidic
1003	Curriculum Vitae of Dr. Radisav Vidic
1004	U.S. Patent Publication No. US 2008/0107579 (May 8, 2008) **("Downs")**
1005	U.S. Provisional Patent Application No. 60/555,353 (filed Mar. 22, 2004) **("Downs-Provisional")**
1006	Redline comparison between U.S. Patent Publication No. US 2008/0107579 (Downs, EX1004) and U.S. Provisional Patent Application No. 60/555,353 (Downs-Provisional, EX1005) using Downs-Provisional as the original version **("Downs-Redline")**
1007	U.S. Patent No. 5,827,352 (Oct. 27, 1998) **("Altman")**
1008	U.S. Patent Pub. No. 2004/0003716 to Nelson (published Jan. 8, 2004) **("Nelson")**
1009	U.S. Provisional Patent Application No. 60/377,790 (filed May 6, 2002) **("Nelson-Provisional")**
1010	Redline comparison between U.S. Patent Pub. No. 2004/0003716 (Nelson, EX1008) and U.S. Provisional Patent Application No. 60/377,790 (Nelson-Provisional, EX1009) using Nelson-Provisional as the original version **("Nelson-Redline")**
1011	US Patent Publication No. 2004/0013589 (Jan. 22, 2004) **("Vosteen")**
1012	Steve Blankinship, "A Variety of Hg Capture Solutions Are Available," Power Engineering, Vol. 113, Issue 6, (Jan. 6, 2009) **("Blankinship")**
1013	U.S. Patent No. 8,652,235 (Feb. 18, 2014) **("Olson-235")**
1014	S. Julien et al., "The Effect of Halides on Emissions from Circulating Fluidized Bed Combustion of Fossil Fuels," Fuel, 75(14):1644–1663 (1996) **("Julien")**
1015	Hawley's Condensed Chemical Dictionary, (Van Nostrand Reinhold, 13th Ed.), Definition of "Compound," 291 (1997)
1016	Hawley's Condensed Chemical Dictionary, (Van Nostrand Reinhold, 13th Ed.), Definitions of "Alkaline-Earth Metals," "Calcium Hydroxide" and "Lime, Hydrated," 33, 196, 671-672 (1997)
1017	U.S. Provisional Application No. 60/605,640 as filed with U.S. Patent and Trademark Office (USPTO) **("the Provisional")**

Exhibit No.	**Exhibit Description**
1018	U.S. Application No. 11/209,163 as filed with USPTO **(“ ‘163 Application”)**
1019	U.S. Application No. 12/201,595 as filed with USPTO **(“ ‘595 Application”)**
1020	U.S. Application No. 12/419,219 as filed with USPTO **(“ ‘219 Application”)**
1021	U.S. Application No. 13/427,665 as filed with USPTO **(“ ‘665 Application”)**
1022	U.S. Application No. 13/966,768 as filed with USPTO **(“ ‘768 Application”)**
1023	U.S. Application No. 14/318,270 as filed with USPTO **(“ ‘270 Application”)**
1024	File History for United States Patent No. 10,589,225 (U.S. Application No. 14/712,558)**(“the ‘558 Application”**) – but NOT including prior art references therein
1025	Reserved
1026	Reserved
1027	Reserved
1028	Redline comparison between U.S. Application No. 11/209,163 and 12/201,595
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1033	Redline comparison between U.S. Application No. 14/318,270 and 14/712,558
1034	Reserved
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1036	Reserved
1037	US Patent Publication No. US 2018/0280870A1 **(“Olson-870”)**
1038	Institution Decision, IPR2020–00832, Patent 10,343,114 **(“832 DI”)**
1039	Institution Decision, IPR2020–00834, Patent 10,343,114 **(“834 DI”)**

Exhibit No.	**Exhibit Description**
1040	Oxtoby et al., PRINCIPLES OF MODERN CHEMISTRY, 4th ed (Saunders College Publishing: 1999) **("Oxtoby")**
1041	Evan J. Granite et al., "Sorbents for Mercury Removal from Flue Gas," DOE/FETC/TR–98–01, U.S. Department of Energy (Jan. 1998) **("Granite")**
1042	Babcock & Wilcox, STEAM: ITS GENERATION AND USE, 40th ed. (The Babcock & Wilcox Company: 1992) **("B&W: Steam")**
1043	U.S. EPA, AP–42: External Combustion Sources, Chapter 1: Fifth Edition, Volume I (Sep. 1998), available at https://www3.epa.gov/ttn/chief/ap42/ch01/index.html (last visited Apr 10, 2020) **("Chapter 1 of AP–42")**
1044	Thomas J. Feeley, et al., "A Review of DOE/NETL's Mercury Control Technology R&D Program for Coal-Fired Power Plants," *DOE/NETL &g R&D Program Review* (April 2003) **("Feeley")**
1045	Clean Air Mercury Rule: Basic Information, available at https://web.archive.org/web/20050920005951/http:/www.epa.gov/mercuryrule/basic.htm **("Clean Air Mercury Rule")**
1046	EPA, "Mercury Study Report to Congress Volume VIII: An Evaluation of Mercury Control Technologies and Costs," EPA Report No. EPA–452/R–97–010 (Dec. 1997), available at https://www3.epa.gov/airtoxics/112nmerc/volume8.pdf **("EPA 1997 Mercury Study Report Vol. VIII")**
1047	Deposition Transcript of Edwin Olson (Aug. 26, 2022) (excerpted), taken in Midwest Energy Emissions Corp., et al. v. Arthur J. Gallagher & Co., et al., No. 1:19-cv-01334-CJB.
1048	Deposition Transcript of Michael Holmes (Aug. 24, 2022) (excerpted), taken in Midwest Energy Emissions Corp., et al. v. Arthur J. Gallagher & Co., et al., No. 1:19-cv-01334-CJB.
1049	U.S. Patent No. 1,984,164 to Stock et al. (issued Dec. 11, 1934) **("Stock")**
1050	B.R. Puri, *Surface Complexes on Carbons*, *in* CHEMISTRY AND PHYSICS OF CARBON 191 (Philip L. Walker, ed.) (Marcel Dekker: 1970) **("Puri")**
1051	Roop Chand Bansal, et al., ACTIVE CARBON (Marcel Dekker:1988) 482 pages **("Bansal")**

Exhibit No.	Exhibit Description
1052	Frank E. Huggins et al., "XAFS Examination of Mercury Sorption on Three Activated Carbons," *Energy & Fuels* 1999(13), p. 114–121 (1999) **("XAFS")**
1053	Charlene R. Crocker et al., "Mercury Control with the Advanced Hybrid Particulate Collector Technical Progress Report," U.S. DOE–NETL (Nov. 2003) **("Crocker")**
1054	C. Eckberg et al., "Mercury Control Evaluation of Halogen Injection into a Texas Lignite-Fired Boiler," Track A, Session A3 (Mercury – Control), Presentation A3c, EUEC: 8TH ELECTRIC UTILITIES ENVIRONMENTAL CONFERENCE (Tucson, Arizona: January 25, 2005) **("Eckberg")**
1055	US Patent Publication No. 2006/0048646 (Mar. 9, 2006) **("Olson-646")**
1056	Vosteen, B. W. et al.: Mercury-Related Chemistry in Waste Incineration and Thermal Process Flue Gases. Poster, Air Quality IV Conference. September 22nd – 24th, 2003, Arlington VA. **("Vosteen poster")**
1057	"Mercury Reduction Technology Shows Promise for Texas Lignite," Power Engineering, Vol. 109, Issue 3, (Mar. 1, 2005)
1058	J. Bustard, S. Sjostrom, et al., "Full Scale Evaluation of Sorbent Injection for Mercury Control on Coal-Fired Power Plants," International Conference on Air Quality III, Paper No. A5–4 (Sept. 9–12, 2002: Arlington, VA) **("Bustard")**
1059	Sharon Sjostrom et al., "Field Studies of Mercury Control Using Injected Sorbents," AWMA ANNUAL MEETING, Session Ae–1b (2002) **("Sjostrom-III")**
1060	Proposed National Emission Standards for Hazardous Air Pollutants; and, in the Alternative, Proposed Standards of Performance for New and Existing Stationary Sources: Electric Utility Steam Generating Units, 69 Fed. Reg. 4652–4752 [Volume 69, No. 20] (Jan. 30, 2004) **("EPA-Proposal")**
1061	Vosteen et al., "Energy Process Engineering and Environmental Protection," Study commissioned by the State Environmental Agency of North Rhine-Westphalia (April 22, 2004)
1062	S. Sjostrom et al., "Full Scale Evaluation of Mercury Control by Injecting Activated Carbon Upstream of a Spray Dryer and Fabric Filter," POWER GEN CONFERENCE (Orlando, Florida: Nov. 29 – Dec. 2, 2004) **("Sjostrom-I")**

Exhibit No.	Exhibit Description
1063	Sjostrom, S., "Evaluation of Sorbent Injection for Mercury Control," Report No. 41986R04 (Oct. 29, 2004)
1064	Sjostrom, S., "Evaluation of Sorbent Injection for Mercury Control," Report No. 41986R05 (Feb. 2, 2005)
1065	Mercury Information Clearinghouse, "Quarter 6 – Mercury Control Field Demonstrations" (Apr. 2005)
1066	Sharon Sjostrom, "Full Scale Evaluations of Mercury Control Technologies with PRB Coals," Track A, Session A3 (Mercury – Control), Presentation A3b, EUEC: 8TH ELECTRIC UTILITIES ENVIRONMENTAL CONFERENCE (Tucson, Arizona: January 25, 2005) **("Sjostrom-II")**
1067	Sharon Sjostrom, "Evaluation of Sorbent Injection for Mercury Control," Report No. 41986R08 (Aug. 2, 2005)
1068	Chu, P. and Porcella, D. B. "Mercury stack emissions from U.S. electric utility power plants," Water, Air, Soil Pollution, 80, 135-144, 1995.
1069	Meij, R. "The fate of mercury in coal-fired power plants and the influence of wet flue-gas desulfurization," Water, Air, Soil Pollution, 56, 21, 1991.
1070	Galbreath, K.C. and Zygarlicke, C.J. "Mercury transformations in coal combustion flue gas," Fuel Processing Technology, 65–66, 289–310, 2000.
1071	Institution Decision, IPR2020–00928, Patent 8,168,147 ("928 DI")
1072	Senior, C.L., Sarofim, A.F., Zeng, T., Helble, J.J., and Mamani-Paco, R. "Gas-phase transformations of mercury in coal-fired power plants," Fuel Processing Technology, 63, 197–213, 2000.
1073	Sliger, R.M., Kramlich, J.C., Marinov, N.M. "Towards the development of a chemical kinetic model for the homogeneous oxidation of mercury by chlorine species," Fuel Processing Technology, 65–66, 423–438, 2000.
1074	Chang, R. and Offen, G., "Mercury Emission Control Technologies: An EPRI Synopsis," Power Engineering, Vol. 99, No. 11, pp. 51-57, 1995.
1075	Liu, W., Vidic, R.D., Brown, T.D. "Optimization of high temperature sulfur impregnation in activated carbon for permanent sequestration of mercury," Environmental Science Technology, 34, 483-488, 2000.
1076	Liu, W., Vidic, R.D., Brown, T.D. "Impact of flue gas conditions on mercury uptake by sulfur-impregnated activated carbon," Environmental Science Technology, 34, 154-159, 2000.

Exhibit No.	Exhibit Description
1077	Brief in Support of Plaintiff's Motion for Transfer of Actions to the Southern District of Iowa, filed in *In re Midwest Energy Emissions Corp. Patent Litigation*, No. 4:24-md-1332 (S.D. Iowa).
1078	Granite, E.J., Pennline, H.W. and Hargis, R.A. "Novel sorbents for mercury removal from flue gas," Industrial Engineering Chemistry Research, 39, 1020-1029, 2000.
1079	Lee, S.J., Seoa, Y-C., Jurng, J., Lee, T.J. "Removal of gas-phase elemental mercury by iodine- and chlorine-impregnated activated carbons," Atmospheric Environment, 38, 4887–4893, 2004.
1080	U.S. Patent No. 5,435,980 ("**Felsvang**")
1081	U.S. Patent No. 6,878,358 to Vosteen
1082	Declaration of Tracey J. Olanyk (6/2/2025), authenticating various exhibits including Blankinship EX1012
1083	Expert Report of Philip J. O'Keefe, PE Regarding Infringement (Oct. 25, 2022) (excerpted), submitted by Patent Owner in Midwest Energy Emissions Corp., et al. v. Arthur J. Gallagher & Co., et al., No. 1:19-cv-01334-CJB
1084	Buschmann, J, et al., "The KNX^{TM} Coal Additive Technology A Simple Solution for Mercury Emissions Control," POWER GEN CONFERENCE (Las Vegas, Nevada: Dec. 6 – Dec. 8, 2005)
1085	Vassileva, S.V., et al., "Contents, modes of occurrence and origin of chlorine and bromine in coal," Fuel 79 (2000) 903–921.
1086	Reserved
1087	NAS-NRC COMMITTEE ON CHEMISTRY OF COAL, CHEMISTRY OF COAL UTILIZATION: SECOND SUPPLEMENTARY VOLUME (Martin A. Elliott ed., 1981) (excerpted)
1088	Excerpt from File History for United States Patent No. 10,596,517 (U.S. Application No. 15/997,091)

All exhibits not containing consecutive page numbers, including the prosecution history, are cited in this Petition using page numbers added by Petitioner. All other exhibits are cited by their original page or paragraph numbers.

TABLE OF CHALLENGED CLAIMS

Claim Element	Claim Language
1(Preamble)	1. A method for treating a mercury-containing gas, the method comprising:
1(a)	combusting a mixture comprising coal, pyrolysis char, and an additive comprising HBr, a bromide compound, or a combination thereof, to form the mercury-containing gas; and
1(b)	adding a particulate sorbent material comprising activated carbon into the mercury-containing gas.
2	2. The method of claim 1, wherein the pyrolysis char is a promoted pyrolysis char.
5	5. The method of claim 1, further comprising using a particle separation device to remove mercury from the flue gas and comprising collecting greater than 70 wt % of the mercury in the mercury-containing gas to produce a cleaned gas.
6	6. The method of claim 5, further comprising: measuring the mercury content of the mercury-containing gas; and modifying, in response to the measured mercury content: an injection rate of injecting the sorbent into the mercury-containing gas, an amount of the additive in the mixture, or a combination thereof.
7	7. The method of claim 1, wherein the additive further comprises Br_2.
8	8. The method of claim 1, wherein the sorbent material is chosen from powdered activated carbon, granular activated carbon, carbon black, carbon fiber, aerogel carbon, pyrolysis char, and combinations thereof.
9	9. The method of claim 1, further comprising adding an alkaline component to the mercury-containing gas, the alkaline component chosen from alkali elements, alkaline earth

Claim Element	Claim Language
	elements, alkali salts, alkaline earth salts, and combinations thereof.
10	10. The method of claim 1, further comprising contacting the sorbent material with a mercury-stabilizing reagent chosen from S, Se, H_2S, SO_2, H_2Se, SeO_2, CS_2, P_2S_5, and combinations thereof.
11	11. The method of claim 1, further comprising contacting the sorbent material with a secondary component chosen from halogens, hydrogen halides, Group V halides, Group VI halides, and combinations thereof.
12	12. The method of claim 11, wherein the secondary component is chosen from halogens, halide salts, HI, HBr, HCl, and combinations thereof.
13	13. The method of claim 11, wherein the secondary component is chosen from I_2, HI, and combinations thereof.
14(Preamble)	14. A method for treating a mercury-containing gas, the method comprising:
14(a)	combusting coal in a combustor comprising pyrolysis char and an additive comprising HBr, a bromide compound, or a combination thereof, to form the mercury-containing gas; and
14(b)	adding a particulate sorbent material comprising activated carbon into the mercury-containing gas.
15	15. The method of claim 14, wherein the pyrolysis char is a promoted pyrolysis char.
17(Preamble)	17. A method for treating a mercury-containing gas, the method comprising:
17(a)	combusting a mixture comprising coal, pyrolysis char, and an additive comprising HBr, a bromide compound, or a combination thereof, to form the mercury-containing gas; and
17(b)	adding a sorbent material comprising activated carbon into the mercury-containing gas.
18	18. The method of claim 1, further comprising modifying, in response to a measured mercury content,

Claim Element	Claim Language
	an injection rate of injecting the sorbent into the mercury-containing gas, an amount of the additive in the mixture, or a combination thereof.
19	19. The method of claim 1, wherein the coal comprises added sorbent enhancement additive that comprises the bromide compound.
20	20. The method of claim 1, wherein the coal is combusted in a combustion chamber at a coal-combustion facility, wherein the HBr, bromide compound, or combination thereof, is added to the coal before the coal enters the combustion chamber, wherein the addition of the HBr, bromide compound, or combination thereof, to the coal is performed at the coal-combustion facility.
22	22. The method of claim 1, wherein the sorbent is contacted with a halogen or halide promoter prior to the addition of the sorbent to the mercury-containing gas.
23	23. The method of claim 1, wherein the sorbent is free of contact with a halogen or halide promoter prior to the addition of the sorbent to the mercury-containing gas.
24	24. The method of claim 6, wherein the measurement of the mercury content of the mercury-containing gas comprises continuous measurement.
25	25. The method of claim 1, wherein the coal comprises subbituminous coal.
26	26. The method of claim 1, wherein the coal comprises lignite coal.
27	27. The method of claim 1, wherein the mixture is combusted in a combustion chamber of a coal-combustion facility upstream of a scrubber, a particulate control system, or a combination thereof, wherein the particulate sorbent is added to the mercury-containing gas before the mercury-containing gas encounters the scrubber, the particulate control system, or the combination thereof.

Claim Element	Claim Language
28	28. The method of claim 26, wherein the particulate control system comprises an electrostatic precipitator, a baghouse, a fabric filter, or a combination thereof.
29	29. The method of claim 19, wherein the combustion chamber is a coal combustion furnace.

I. INTRODUCTION

Petitioner requests IPR of claims 1-2, 5-15, 17-20 and 22-29 of U.S. Patent 10,589,225 ("'225 Patent"). EX1001. Dr. Radisav Vidic provided his expert declaration in support. EX1002-EX1003.

II. MANDATORY NOTICES UNDER 37 C.F.R. 42.8

A. Real Parties-in-Interest (42.8(b)(1))

The real parties-in-interest are the Petitioner and its parent, Ameren Corporation. No other person or entity is funding this Petition, advising on strategy for the Petition, or exercising any control over Petitioner's decision to file the Petition or any arguments therein.

B. Related Matters (42.8(b)(2))

Patent Owner ("PO") is currently asserting the Challenged Patent in the following proceedings:

- *Midwest Energy Emissions Corp. v. Ameren, Inc. et al.*, Case No. 4:24-cv-00980 (E.D. Mo.) ("the Missouri Case");
- *Midwest Energy Emissions Corp. v. Berkshire Hathaway Energy Company et al.*, Case No. 4:24-cv-00243 (S.D. Iowa) ("the Iowa Case");
- *Midwest Energy Emissions Corporation v. Tucson Electric Power Company et al.*, Case No. 3:24-CV-8145 (D. Ariz) ("the Arizona Case");
- *Midwest Energy Emissions Corporation v. Evergy, Inc., et al.,* Case No. 4:25-CV-0050 (W.D. Mo.) ("the Western Missouri Case");
- *Midwest Energy Emissions Corporation v. Wisconsin Power and Light Company,* Case No. 3:25-CV-0026 (W.D. Wis.) ("the Wisconsin Case");

- *In re Midwest Energy Emissions Corp. Patent Litigation*, MDL Case No. 4:24-md-3132 (S.D. Iowa) (consolidating the Missouri, Iowa, Arizona, Western Missouri, and Wisconsin Cases) ("the MDL proceeding").

Petitioner is a defendant in the Missouri case and MDL proceeding.

PO previously asserted the Challenged Patent in the District Court for the District of Delaware in *Midwest Energy Emissions Corp. v. Arthur J Gallagher & Co., et al.*, No. 1:19-cv-01334-RGA (D. Del.) (filed July 17, 2019) ("the Delaware Litigation").

The Board previously granted institution of IPR on two Petitions against the Challenged Patent in the following proceedings:

- *NRG Energy, Inc. et al. v. Midwest Energy Emissions Corp.*, IPR2020-00832, Paper 17 (P.T.A.B. Oct. 26, 2020) ("IPR832 Institution");
- *NRG Energy, Inc. et al. v. Midwest Energy Emissions Corp.*, IPR2020-00834, Paper 18 (P.T.A.B. Oct. 26, 2020) ("IPR834 Institution").

The prior IPRs and district court matters involved Midwest Energy Emissions Corp. ("ME2C") as Patent Owner/Plaintiff. On November 7, 2024, ME2C filed a notice with the USPTO that it had changed its name to Birchtech Corp. *See* Reel 069187, From 0413. ME2C has indicated that it will nevertheless continue in the district court litigations under the name ME2C.

C. Lead and Back up Counsel (42.8(b)(3))

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Service information for lead and backup counsel is provided in the designation of lead and backup counsel, above. Petitioner consents to electronic service to lead and backup counsel, using the email addresses above.

III. PAYMENT OF FEES

Payment of any fees is authorized from Deposit Account No. 50-0975.

IV. GROUNDS FOR STANDING

Petitioner certifies the '225 Patent is available for *inter partes* review and Petitioner is not barred or estopped from requesting such review. This petition is being filed within one year of Petitioner being served with a complaint alleging infringement.

V. IDENTIFICATION OF CHALLENGED CLAIMS AND RELIEF SOUGHT

Petitioner requests (i) review of claims 1-2, 5-15, 17-20 and 22-29 of the '225 Patent ("Challenged Claims") on the grounds set forth below and (ii) that these claims be found unpatentable.

Ground	Claim(s)	Basis for Unpatentability
1	1-2, 5, 7-8, 11-12, 14-15, 17, 19-20, 23, 25-29	Anticipated by Downs**
2	1-2, 5-9, 11-12, 14-15, 17-20, 22-29	Obvious over Downs and Altman, or Downs, Altman and Nelson**
3	1-2, 5-15, 17-20, 22-29	Obvious over Vosteen and Altman, or Vosteen, Altman and Nelson
4	1-2, 5, 8, 11-12, 14–15, 17, 19-20, 22–23, 25–29	Anticipated by Blankinship**
5	1-2, 5-15, 17-20, 22-29	Obvious over Blankinship and Vosteen, or Blankinship and Olson-235

**As evidenced by Julien for claims 11-12

VI. THE BOARD SHOULD NOT DENY INSTITUTION

The Board should not deny institution under 35 U.S.C. § 314(a). First, the district court proceeding in Missouri is in its early stages and was consolidated with several other lawsuits for pretrial proceedings in an MDL in the Southern District of Iowa on December 12, 2024 (MDL No. 3132). The Iowa court entered a Case Management Order on March 7, 2025, but no depositions have been taken yet and the first Markman Brief is not due until October 10, 2025. The "Ready for Trial" date is October 12, 2026, but trial will be long after that as the Missouri court will have to receive the case back and set a trial date which will require at least six additional months – particularly given that PO has stated that it intends to pursue trial against other MDL defendants before trial against Petitioner. As the Iowa Court noted in an Order filed on May 22, 2025, "…the litigation is at a relatively early stage…" Doc. [131], 6. Accordingly, a Final Written Decision here will likely be issued well before trial in any of the lawsuits once they are returned to their original venues following the conclusion of the MDL.

Second, institution should not be denied under 35 U.S.C. § 325(d), because the Examiner did not consider Blankinship during prosecution. *See Becton, Dickinson & Co. v. B. Braun Melsungen AG*, IPR2017–01586, Paper 8 at 17–18 (Dec. 15, 2017) (factors (a)–(b) and (d) indicate the same art was not presented previously to the Office). While the '225 Patent cites Downs, Altman and Olson-235—in a list spanning *16 columns* (9 pages) of cited references—none were used in a substantive rejection.[1] *Id.* at 17–18 (factors (a)–(d)). Further, Downs and Olson-235 are dated after the alleged earliest '225 Patent priority date, and patent examiners accept applicant's asserted priority date without making findings concerning priority. M.P.E.P. § 201.08.

VII. OVERVIEW

A. Level of Ordinary Skill

A person of ordinary skill in the art at the time of the invention ("POSITA") would have at least a bachelor's degree in chemical, mechanical, or environmental engineering or a related field of study, and at least two years of experience with

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[1] Olson–235 was only cited for obviousness–type double patenting, with the examiner stating that Olson–235 corresponds to the current claims "except for combusting a mixture comprising coal, pyrolysis char, and a promoter." EX1024, 675.

investigating, researching, or implementing pollution control in natural gas or coal power generation plants and/or industrial waste incineration. EX1002, ¶ 33.

B. Alleged Invention

The ‘225 Patent relates to removal of mercury from a flue gas. EX1001, 1:28–33. It admits that known “mercury control methods” included “injection of fine sorbent particles into a flue gas duct” such as “activated carbon.” EX1001, 1:58–62.

The ‘225 Patent discloses preparing a **promoted** sorbent **outside** the mercury-containing flue gas as shown in Figure 1, below,[2] and then injecting the promoted sorbent **into** the flue gas **downstream** from the combustion chamber as shown in Figure 3, below. Figure 3 is thus limited to injections into flue gas.

Each independent claim requires both (1) combusting coal, pyrolysis char and an additive comprising “HBr, a bromide compound, or a combination thereof” and (2) adding activated carbon sorbent to the mercury-containing gas. EX1001, Claims 1, 14, 17. There is no support for adding a promoter to coal or a combustor (and thus combusting coal and the promoter) in the application as filed or in any of its priority applications. EX1002, ¶¶ 36, 62-114.

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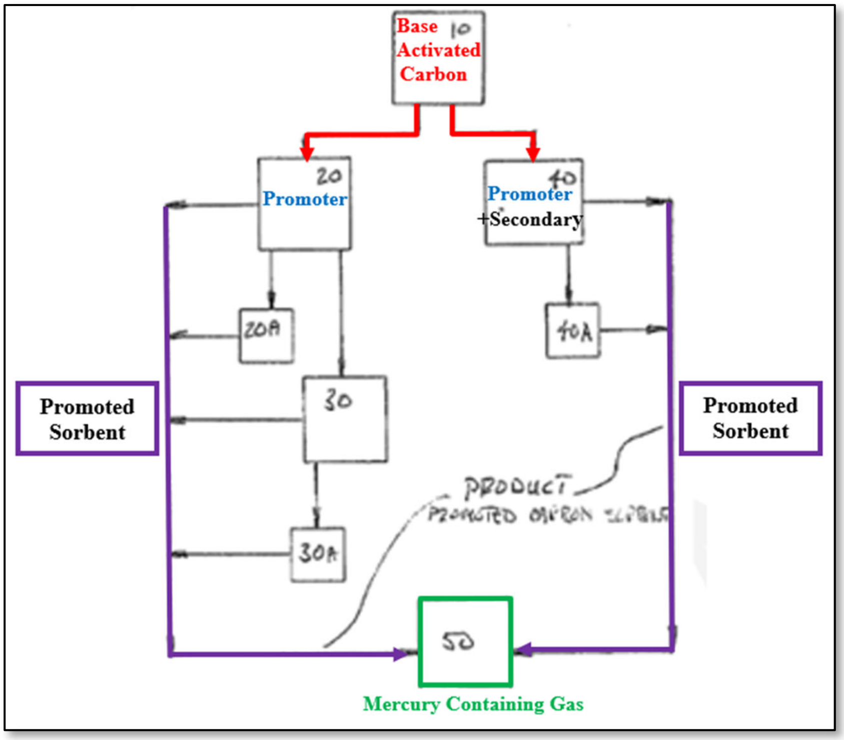
[2] This version of Figure 1 is what was originally filed, as explained in § VII.B.6.b.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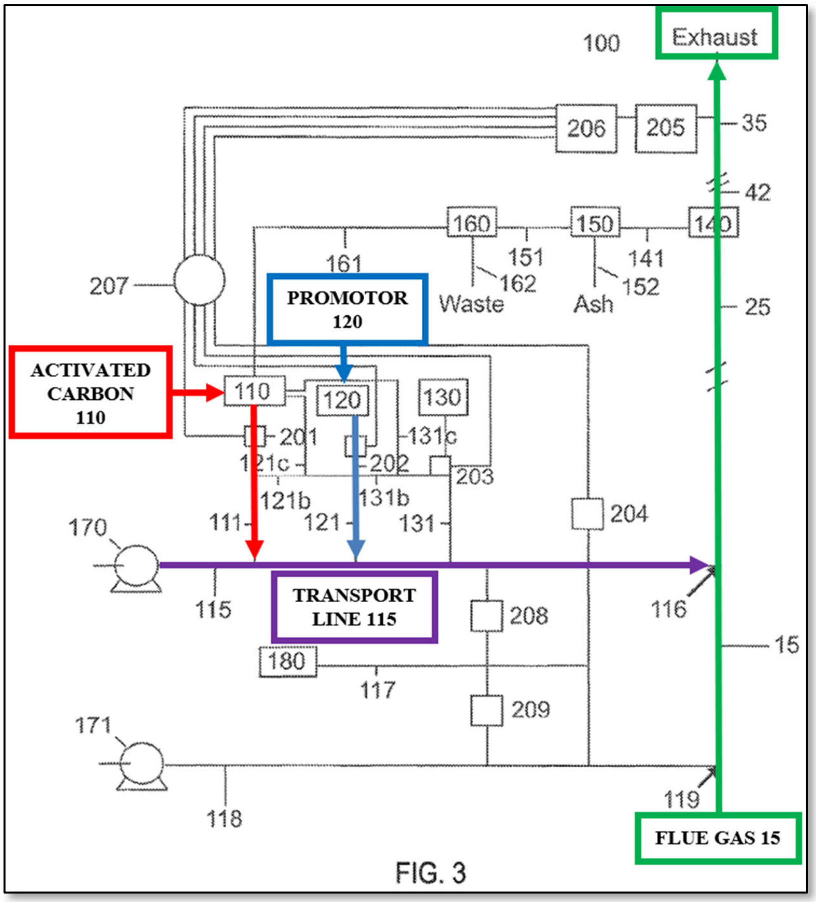
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121b
131b
204
170
111
121
131
TRANSPORT
LINE 115
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208
116
15
180
117
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171
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119
FLUE GAS 15

FIG. 3

1. The Application for the '225 Patent Lacks Written Description Support for the Challenged Claims

The Challenged Claims are not entitled to a priority date before the May 14, 2015 filing date of the application for the '225 Patent ("the '558 Application") for lack of written description support[3]. Each independent Challenged claim requires combusting coal, pyrolysis char and an additive comprising "HBr, a bromide compound, or a combination thereof." EX1001, Claims 1, 14, 17. There is no disclosure of each such promoter being added <u>to the combustor or to coal added to the combustor</u> in the '558 Application.

2. '558 Application Does Not Disclose HBr, Bromide Compound, or a Combination Thereof Added to Coal

a) '558 Application Disclosure

"Coal" is described in the '558 Application generally as a fossil fuel (EX1024, [0004]; citations are to original paragraph numbers in EX1024) or in the context of coal combustion facilities or coal combustion flue gas (EX1024, [0004], [0068], [0107], [0116]), and in examples where subbituminous, lignite or pulverized coal is introduced to a combustor (EX1024, [0094], [0096], [0108]). None of these disclosures describe promoter compounds such as HBr, a bromide compound, or a combination thereof added to coal or a combustor.

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[3] Petitioner is asserting this lack of written description to determine the priority date. Petitioner is not asserting invalidity under Section 112, an issue outside the scope of an IPR.

"Additive" is described generally in the '558 Application as "sorbent enhancement additives" (EX1024, [0007]), "optional additives discussed herein" (EX1024, [0042]), "additive to a treatment facility" (EX1024, [0076]) and "additive-sorbent ratios" (EX1024, [0076]). None of these disclosures or the disclosures of "combustor" describe a promoter added to coal or a combustor as in the Challenged Claims. EX1024, [0004], [0042], [0068], [0094], [0096], [0098]-[0099], [00111].

In Example 10, "the halogen/halide promoted carbon sorbent was injected into the flue gas after the boiler. In general, however, the inventive sorbent can be injected where desired (e.g., before, after or within the boiler.)" EX1024, [00107]. This disclosure is similar to the description for Provisional Figure 2 and it indicates the <u>promoted sorbent</u> was injected into the flue gas downstream from the boiler, but could be injected before or within the boiler. Promoted sorbent injection before the boiler is <u>not</u> a disclosure of a <u>promoter</u> added to coal or a combustor. Nor is it a disclosure of adding HBr, a bromide compound, or a combination thereof before the boiler because, in making the promoted sorbent, these promoters react with the activated carbon and no longer exist in the form of HBr, a bromide compound, or a combination thereof.

PO asserted that a disclosure of "multiple injection points" for the promoted carbon sorbents provided support for adding a promoter to coal in an IPR for the '114 Patent. The Board properly rejected that argument because the "multiple injection points" disclosure refers to injection points in the flue gas stream, not multiple injection points at different points in the process, such as before combustion. EX1038, 28–29; EX1019, [0056]. *See also* EX1024, [0056].

The only disclosure in the '558 Application of pyrolysis char is as a type of activated carbon sorbent. EX1024, [0047]-[0048]. Since the Board decided that the Example 10 language "describes other injection points ("e.g., before, after, or within the boiler")" for "promoted sorbent," by adding the promoted sorbent "at a single point" and not "the addition of the promoter" to "the coal or the combustion chamber" (EX1038, 28), the pyrolysis char disclosures do not describe adding the promoter to coal or a combustor.

A POSITA would have known that pyrolysis char forms during coal combustion and is necessarily present in the combustor when coal is combusted to form the mercury-containing gas. EX1087, 673 ("pyrolysis, even under the most favorable conditions, includes the formation of … residual char"). If the Patent Owner disputes that pyrolysis char is necessarily present during coal combustion, then the Challenged Claims are not entitled to an earlier priority date for the additional reason of a lack of disclosure of combusting coal, pyrolysis char and HBr, a bromide compound, or a combination thereof in the specification of the '558 Application or any of its purported priority applications. EX1002, ¶ 74.

Thus, the ‘558 Application does not disclose a promoter added to coal or a combustor. EX1002, ¶¶ 62-80.

b) Provisional Disclosure

The earliest related application, 60/605,640 (“the Provisional”) mentions mercury removal from “coal-fired utility or synthesis gas” (EX1017, 6), mercury within coal (EX1017, 6), coal combustion flue gas (EX1017, 7), and a facility fired with lignite coal (EX1017, 14). None of these disclosures describe promoter compounds added to coal or a combustor.

The Provisional includes Figure 2 showing a “coal fueled facility” burning “pulverized coal” where “additive can be injected where desired (e.g., before, after or within the boiler).” EX1017, 12, Figure 2. However, the term “additive” is undefined there. And additive injection “before, after or within the boiler” is not a disclosure of additive injection to coal. There are common system components that supply an additive to the airstream before, after or within a boiler (and not to the coal) such as a separate feed inlet, a secondary-air system, or a low-No_x overfire air system. EX1002, ¶¶ 81-84.

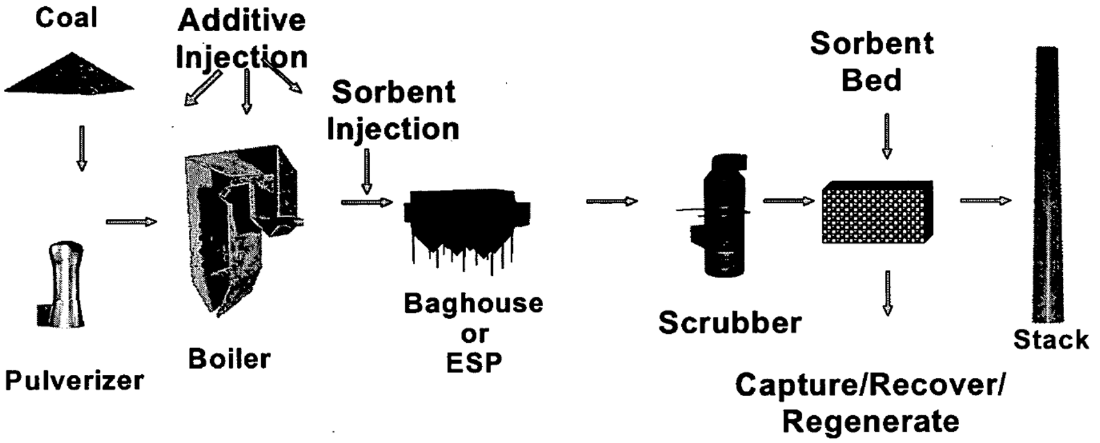


FIG. 2

The rest of the Provisional is no help to PO, either. The Provisional provides "an outline of [15] examples of the invention." EX1017, 2. But none discloses applying HBr, a bromide compound, or a combination thereof as an "additive" to coal or the combustor. EX1002, ¶¶ 85-87.

More particularly, Examples 1–4 disclose a modified carbon sorbent prepared by reacting carbon with a Br_2 solution, a Br_2 gas, an HBr solution or an HBr gas. EX1017, 2–3. Provisional Examples 5 and 6 further include a sulfur or selenium reagent when preparing the promoted sorbent. EX1017, 4. Example 7 treats "carbon with a Group V or VI element combined with Group VII element, such as PBr_3." EX1017, 4. These Provisional Examples 1-7 disclose methods of preparing a promoted sorbent by reacting a carbon sorbent with the promoter. These Examples do not disclose applying the promoted sorbent to coal or applying Br_2, HBr, a bromide compound, or a combination thereof to coal or the combustor.

Provisional Examples 1-3 may include an ”additional promoting substance” in the Br_2 solution, Br_2 gas, or HBr solution used in preparing the promoted sorbent. EX1017, 2-3. This additional promoter can be HBr. EX1017, 3. This additional substance is outlined under “1E” and “same additives as 1E” without indicating what the “additive” references. Again, this additional substance is used in preparing a promoted sorbent and not as an “additive” to coal, and only HBr and <u>not</u> Br_2 is disclosed. During prosecution of related applications, PO distinguished HBr from Br_2. EX1088, p. 7, ¶ 17. A disclosure of one species (HBr) in the Provisional does not support the genus of “bromide compounds.” *See Ariad Pharm., Inc. v. Eli Lilly & Co.*, 598 F.3d 1336, 1350 (Fed. Cir. 2010). EX1002, ¶¶ 88-90.

Provisional Example 8 describes injecting the promoted sorbents of Provisional Examples 1-6 into a contaminated <u>gas stream</u>. EX1017, 4. Provisional Example 9 refers to the promoted sorbents as “additives (1-8)” and describes their use with sorbents to capture acid gases, further referring to these sorbents as “additives” or “additives of base chemistry.” EX1017, 4, 1. Thus, Provisional Example 9 uses the term “additive” to describe sorbents. Provisional Examples 10-15 do not use the term “additive.”

As a further point, the “additive” is not the modified carbon sorbents of the Provisional Examples 1–7 since Figure 11, above, separately depicts “sorbent injection," and the figure description states that "[i]n the example shown, the sorbent is injected into the flue gas after the boiler." EX1017, 12, Figure 2.

The remaining mentions of "additive" in the Provisional disclosure do not disclose what the "additive" is, either. EX1017, 6 ("a combination of additives to remove pollutants"); EX1017, 11 ("additive to a treatment facility"); EX1017, 11 ("additive-sorbent ratios").

Thus, the '558 Application fails to provide written description support for promoter compounds such as Br_2, HBr, a bromide compound, or a combination thereof being added <u>to coal or the combustor</u> and thus does not disclose "combusting … coal … and an additive". EX1002, ¶ 94. Accordingly, none of the Challenged Claims have a priority date before the filing date of the '558 Application. Each reference relied upon in Grounds 1–5 thus qualifies as prior art under the AIA and renders the Challenged Claims not patentable.

3. The '558 Application Reveals that PO Was <u>Not</u> in Possession of Adding a Promoter <u>to Coal or the Combustor</u> at the Time of Invention

The '558 Application teaches that adding bromine by itself to the flue gas would not sufficiently oxidize mercury to allow easy capture by activated carbon, and so bromine was added to the activated carbon to make a promoted sorbent to add to the flue gas. EX1002, ¶¶ 75-76.

In particular, the '558 Application discloses:

1. Molecular bromine (Br_2) "reaction with hot flue gas components leave little to react with elemental mercury." EX1024, [0068].
2. Elemental bromine (Br) "is about a million times more reactive to mercury" but is in such "extremely low" concentration that it will not result in mercury oxidation in flue gas. EX1024, [0068].
3. A halide (*e.g.*, a hydrohalide such as HBr) is "much less reactive" than molecular halogen (*e.g.*, Br_2) and "do not, alone, oxidize other compounds." EX1024, [0069].
4. The Provisional disclosure states that for these reasons, "it is not obvious that a halide-halogen treated activated carbon would be effective at oxidizing elemental mercury and provide effective capture of elemental mercury." EX1017, 7. This Provisional disclosure was changed over time in the '558 Application to "[in] the conventional view therefore, a halide-salt-treated activated carbon will not effectively oxidize elemental mercury and capture elemental mercury," recharacterizing PO's rationale for nonobviousness of a promoted activated carbon sorbent into a "conventional view." EX1024, [0069].

A POSITA would have known that lignite or subbituminous coal contains very low amounts of bromine on the order of 1-3 ppm (median). EX1084, 1; EX1085, 905. Thus, a POSITA would have understood the '225 Patent's disclosure of “extremely low” concentrations of elemental bromine (Br) being in the flue gas as meaning that **native untreated coal** was being combusted in the ‘225 Patent, and **not coal to which HBr, a bromide compound or a combination thereof had been added**. EX1002, ¶ 77.

A POSITA would have known that any bromine source added to the combustion chamber would completely convert to hydrogen bromide (HBr). EX1014, 1658; EX1002, ¶ 78. Thus, had HBr, a bromide compound or a combination thereof been added to the coal before combustion, the concentration of elemental bromine (Br) would have been much higher driving a POSITA to the conclusion that the named inventors never described adding a promoter to coal or to the combustion chamber. *Id*. Instead, the named inventors described addition of a promoted activated carbon sorbent. *Id*.

As the ‘225 Patent explains “adding HBr or Br_2 to the carbon forms a similar carbon bromide, in which the positive carbon oxidizes the mercury with the assistance of the bromide ion.” EX1024, [0053]. This carbon bromide results from the reaction between the promoter and activated carbon when making the promoted sorbent before the promoted sorbent is injected into the flue gas. It is not a disclosure of what occurs in the combustion chamber or of adding a promoter to coal. EX1002, ¶ 79-80.

4. The Priority Applications Do Not Provide Written Description Support for HBr, Bromide Compound, or a Combination Thereof Being Added to Coal or a Combustor

Grounds 1–5 of this Petition establish invalidity of the Challenged Claims in light of Downs, Altman, Nelson, Vosteen, Blankinship and Olson-235. Each of these references was published or was otherwise publicly available years before the filing date of the application for the '225 Patent. PO thus bears the burden to produce evidence "to prove entitlement to claim priority to an earlier filing date." *PowerOasis, Inc. v. T-Mobile USA, Inc.*, 522 F.3d 1299, 1304–05 (Fed. Cir. 2008). Petitioner may rebut such arguments.

Notably, patent examiners generally do not make priority findings during prosecution, and generally accept applicant's asserted priority date. *Id.* at 1305; M.P.E.P. § 201.08. Here, the examiner made no finding regarding priority to any earlier filed applications for claims 66-94 which later issued as the claims of the '225 Patent. EX1024, 365-377, 437-460, 527-553, 668-682.

a) Legal Standards for Priority Claims

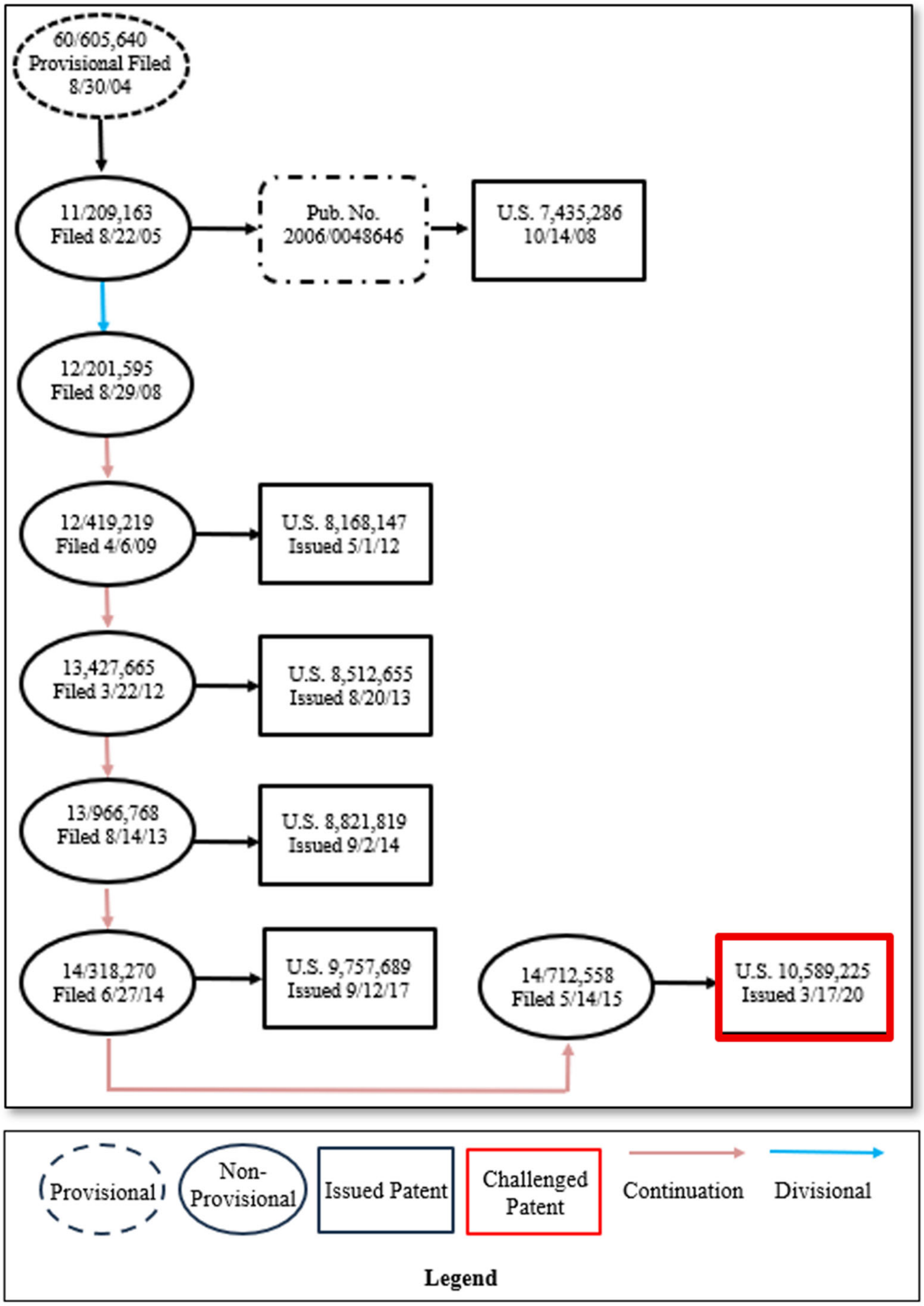
"To receive the benefit of the filing date of an earlier application under 35 U.S.C. § 120, each application in the chain leading back to the earlier application must comply with the written description requirement of 35 U.S.C. § 112." *Lockwood v. Am. Airlines, Inc.*, 107 F.3d 1565, 1571 (Fed. Cir. 1997). PO must prove that the written description of each of the priority applications "convey[s] with reasonable clarity to those skilled in the art that, as of the filing date sought, [the inventor] was in possession of the invention. ... Entitlement to a filing date does not extend to subject matter which is not disclosed, but would be obvious over what is expressly disclosed." *PowerOasis*, 522 F.3d at 1306.

Thus, "[t]he question is not whether a claimed invention is an obvious variant of that which is disclosed in the specification. Rather, **a prior application itself must describe an invention**, and do so in sufficient detail that one skilled in the art can clearly conclude that the inventor invented the claimed invention **as of the filing date sought**." *Lockwood*, 107 F.3d at 1571–72 (emphasis added). Thus, to claim priority back to the Provisional, PO must demonstrate that the Provisional, and **<u>all</u>** intervening applications, expressly or inherently discloses adding each of the claimed specific bromine-containing species (Br_2, HBr, bromine compound and combinations thereof) to coal.

PO cannot meet this burden. Prior to 5/14/2015, a POSITA would not have concluded that the applicant was in possession of the subject matter of the Challenged Claims because applications in the purported priority chain fail to disclose adding any type of bromine species to coal.

b) Priority Applications Do Not Provide Written Description Support

The '558 Application is a descendant of the Provisional application and a series of continuation applications and a divisional application which, by definition, cannot introduce new subject matter to the prior application. *See* EX1001, Cover Page - Related U.S. Application Data. The following image shows the relationships between these applications:



Each priority application as filed and the file history for the ‘225 Patent are submitted as Exhibits EX1017-EX1024.

The disclosures in each intervening non-provisional application between the Provisional and the ‘558 Application have “coal,” “additive” and “combustor” disclosures as discussed in § VII.B.2. Thus, the Provisional disclosure was <u>not</u> included in the ‘163, ‘595, ‘219, ‘665, ‘768, ‘270, or ‘558 Applications, which are themselves essentially the same, with minor differences. *See* EX1028–EX1033 (redline comparisons of each successive non-provisional application as compared to its predecessor). Thus, the priority applications fail to provide written description support for the same reasons provided above for the ‘558 Application in § VII.B.2. EX1002, ¶¶ 95-97.

Indeed, the Board found in its Institution Decision in IPR2020–00832 for related U.S. Patent 10,343,114 that the first two non-provisional applications in the chain (the ‘163 and ‘595 Applications) do <u>not</u> disclose “(1) the addition of the promoter with the coal or the combustion chamber and (2) the injection of a sorbent material into the mercury-containing gas downstream of the combustion chamber,” both of which are required by each of the ‘225 Patent’s independent claims. EX1038, 28–29.

The Board found that the disclosure as referenced in Example 10 of the ‘225 Patent where the “halogen/halide promoted carbon sorbent was injected into the flue gas after the boiler" describes "a **combination of promoter and sorbent material being added at one single point**") (emphasis added). *Id.* The Board also considered the disclosure in that same example that "[i]n general however, the inventive sorbent can be injected where desired (e.g., before, after, or within the boiler)." *Id.* The Board stated that: "Although this describes other injection points ('e.g., before, after, or within the boiler'), this disclosure regards the promoted sorbent material. As a result, it describes the addition of both the promoter and the sorbent material at a single point, not (1) the addition of the promoter with the coal or the combustion chamber and (2) the injection of the sorbent material into mercury-containing gas downstream of the combustion chamber." *Id.* Thus, the Board did not find injection of a promoted sorbent before, after or within the boiler to support adding the promoter to coal and injecting the sorbent into flue gas downstream of the combustion chamber.

For all of these reasons, none of the intervening applications filed before the '970 Application contains such a disclosure, either. EX1002, ¶¶ 98-100.

5. The Passages Cited When Adding or Amending Claims During Prosecution Do Not Provide Written Description Support

In 2018, new claims were filed directed to methods for separating mercury from a mercury-containing gas, which required combusting coal, pyrolysis char and a promoter. EX1024, 327-331, 333, 337-338, Claims 45, 61, 65. The following paragraphs of US Published Application No. 2015/0246315A1 were cited as support for this feature of claims 45, 61 and 65:

Paragraph [0006] specifies that "combustion … of … coal generates flue gas that contains mercury." This paragraph does not describe a promoter.

Paragraph [0119], which is paragraph [0107] of the specification as filed in the '558 Application, states that "the inventive sorbent can be injected where desired (e.g., before, after, or within the boiler)." PO states in the excerpts above that this paragraph means that "the **halogen/halide promoted sorbent** can be added where desired." (emphasis added). As addressed above regarding Example 10, this is not a disclosure of adding a **promoter** where desired.

Paragraph [0073] states that "X-ray spectroscopy has established that the addition of bromine, chlorine, HBr, or HCl formed a chemical compound in the carbon structure. Thus, the sorbent produced from halogen and activated carbon **does not represent a molecular halogen form, but rather a new chemically modified carbon (or halocarbon) structure**" (emphasis added). This paragraph indicates that the promoter is no longer present as such because it has reacted to form a new halocarbon structure. EX1002, ¶ 114.

Paragraph [0093] describes the promoted carbon sorbent as having "a carbocation that accepts electrons from the neutral mercury atom forming the oxidized mercury species." This paragraph does not describe combusting coal and a promoter.

The claims were then cancelled and replaced with claims including the same combusting feature and replacing "promoter" with "additive comprising HBr, a bromide compound, or a combination thereof." EX1024, 354-357, 662-666, Claims 66, 79, 82. Paragraphs [0054] and [0071] of the published application US 2015/0246315A1 were cited as support. EX1024, 611.

Paragraph [0054] refers to Figure 2 and states that "hydrogen bromide reacts with the unsaturated structure of the activated carbon." Paragraph [0071] defines the term "halide." These paragraphs do not describe combusting coal and a promoter.

None of these paragraphs provide written description support for combusting coal and a promoter, much less combusting coal and HBr, a bromine compound or a combination thereof as recited in the Challenged Claims. EX1002, ¶¶ 101-119. There can be no earlier priority date.

6. Breaks in Priority Preclude an Earlier Filing Date for the '225 Patent

a) Break in Continuity of Disclosure from Improper Incorporation by Reference of Provisional

The purported Provisional written description support for adding a promoter to coal or a combustor (and thus combusting coal and a promoter), does not appear in the '558 Application for the '225 Patent.

To incorporate another document, “the host document must identify with detailed particularity what specific material it incorporates and clearly indicate where that material is found in the various documents.” *Callaway Golf Co. v. Acushnet Co.*, 576 F.3d 1331, 1346 (Fed. Cir. 2009).

Here, four of the intervening non-provisional applications between the Provisional and the ‘558 Application (*i.e.*, the ‘219, ‘665, 768 and ‘270 Applications) do not recite the Provisional disclosure in their specifications, and they only incorporate the Provisional by reference “to the extent appropriate.” EX1020-EX1023, [0001].

This limited incorporation language causes a break in the continuity of disclosure, preventing the ‘225 Patent from benefitting from the filing date of these applications and the Provisional which preceded the break in priority. *See Midwest Energy Emissions Corp. v. Arthur J. Gallagher*, No. 19-1334- CJB, 2023 WL 7411160, at *3 (D. Del. Nov. 3, 2023) (holding Provisional was not properly incorporated into ’517 Patent); *Zenon Envtl., Inc. v. U.S. Filter Corp.*, 506 F.3d 1370, 1379, 1382 (Fed. Cir. 2007) (“The plain language expressly limits the incorporation to only relevant disclosures of the patents, indicating that the disclosures are not being incorporated in their entirety…. thus a lack of continuity of disclosure exists in the family chain.”); *Droplets, Inc. v. E* Trade Bank*, 887 F. 3d 1309, 1318-1320 (Fed. Cir. 2018).

The Board previously held that the '219 Application "claims priority 'to the extent appropriate' and fails to identify with detailed particularity the specific material incorporated and fails to clear[ly] indicate where that material is found in the various documents … This ambiguity creates an additional concern regarding the chain of priority for the '219 application." EX1071, 32 (finding no priority to Provisional).

Since these four intervening applications fail to identify with detailed particularity the specific material incorporated from the Provisional and fail to clearly indicate where that material is found, there is a break in continuity of disclosure and priority that prohibits PO from relying upon it for written description disclosure to support an earlier priority date.

b) Provisional was "Essential Material" to Claims of '225 Patent and Intervening Patent 8,168,147

Rule 1.57(d) provides that for applications filed on or after 9/21/2004 that "essential material"—which includes material that is "necessary to: provide a written description of the claimed invention"—"may be incorporated by reference, but ***only*** by way of incorporation by reference to a ***U.S. patent or U.S. patent application publication***." (emphasis added). The Provisional is neither, and thus an "incorporation by reference" of the Provisional cannot provide written description support for a patent's claims.

The ‘225 Patent and a patent in its priority chain have claims for which the purported support derives from the Provisional.

First, claims 18-19 of U.S. Patent 8,168,147 require sorbent and bromine to be separately injected into a mercury-containing gas. The ‘219 application for the ‘147 Patent only describes combining sorbent and bromine in a transport gas such as air or nitrogen to promote the sorbent in-flight and then introduce the promoted sorbent into a mercury-containing flue gas. EX1020, [0055], Figure 3; EX1071, 29 (finding regarding the ’147 Patent that “[t]here is no suggestion that bromine and the activated carbon are separately injected into mercury-containing flue gas”).

During prosecution, PO amended Figure 1 of the ‘147 Patent to add the following highlighted brand-new line between activated carbon 10 and flue gas 50 without supporting description in the specification. EX1071, 30-32 (The Board previously finding Figure 1 does not provide written description support for ’147 Patent claims 18-19).

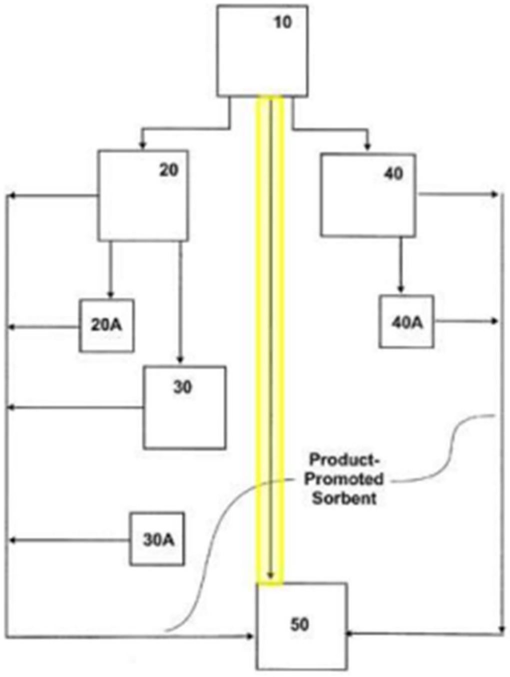


FIG. 1

Purported support from Provisional Figure 2 would make the Provisional "essential material" to these '147 Patent claims in violation of 37 CFR 1.57(d), breaking the chain of priority at the filing date of the '665 Application on 3/22/2012.

Second, claims 14 and 23 of the '225 Patent require adding a promoter to coal, and adding an activated carbon (AC) sorbent free of contact with a promoter before addition to mercury-containing gas, respectively. As explained above, the '558 application for the '225 Patent does not describe adding a promoter to coal (*see* § VII.B.4.b) or adding unpromoted AC sorbent to mercury-containing gas (*see* amended '147 Figure 1 directly above). Purported support from Provisional Figure 2 would make the Provisional "essential material" to these '225 Patent claims in violation of 37 CFR 1.57(d). Thus, the Provisional cannot provide written description support for the claims of the ‘225 Patent.

In sum, the ‘558 Application and its priority applications fail to provide written description support for adding any of the claimed promoters to coal or the combustor and thus does not disclose “combusting … coal … and an additive” as recited in the Challenged Claims. Also, breaks in priority preclude PO from proving a filing date before 5/14/2015. Accordingly, none of the Challenged Claims are entitled to a priority date before the filing date of the ‘558 Application. Each of the references relied upon in Grounds 1–5 thus qualify as prior art under the AIA and render the Challenged Claims unpatentable.

C. <u>State of the Art</u>

The obviousness inquiry “necessarily depends on such artisan’s knowledge,” including an “assessment of the background knowledge possessed” by a POSITA. *Koninklijke Philips N.V. v. Google LLC*, 948 F.3d 1330, 1337 (Fed. Cir. 2020). The subjects below would have been “within the general knowledge of a skilled artisan” by 2004. *Id.* at 1338.

1. Mercury and Halogens

Halogens were known as Group VII elements, which include fluorine (F), chlorine (Cl), bromine (Br), and iodine (I), and that are highly reactive oxidizing agents that cause other species to give up electrons (become more positively charged). EX1040, 788, 791, A.44. Halogens were known to exist naturally as diatomic molecules (*e.g.*, Br_2,), halides/halide compounds (*e.g.*, NaBr, $CaBr_2$), and hydrohalides (*e.g.*, HBr).

Mercury was a known metal in an elemental/metallic (Hg^0) form and as oxidized (either Hg_2^{2+} (mercurous) or Hg^{2+} (mercuric)). EX1002, ¶ 43; EX1041, 12.

2. Coal Combustion

Pulverized-coal was commonly combusted in a combustion chamber known as a "boiler" and produced a mercury-containing flue gas. EX1042, 13–1, 18–1, 19–1. Coal emissions also included particulate matter (fly ash and unburned carbon), mercury (Hg), sulfur oxides (SO_X), and nitrogen oxides (NO_X). EX1043, 1.1–3 to 1.1–6. Downstream components used to control flue gas pollutants included electrostatic precipitators (ESP) and fabric filters (FF) for particulates, and wet or dry flue gas desulfurization (FGD) systems. EX1043, 1.1–6 to 1.1–9; EX1002, ¶¶ 41, 43.

3. EPA Regulations

Mercury posed known health concerns. EX1046, 4–11 to 4–20. In 2000, the EPA announced plans to regulate mercury emissions from coal-fired power plants with rules to be proposed by December 2003 and finalized by December 2004. EX1044, 2, 7–9. The Clean Air Mercury Rule passed in 2005 and required

70% mercury removal. EX1045. The power-generation industry mobilized a massive response to develop mercury emissions control technologies in the early 2000s. EX1044; EX1002, ¶ 42.

4. Activated Carbon and Halogens for Mercury Removal

Adsorption is a process where adsorbate (*e.g.*, mercury) in a fluid (*e.g.*, flue gas) binds to a sorbent's surface (*e.g.*, activated carbon). "Reducing" mercury in flue gas results from adsorbing mercury to the sorbent surface and then removing the sorbent using particulate separators such as ESPs. EX1002, ¶¶ 45-55.

By 1934, it was shown that halogens improved the ability of activated carbon to remove mercury. *See* EX1049, 1:33–41. By 1970, bromine was known to adsorb up to a 31–38% saturation limit (adsorption equilibrium) in carbon materials. EX1050, 260. By 1988, bromine (Br) was shown to react with activated carbon to provide "carbon-bromine surface structures (surface compounds)." EX1051, 259.

By 1998, "[a]ctivated carbons ha[d] been the most thoroughly studied sorbent for the capture of mercury." EX1041, 22. Indeed, two named inventors, Dr. Olson and Mr. Holmes, admitted that "activated carbon was the most common [or heavily] studied sorbent for mercury control." EX1047, 114:21-25. EX1048, 41:5-9.

In 1999, researchers demonstrated that mercury from flue gas formed chemical bonds with halogen species on activated carbons. EX1052, 119. And researchers were investigating improving their effectiveness and cost. EX1001, 1:58-62; EX1046, 2–54 to 2–57; EX1041, 1.

By 2003, bromine was known to be more than 25 times more effective than chlorine for metallic mercury oxidation in coal combustion. EX1049, 2. In 2003, Vosteen's group was testing to achieve 95% mercury removal by combining bromine injection with powdered activated carbon ("PAC") injection and to reduce PAC consumption to one-fifth. EX1061, 96.

It was known that halogens, particularly bromine-containing species, improved the effectiveness of activated carbon in removing mercury. *See, e.g.*, EX1004; EX1012; EX1008; EX1066. EX1002, ¶ 52.

Calcium bromide was known to achieve the highest mercury removal at the lowest dosage rate as compared to other halogens tested in lignite coal combustion in March 2005. EX1057, 12; EX1054, 15.

It was also well known that adjusting the sorbent injection rate would control mercury emissions. EX1058, 14; EX1059; EX1060, 4676. EX1002, ¶ 52.

Coal-fired power plants used bromide compounds pre-combustion and activated carbon post-combustion to remove mercury from flue gas and sold the electric power generated in June 2004 at Holcomb Station (EX1062, 11, 15;

EX1063, EX1064; EX1066), by March 2005 at Laramie River (EX1067, 11, 23), and by September 2005 at Meramec Station (EX1065, 17–18; EX1066, 16; EX1063; EX1064).

VIII. CLAIM CONSTRUCTION

Petitioner does not contend that any term requires construction and has given all terms their plain and ordinary meaning consistent with the construction provided by Magistrate Judge Burke in the District of Delaware. EX1002, ¶¶ 120-126.

IX. THE CITED REFERENCES QUALIFY AS PRIOR ART

Petitioner relies on six prior art references: Downs (EX1004); Altman (EX1007); Nelson (EX1008); Vosteen (EX1011); Blankinship (EX1012); and Olson-235 (EX1013). These references render the Challenged Claims unpatentable as anticipated or obvious.

A. Downs

Downs was published as US2008/0107579 on 5/8/2008 before the 5/14/2015 effective filing date of the ‘225 Patent, and is a prior art patent publication under 35 U.S.C. § 102(a)(1) (as of its 5/8/2008 publication date) and 102(a)(2) (AIA) (as of its 3/22/2004 provisional filing date). If the effective filing date of the ‘225 Patent is instead determined to be 8/30/2004, then Downs is prior art under 35 U.S.C. § 102(e) (pre–AIA) as of its 3/22/2004 provisional filing date because the provisional application has proper support for the subject matter relied upon as prior art and at least one claim of the Downs patent is supported by the written description of the provisional application under pre-AIA 35 U.S.C. 112, first paragraph. *In re Riggs*, 131 F.4th 1377, 1384-85 (Fed. Cir. 2025); *Dynamic Drinkware, LLC v. Nat'l Graphics, Inc.*, 800 F.3d 1375, 1378 (Fed. Cir. 2015); *Amgen Inc. v. Sanofi*, 872 F.3d 1367, 1380 (Fed. Cir. 2017) (*Dynamic* applies to published patent applications). The PTAB previously found that Downs qualifies as prior art back to 3/22/2004. EX1045, 29, 32.

The disclosure of Downs is supported by Downs-Provisional, as illustrated by a redline comparison (EX1006) and confirmed by Dr. Vidic. EX1002, ¶¶ 132-154. At least Downs' claim 1 has written description support in Downs-Provisional, which describes: a "method of removing elemental mercury from coal combustion flue gases" (EX1005, Title, [0021]); providing a "bromine-containing reagent" to mercury-containing flue gas in the combustion chamber to "promote the oxidation of elemental mercury" and create an oxidized form (EX1005, Title, Fig. 2, [0002]-[0006], [0018]-[0019], [0021], [0027], claim 1); and removing "both oxidized and elemental mercury species" from the flue gas (EX1005, [0004]-[0005], [0018]-[0019]).

Downs explains that "[b]romine-containing compounds, added to the coal, or to the boiler combustion furnace, are used to enhance the oxidation of mercury, thereby enhancing the overall removal of mercury in downstream pollution control devices." EX1004, Abstract, [0001], [0010]; EX1005, [0009], [0018]. Downs' schematic is reproduced below:

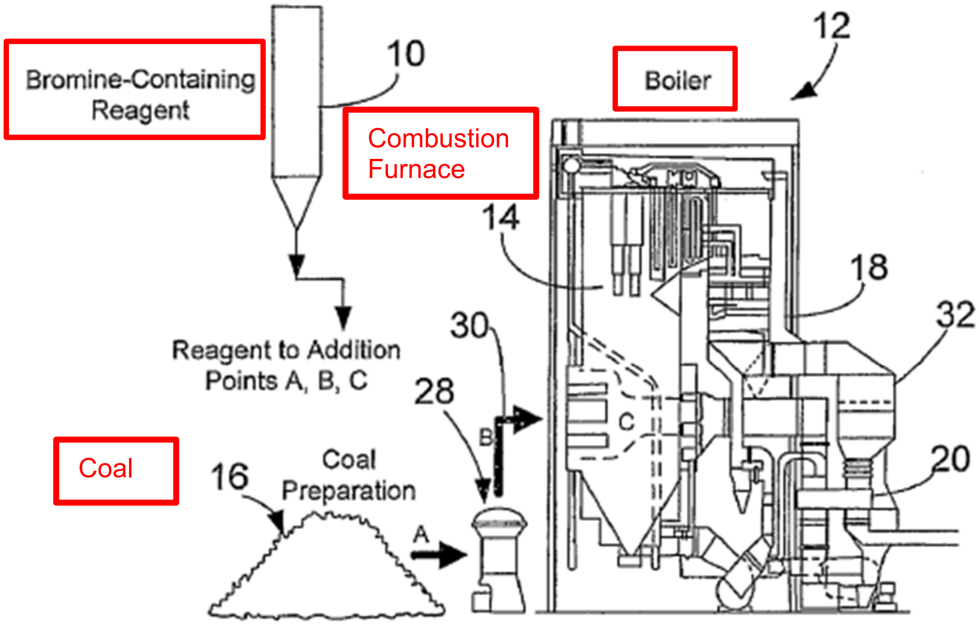


FIG. 2

EX1004, Figure 2 (annotations added in red); EX1005, Figure 2. Figure 2 shows adding bromine-containing reagent 10 to boiler 12 of combustion furnace 14 "either directly or by premixing with the incoming coal 16." EX1004, [0015]; EX1005, [0018]. Downs describes injecting an aqueous solution of calcium bromide into furnace 14, and using "alkali metal and alkaline earth metal bromides, hydrogen bromide (HBr) or bromine (Br_2)" as the bromine-containing reagent 10. EX1004, [0018], [0021]; EX1005, [0021], [0024]. Downs describes "downstream pollution control systems such as wet 22 and SDA 24 FGD systems, and PAC injection systems" with "powdered activated carbon (PAC)" as a sorbent. EX1004, [0015], [0025]; EX1005, [0018], [0028]. Wet 22 and SDA 24 FGD systems and ESP or FF particulate collectors 26 are shown in Figures 4 and 6, below:

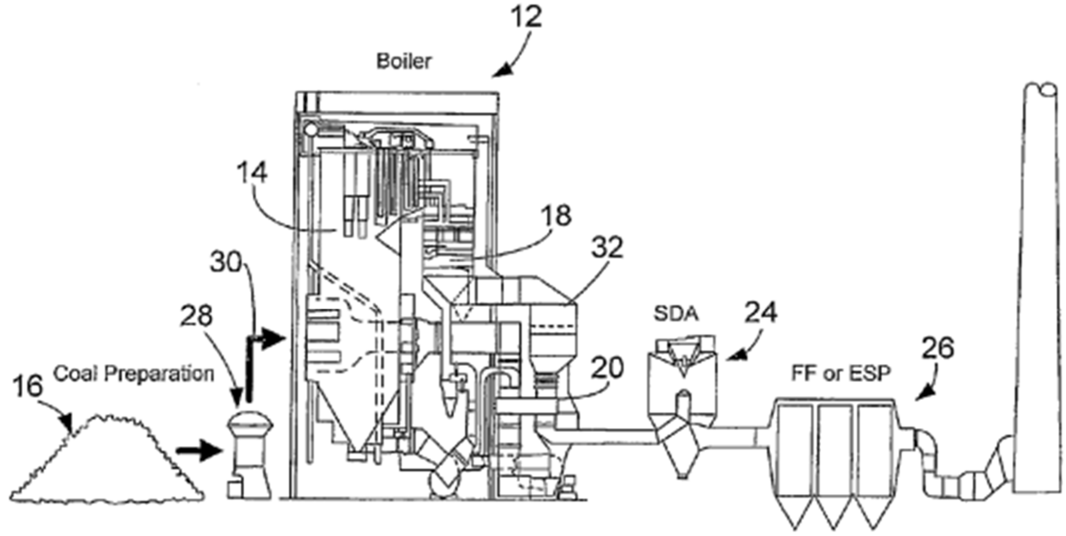


FIG. 4

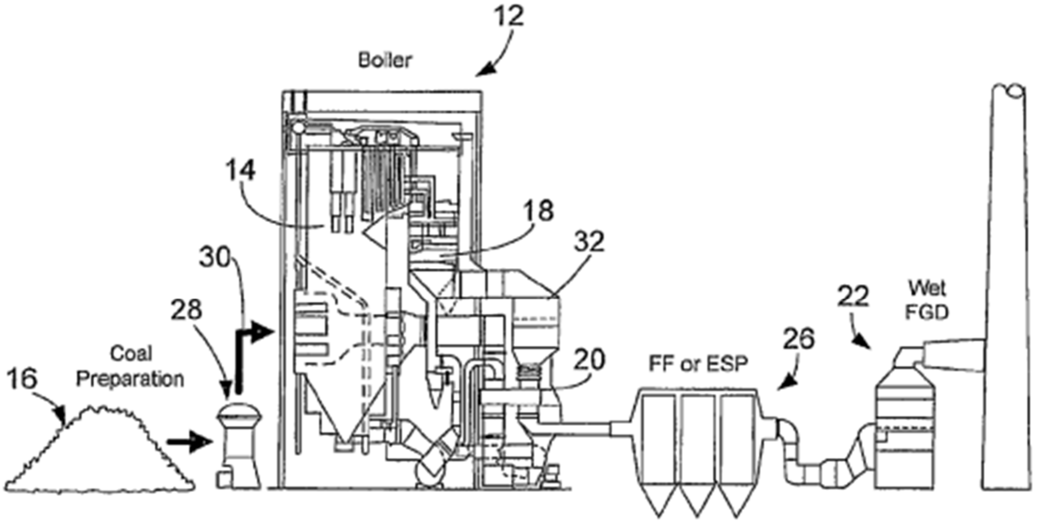


FIG. 6

EX1004, Figures 4 & 6; EX1005, Figures 4 & 6. Downs states that "experimental results indicate that bromine addition also results in an increased fraction of particulate-bound mercury," enhancing mercury removal from particulate collectors 26 (FF or ESP). EX1004, [0015]; EX1005, [0018]; EX1002, ¶¶ 127-154.

B. Altman

Altman issued as US Patent 5,827,352 on 10/27/1998 and is a prior art patent under 35 U.S.C. §§ 102(a)(1) and 102(a)(2) (AIA) or 35 U.S.C. §§102(a) and 102(b) (pre-AIA) regardless of the effective filing date of the '225 patent.

Altman discloses that injection of activated carbon into flue gas was known to remove mercury in coal-fired boilers before April 1997. EX1007, 2:23–31, 1:41–2:22, 32–46.

Altman injects activated carbon sorbent into flue gas to remove mercury from the flue gas of a coal-fired boiler 12. EX1007, 1:5–9, 3:41–45, 4:57–58. Flue gas exiting boiler 12 is processed through ESP 19 to remove fly ash 21 and then through tower 24 and silo 27:

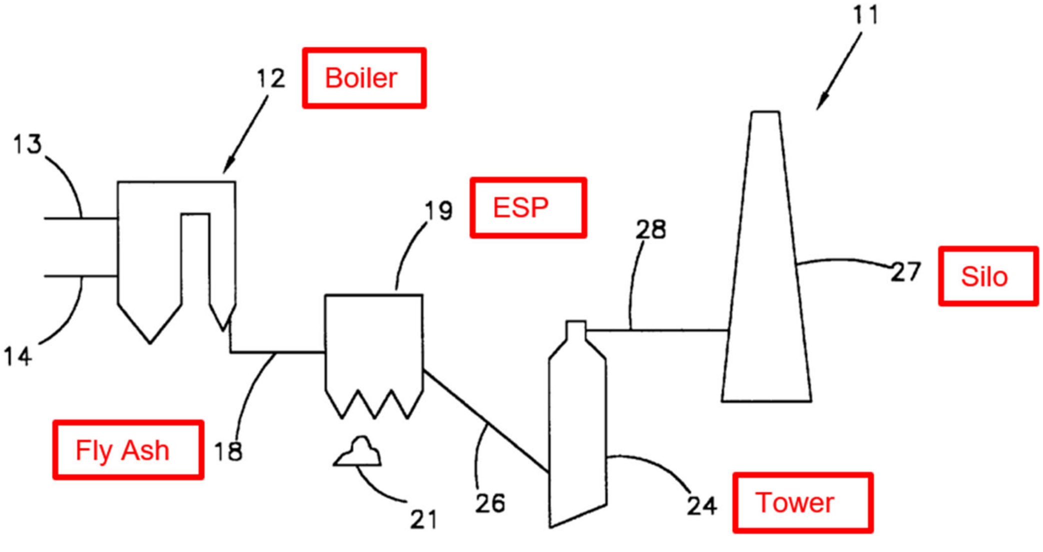
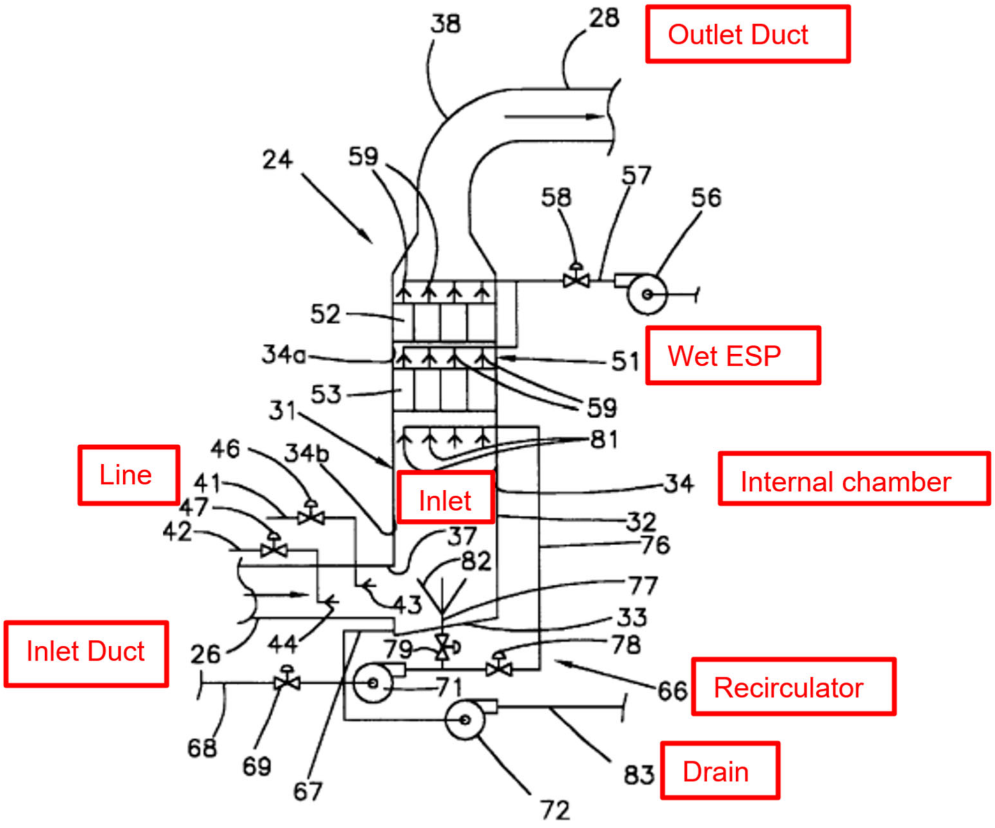


FIG. 1

EX1007, Figure 1, 3:53–65 (annotations added in red). Tower 24 includes a particulate control device (wet ESP 51) located above internal chamber 34:



EX1007, Figure 2, 3:66–4:4, 17–20 (annotations added in red). The activated carbon sorbent is "injected into the flue gas" – either "injected into chamber 34" or into inlet duct 26 via line 41. EX1007, 4:53–61. Water or a water/sorbent mixture is injected into chamber 34 to lower the temperature of the flue gas such that temperature and sorbent injection rate provide "optimal mercury sorption" by activated carbon sorbent. EX1007, 4:62–5:5. Flue gas residence time within chamber 34 ranges from 1–20 seconds, preferably 5–10 seconds, to "allow a large portion of the mercury in the flue gas to be removed by the injected sorbent." EX1007, 5:6–12. The flue gas rises through chamber 34 into wet ESP 51 where sorbent, remaining fly ash and condensed water are collected and either removed from tower 24 through drain 83 or partially recycled by recirculator 66. EX1007, 5:18–22, 41–49.

Instead of using complex packed beds with stationary sorbent, Altman injects activated carbon and lime sorbent particles into flue gas. EX1007, 1:30–40, 4:53–61, 5:50–61. EX1002, ¶¶ 155-163.

C. **Nelson**

Nelson published as US Patent Application Publication US2004/0003716 on 1/8/2004, and is a prior art published patent application under 35 U.S.C. §§ 102(a)(1) (as of its 1/8/2004 publication date) and 102(a)(2) (AIA) (as of its 5/6/2002 provisional filing date). If the effective filing date of the '225 Patent is instead determined to be 8/30/2004, then Nelson is prior art under 35 U.S.C. §§ 102(a) (as of its 1/8/2004 publication date) and 102(e) (pre-AIA) as of its 5/6/2002 provisional filing date for the reasons provided in § IX.A, above. The disclosure of Nelson is supported by Nelson-Provisional, as illustrated by a redline comparison (EX1010) and confirmed by Dr. Vidic. EX1002, ¶¶ 169-184. At least Nelson's claim 18 has written description support in Nelson-Provisional, which describes "exposing powdered activated carbon (PAC) to gaseous bromine, Br_2 (g), or gaseous hydrogen bromide, HBr (g), significantly increases its ability to remove elemental mercury when injected into coal-fired flue-gas compositions at high temperatures.…By simply exposing PAC to concentrated bromine gas, a relatively large quantity of this gas appears to react with the carbon, forming surface compounds on the large surface-area of the carbon." EX1009, 4.

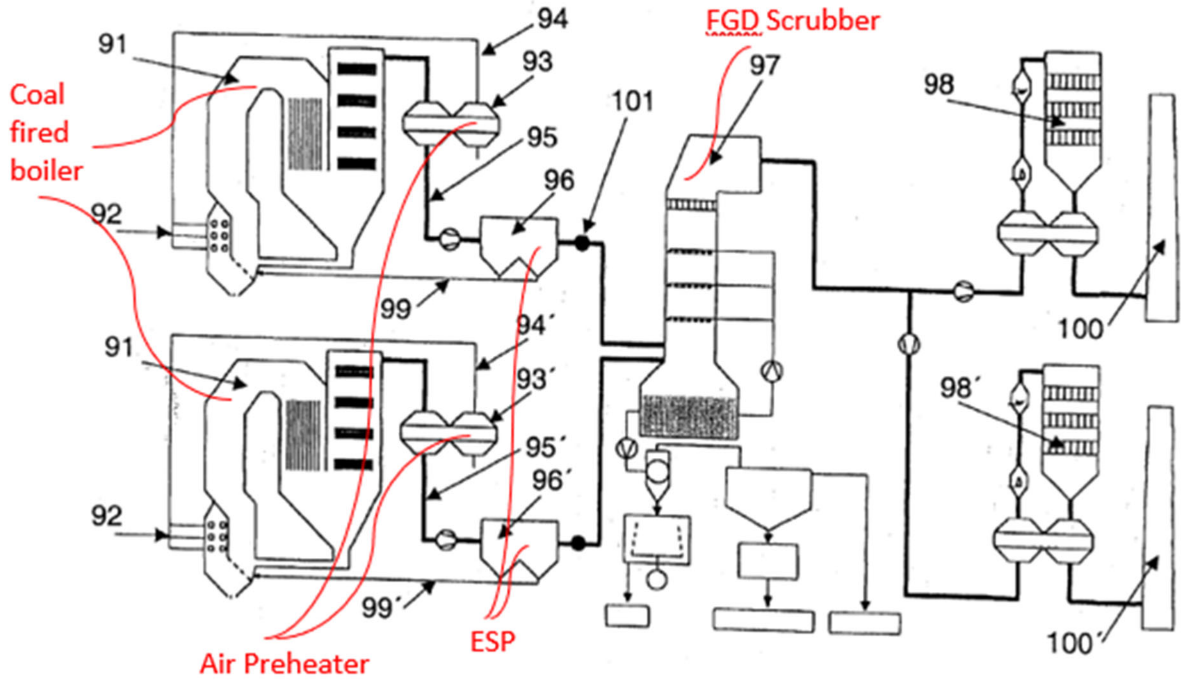
Nelson describes exposing activated carbon sorbent to a bromine-containing gas before the sorbent is mixed with mercury-containing flue gas. EX1008, [0040]; EX1009, 4. Nelson indicates that exposure of sorbent to Br_2 or HBr gas "significantly increases the carbonaceous materials ability to remove mercury species." EX1008, [0041]; EX1009, 4; EX1002, ¶¶ 164-184.

D. __Vosteen__

Vosteen published as US2004/0013589 on 1/22/2004, and is a prior art published patent application under 35 U.S.C. §§ 102(a)(1) (as of its 1/22/2004 publication date) and 102(a)(2) (as of its 7/24/2002 filing date) (AIA). If the '225 Patent's effective filing date is determined to be 8/30/2004, then Vosteen is prior art under 35 U.S.C. § 102(a) (as of its 1/22/2004 publication date) and 102(e) (pre-AIA) (as of its 7/24/2002 filing date).

Vosteen describes "a process for removing mercury from flue gases of high temperature plants, in particular power stations" EX1011, [0001]. Vosteen discloses that "addition of bromine or bromine compounds to the furnace causes ... a substantial, essentially complete, oxidation of the mercury" allowing "substantially complete removal of mercury (Hg), from flue gases." EX1011, [0005], [0007]. More than 90% mercury removal is reported. EX1011, Figure 5, [0028], [0042].

Vosteen reports adding sodium bromide (NaBr), a bromide compound, into coal-fired boilers 91 of a power plant to "demonstrate the effect of bromine on Hg oxidation." EX1011, Example 5, [0047]. Vosteen describes a flue gas emissions control system as known in the art "based either on wet scrubbing or dry cleanup or a combination of the two." EX1011, [0017]. Vosteen exemplifies a boiler flue gas fed through air preheaters 93,93' ESPs 96,96' and FGD scrubber 97 as depicted below.



EX1011, Figure 9 (annotations added in red), Example 5, [0047]. Vosteen discloses activated carbon and alkaline materials such as lime for use in the flue gas emissions control system. EX1011, [0019]. EX1002, ¶¶ 185-194.

E. **Blankinship**

Blankinship published on 6/2/2009, before the ‘225 Patent’s 5/14/2015 effective filing date, and is a prior art printed publication as of 6/22/2009 under 35 U.S.C. §§ 102(a)(1) (AIA) or 35 U.S.C. §§ 102(a) and 102(b) (pre-AIA).

“A reference is considered publicly accessible if it was disseminated or otherwise made available to the extent that persons interested and ordinarily skilled in the subject matter or art, exercising reasonable diligence, can locate it.” *Acceleration Bay, LLC v. Activision Blizzard Inc.*, 908 F.3d 765, 772 (Fed. Cir. 2018) (internal quotation omitted). Blankinship was in Volume 113, Issue 6 of Power Engineering magazine, as received by the University of Pittsburgh Libraries on June 22, 2009 (confirmed by date stamp) and made publicly available within days of receipt. EX1082, ¶¶ 1-4, 4a, Exhibit A. This Library subscribed to the print version of Power Engineering magazine from 1950 to 2018. *Id.*

Blankinship describes Alstom’s approach to removing 80–90% mercury from flue gases in coal-fired power plants burning subbituminous or lignite coal by using a bromide compound pre-combustion and activated carbon injection post-combustion “upstream of a particulate control device.” EX1012, 58. Alstom’s KNX™ calcium bromide solution is “added to the boiler or to the coal” pre-combustion in concentrations where it "enhances mercury oxidation without causing other concerns such as corrosion in the boiler." *Id.*, 56, 58. A MER-CURE™ activated carbon sorbent injection system is used post-combustion to capture mercury on activated carbon particles injected into the flue gas upstream of the air heater to provide "more residence time for the sorbent to absorb the mercury," reducing "sorbent usage about 50 percent compared to traditional activated carbon systems." *Id.*, 58. EX1002, ¶¶ 195-200.

F. **Olson-235**

Olson-235 issued as U.S. Patent 8,652,235 on 2/18/2014 before the '225 Patent's 5/14/2015 effective filing date and is a prior art patent as of 2/18/2014 under 35 U.S.C. §§ 102(a)(1) and as of 4/23/2009 under 102(a)(2) (AIA).

Olson-235 discloses a method for removing mercury in flue gas by injecting a promoted sorbent into the gas. EX1013, 5:30–36. Olson-235 also discloses an embodiment wherein "the injected sorbent is prepared in-flight by reacting a base sorbent (carbon, non-carbon or their combination) and a promoter within a pneumatic transport line from which the reaction product is injected to the mercury-containing flue gas stream." EX1013, 5:43–48. Olson-235 also discloses addition of an alkali, secondary component or mercury-stabilizing reagent to the flue gas to "increase reactivity and mercury capacity." *Id.*, 3:25-35; 4:39-52; 17:5-45.

Olson-235 describes that "promoted sorbent … is injected into contaminated flue gas stream 15." EX1013, 14:30-32, Figure 3. The sorbent of the promoted sorbent can be a "pyrolysis char." *Id.*, 10:51-59.

Olson-235 describes "collecting greater than 70 wt % of the mercury in the flue gas on the promoted sorbent to produce a cleaned flue gas." EX1013, 3:25–32, 5:30–36, 7:52–58, 10:51–59.

Olson-235 describes "continuous measurement of mercury emissions as feedback to assist in control of the sorbent injection rate." EX1013, 20:1-11, 14:20–29. Olson-235 discloses that "the rate at which the promoter is added and the rate of promoted sorbent injection are determined by a digital computer based, at least in part, on the monitored mercury content of the cleaned flue gas." EX1013, 6:15-31. EX1002, ¶¶ 201-207.

X. OBVIOUSNESS CONSIDERATIONS

A. Reasons to Combine

A POSITA would have been motivated to combine Downs/Altman or Downs/Altman/Nelson (Ground 2), Vosteen/Altman or Vosteen/Altman/Nelson (Ground 3), or Blankinship/Vosteen or Blankinship/Olson-235 (Ground 5) with reasonable expectation of success, because all of these references are directed towards the same goal (removing mercury from coal-combustion flue gases) and are directed to using known techniques to improve similar devices. More particularly, these references (i) add a promoter to coal or a combustion chamber and thus to combust coal, pyrolysis char and a promoter (Downs, Vosteen or Blankinship) to oxidize mercury and (ii) add (Vosteen) or inject (Downs, Blankinship, Altman, Nelson, Olson-235) sorbent post-combustion to adsorb the mercury and use a particulate control device (*i.e.*, an ESP) to collect the sorbent containing the mercury and remove it from the cleaned gas. It follows that these references are analogous art to the '225 Patent, in the same field of endeavor, and reasonably pertinent to the problems the inventors faced. EX1002, ¶¶ 298-303, 383-390, 644-651.

1. Downs/Altman or Vosteen/Altman

Downs discloses using a PAC "sorbent injection system" and states that many "studies have focused on the injection of a carbonaceous sorbent (*e.g.*, powdered activated carbon, or PAC) into the flue gas .... The sorbent, and its burden of adsorbed mercury, are subsequently removed from the flue gases in a downstream particulate collector." EX1004, [0004], [0025], claims 15–16.

Vosteen suggests using wet scrubbers, dry systems or both as known in the art. EX1011, [0017]. Vosteen describes wet scrubbing "performed, for example, in … a packed-bed scrubber" without indicating what packing was used in the packed-bed. *Id.*

A POSITA had reason to select Altman's wet flue gas emissions system (including tower 24 having chamber 34 and wet ESP 51) as Downs' PAC sorbent injection system or to substitute Altman's emissions system for Vosteen's packed bed wet scrubber because: (i) Altman's tower ensures "there is sufficient activated carbon mercury adsorption capacity at reasonable adsorption injection rates" to achieve "optimal mercury sorption" in a flue gas residence time of only 1 to 20 seconds; (ii) Altman discloses that activated carbon sorbent injection into flue gas entering a wet scrubber avoids the disadvantages of high pressure drop and sorbent regeneration associated with Vosteen's packed-bed wet scrubber; (iii) Downs describes its process as enhancing mercury removal in conventional particulate collectors 26 such as ESPs and in a PAC injection process due to "higher reactivity of oxidized mercury with PAC;" (iv) Downs and Altman disclose that activated carbon injection into flue gas was known for mercury removal by 1997; and (v) Altman's wet ESP captures sorbent particles for recycling or disposal. EX1007, 1:23–40, 2:23–31, 4:62–5:17, 59–61; EX1004, [0004], [0016]; EX1005, [0005], [0019]. EX1002, ¶¶ 317-321, 353-359.

A POSITA had reason to combine Downs or Vosteen with Altman with reasonable expectation of success because Altman describes activated carbon injection (ACI) into flue gas from a coal-fired combustion system having an ESP particulate control device as suggested by Downs or Vosteen. The combination represents prior art elements according to known ACI methods to yield predictable results in removing mercury. *See* § IX.B regarding Altman. EX1002, ¶¶ 317, 360.

2. Downs/Altman/Nelson or Vosteen/Altman/Nelson or Blankinship/Olson-235

Regarding ‘225 Patent claim 22, a POSITA had reason to substitute Nelson’s brominated-activated carbon sorbent for Altman’s activated carbon sorbent in the Vosteen/Altman or Downs/Altman process, or Olson-235’s brominated-activated carbon sorbent for Blankinship’s activated carbon sorbent, with a reasonable expectation of success because Nelson indicates that exposure of sorbent to Br_2 or HBr gas “significantly increases the carbonaceous materials ability to remove mercury species” and Olson-235 states that it “increases the surface reactivity toward mercury.” EX1008, [0041]; EX1009, 4; EX1013, 11:50-52. A POSITA would have known that this approach would have increased overall mercury capture. EX1002, ¶¶ 322, 354, 612-613. For example, mercury vapors were removed in the 1930s by injecting halogen-impregnated activated-carbon sorbents into a mercury-containing flue gas. EX1041, 1:33–41.

3. Blankinship/Vosteen

Vosteen discloses “mercury content of the flue gas … is measured continuously … and on the basis of the measured mercury content the amount of bromine fed and/or bromine compounds . . . is controlled.” EX1011, [0022], claim 10. If mercury is removed incompletely, additional bromine compound is fed. *Id.* Vosteen adds Br_2, HBr, and bromide compounds (*e.g.*, NaBr) to the combustion chamber and/or to the coal upstream of the combustion chamber as discussed in § XI.B.2.

A POSITA would have considered it obvious to optimize the amount of bromine additive in Blankinship since Vosteen describes this variable as affecting mercury removal from a flue gas. EX1011, [0022]; EX1007, 17, 20, Table 2, Figures 5-6. EX1002, ¶¶ 606-611.

B. Simultaneous Invention

"Independently made, simultaneous inventions, made within a comparatively short space of time, are persuasive evidence that the claimed apparatus was the product only of ordinary mechanical or engineering skill." *Geo. M. Martin Co. v. Alliance Mach. Sys. Int'l LLC,* 618 F.3d 1294, 1305 (Fed. Cir. 2010). *See also Medtronic, Inc. v. Teleflex Innov. SARL*, 70 F.4th 1331, 1339-40 (Fed. Cir. 2023) ("a competitor's independent and contemporaneous development of a similar product may, in some cases, even suggest the patented product *would* have been obvious."). Notably, simultaneous invention(s) need not be prior to the purported '225 Patent invention date to be pertinent to the obviousness determination. *Trustees of Columbia Univ. v. Illumina*, 620 Fed.Appx 916, 920 (Fed. Cir. 2015).

In the Iowa MDL, PO emphasized that the '517 Patent (as well as each of the other patents asserted in the lawsuits) is directed to a straightforward two-step mercury capture process: (1) apply a halogen, and more specifically bromine, to coal and/or the combustion chamber; and (2) inject activated carbon into the flue gas as a sorbent. EX1077, 4-5. But this two-step process was developed, tested, and implemented by many others at the time of the alleged invention. Such simultaneous invention is further evidence that the Challenged Claims would have been obvious to a POSITA. EX1002, ¶¶ 655-662.

For example, Downs used such a two-step process before the Provisional filing date. *See* § IX.A. Alstom also developed a bromine-promotor added to coal or the combustion chamber for mercury control by 2004 that sold as KNX™. ADA-ES performed testing by the third quarter of 2004 under a Department of Energy Cooperative Agreement wherein Alstom's KNX product was applied to coal at Sunflower Electric's Holcomb Station and "enhance[d] the performance of standard activated carbon," achieving "[m]ercury removal of 86%." EX1063, 3, 25. Similar tests were also performed by ADA-ES in the fourth quarter of 2004 at Union Electric's Meramec Station using Alstom's KNX as a coal additive in combination with activated carbon. EX1064, 8, 21. Similar processes were also tested by EPRI and others at Texas Genaco's Limestone Electric Generating Station combusting lignite coal with injection of calcium bromide into the boiler and an ESP for particulate reduction and 81% mercury removal. EX1057, 12. These stations were in commercial operation supplying electricity to customers during the testing.

XI. INDEPENDENT CLAIMS 1, 14 AND 17 ARE UNPATENTABLE AS ANTICIPATED OR OBVIOUS

This section addresses each limitation of claims 1, 14 and 17 together since the independent claims are nearly the same.

A. Element 1(Preamble), 14(Preamble), 17 (Preamble) – "A method for treating a mercury-containing gas, the method comprising:"

1. Ground 1 – Downs

Downs discloses processes for removing mercury from flue gas by adsorbing the mercury with PAC sorbent and separating the sorbent from the flue gas via particulate collectors. EX1004, [0007], [0018]; EX1005, [0009], [0021]; EX1002, ¶¶ 211-215, 278-282, 300-304.

2. Ground 2 – Downs/Altman

See § XI.A.1. Altman discloses processes for removing/separating mercury from flue gas. EX1007, Abstract; EX1002, ¶ 324.

3. Ground 3 – Vosteen/Altman

See § XI.A.2 regarding Altman. Vosteen discloses processes for removing/separating mercury from flue gas. EX1011, Abstract. EX1002, ¶¶ 361-365, 448-453, 473-478.

4. Ground 4 –Blankinship

Blankinship discloses a process for removing 80–90% of mercury from a coal combustion flue gas. EX1012, 58. EX1002, ¶¶ 496-500, 564-569, 587-592.

5. Ground 5 – Blankinship/Vosteen

See §§ XI.A.3–XI.A.4 regarding Blankinship and Vosteen. EX1012, ¶ 610.

B. Element 1(a), 17(a) – "combusting a mixture comprising coal, pyrolysis char, and an additive comprising HBr, a bromide compound, or a combination thereof, to form the mercury-containing gas; and"

Element 14(a) – "combusting coal in a combustor comprising pyrolysis char and an additive comprising HBr, a bromide compound, or a combination thereof, to form the mercury-containing gas; and"

Pyrolysis char is necessarily present when coal is combusted to form a mercury-containing flue gas. EX1087, 673 ("pyrolysis, even under the most favorable conditions, includes the formation of … residual char"). Thus, a mixture of coal and pyrolysis char is present during power plant coal combustion processes. EX1002, ¶ 74.

1. Grounds 1–2 – Downs, Downs/Altman

Downs reports adding alkali metal or alkaline earth metal bromides (*i.e.*, bromide compounds), HBr or Br_2 as the bromine-containing reagent 10 that is premixed with the incoming coal 16. Downs also discloses calcium bromide injected into the combustion chamber through a coal burner. EX1004, [0002], [0007], [0011], [0021]; EX1005, [0003], [0009], [0018], [0021]; EX1002, ¶¶ 216-223, 283-288, 305-310.

2. Ground 3 – Vosteen/Altman

Vosteen discloses a "coal-fired power station, including a "combustion chamber." EX1011, [0005]. Vosteen further discloses "addition of bromine or bromine compounds to the furnace causes . . . a substantial, essentially complete, oxidation of the mercury and therefore allows substantial removal of the mercury from flue gases." EX1011, [0007]. Vosteen adds Br_2, HBr, and bromide compounds (*e.g.*, NaBr) to the combustion chamber and/or to the coal upstream of the combustion chamber:

> The invention relates to a process for removing mercury from flue gases of … power stations …, in which **bromine and/or a bromine compound and/or a mixture of various bromine compounds** is fed to the appropriate multistage furnace….
>
> [A]n aqueous solution of **hydrogen bromide** [HBr] or an alkali metal bromide, in particular sodium bromide [NaBr], or an aqueous solution of the alkali metal bromide is used.…
>
> The bromine compound, … can be added … **to the … coal or the like to be burnt, upstream of the furnace**…. **The compound can also be fed during the combustion process** … [or] after the combustion…

EX1011, [0006], [0009], [0013] (emphasis added). EX1002, ¶¶ 366-370, 454-461, 479-488.

3. Ground 4 – Blankinship

Blankinship discloses "Alstom is attacking Hg from two different approaches that, in some cases, might be used simultaneously." EX1012, 58. Blankinship explains Alstom's KNX™ calcium bromide solution "can be added to the boiler or to the coal to oxidize the mercury and facilitate its capture in wet scrubbers" or in electrostatic precipitators (ESPs). EX1012, 56, 58. Calcium bromide is a "bromide compound" because it is "a substance composed of atoms or ions of two or more elements in chemical combination" in which "constituents are united by bonds or valence forces." EX1015, 291. *See* § XI.B.2 regarding Julien. Thus, HBr is in vapor or gaseous form in the flue gas post-combustion. EX1002, ¶¶ 501-506, 570-575, 593-599.

4. Ground 5 – Blankinship/Vosteen

See §§ XI.B.2–XI.B.3 regarding Vosteen and Blankinship. EX1002, ¶ 620.

C. Element 1(b), 14(b), 17(b) – "adding a [particulate-Cl. 1(b), 14(b)] sorbent material comprising activated carbon into the mercury-containing gas."

1. Ground 1 – Downs

Downs discloses using a PAC sorbent injection system to remove mercury from coal combustion flue gas downstream from the combustion chamber via particulate collectors such as ESPs. EX1004, [0004], [0015]; EX1005, [0005], [0018]. EX1002, ¶¶ 224-229, 289-294, 311-315. Further, the "increased fraction of oxidized mercury" resulting from bromine addition "enhances the removal of mercury across a PAC injection process, due to the higher reactivity of oxidized mercury with PAC." EX1004, [0015]–[0016], EX1005, [0018]. Downs describes "injection of a carbonaceous sorbent (*e.g.*, powdered activated carbon, or PAC) into the flue gas … to adsorb vapor-phase mercury" and that the "sorbent, and its burden of adsorbed mercury, are subsequently removed from the flue gases in a downstream particulate collector." EX1004, [0004]; EX1005, [0005].

2. Ground 2 – Downs/Altman

See § XI.C.1 regarding Downs. Altman describes injecting PAC into flue gas to remove elemental and oxidized mercury using an ESP. EX1007, 1:30–2:46; 4:53–61, 5:6-12, 50–61. EX1002, ¶ 327.

3. Ground 3 – Vosteen/Altman

See § XI.C.2 regarding Altman. Vosteen discloses "removal of mercury from the flue gases in a flue gas emission control system downstream of the combustion" EX1011, [0007]. One sorbent disclosed by Vosteen is "finely pulverulent slaked lime/activated carbon." *Id.*, [0019]. The mercury/sorbent composition is separated from the flue gas in an ESP. *Id.*, [0019], [0047]–[0049]. EX1002, ¶¶ 371-376, 462-467, 489-494.

4. Ground 4 – Blankinship

Blankinship discloses that KNX can be "applied in combination with another mercury control technology such as our Mer-Cure post-combustion technology or activated carbon injection." EX1012, 58. Blankinship reports "[t]here are many cases where the combination of the two work very effectively together" because the "KNX applied to the coal provides better oxidation of the mercury at a lower cost that brominated sorbents, allowing the Mer-Cure system further downstream to capture the mercury more efficiently." EX1012, 58. The Mer-Cure system "inject[s] the activated carbon into the duct work." *Id.*

Blankinship further reports mercury removal of 80–90% for the Alstom process. EX1012, 58. A POSITA would understand that the activated carbon sorbent in the Mer-Cure system collected the mercury from the flue gas. EX1002, ¶¶ 507-512, 576-581, 600-604.

Blankinship describes using Alstom's KNX process of calcium bromide addition "to the boiler or to the coal" and "injecting activated carbon upstream of the [flue gas desulfurization] FGD to improve its mercury capture performance even more. Power plants without an FGD would likely use sorbent injection, mostly an activated carbon, upstream of a particulate control device." EX1012, 56. A POSITA would have known that a particulate control device separates and removes the sorbent from the flue gas. EX1002, ¶ 44.

5. Ground 5 – Blankinship/Vosteen

See §§ XI.C.3–XI.C.4 regarding Vosteen and Blankinship. EX1002, ¶ 621.

XII. DEPENDENT CLAIMS ARE UNPATENTABLE

Claim 15 depends from claim 14. All other dependent claims depend from claim 1 unless specified.

A. Claims 2, 15–"the pyrolysis char is a promoted pyrolysis char."

According to PO's expert in the Delaware litigation, "pyrolysis char forms in the presence of bromine that has been added to the coal. Thus, it is promoted pyrolysis char." EX1083, 163; EX1002, ¶¶ 230-231, 295-296, 377-378, 468-469, 513-514, 582-583, 622.

B. Claim 5– "using a particle separation device to remove mercury from the flue gas and comprising collecting greater than 70 wt % of the mercury in the mercury-containing gas to produce a cleaned gas."

1. Ground 1 – Downs

Downs' Figure 3 reports reducing vapor-phase mercury of flue gas by 77% from 9 μg/dscm mercury at fabric filter (FF)-inlet to 2 μg/dscm mercury at FF-outlet:

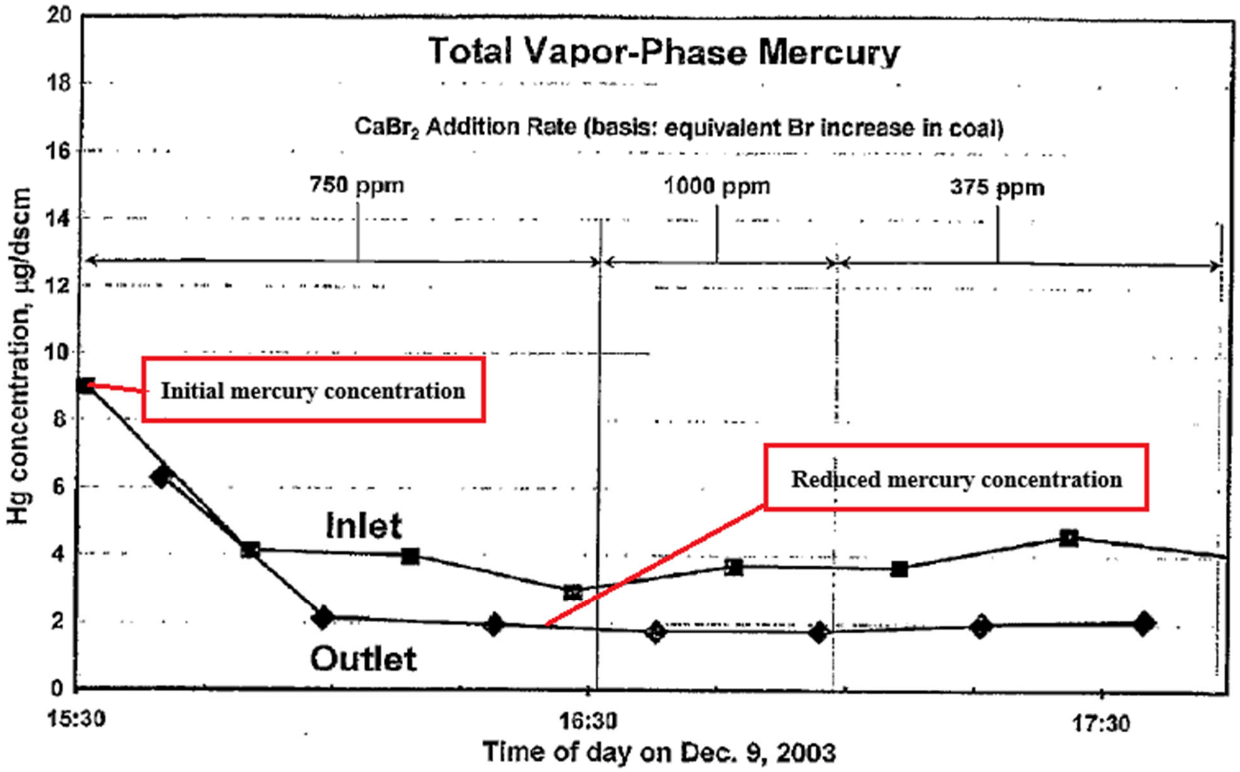


FIG. 3

EX1004, Figure 3, [0018]; EX1005, Figure 3, [0021] (red annotations added). Downs describes "an increased-fraction of particulate-bound mercury" that enhances removal across particulate collectors such as FFs and ESPs. EX1004, [0015]; EX1005, [0018]. EX1002, ¶¶ 232-239.

2. Ground 2 – Downs/Altman

See § XII.B.1 regarding Downs. Altman describes 90% mercury removal using “an appropriate sorbent” and a wet ESP as a particulate control device to collect sorbent EX1007, 2:14-22, 5:27–29. A POSITA would have reasonably expected that the Downs/Altman combination of bromide and sorbent treatments would achieve greater than 70% mercury removal by the sorbent due to bromide’s ability to increase oxidized mercury and “higher reactivity of oxidized mercury with PAC.” EX1004, [0016]; EX1005, [0019]; EX1002, ¶ 328.

3. Ground 3 – Vosteen/Altman

See § XII.B.2 regarding Altman. Vosteen reports mercury removal greater than 70 wt.% in that flue gas Hg_{met} content was about 40 wt.% and was reduced to 10 wt.% at time 10:30 using a flue gas emissions control system. EX1011, Figure 8, [0017], [0049], Figure 5, [0042], [0015], [0037]. A POSITA would have reasonably expected that the Vosteen/Altman combination of bromide and sorbent treatments would achieve greater than 70% mercury removal by the sorbent due to bromide’s ability to increase oxidized mercury and “higher reactivity of oxidized mercury with PAC.” EX1002, ¶¶ 379-392.

4. Ground 4 – Blankinship

Blankinship reports mercury removal of 80–90% for the Alstom process, and that the sorbent absorbs the mercury. EX1012, 58. A POSITA would have understood that the activated carbon sorbent of the Mer-Cure system collected the mercury from the flue gas, and that the Mer-Cure system includes a particulate control device. EX1002, ¶¶ 515-521.

5. Ground 5 – Blankinship/Vosteen

See §§ XII.B.3–XII.B.4 regarding Vosteen and Blankinship. EX1002, ¶ 623.

C. Claim 6—"measuring the mercury content of the mercury-containing gas; and modifying, in response to the measured mercury content: an injection rate of injecting the sorbent into the mercury-containing gas, an amount of the additive in the mixture, or a combination thereof."

Claim 24—"the measurement of the mercury content of the mercury-containing gas comprises continuous measurement."

Claim 18—"modifying, in response to a measured mercury content, an injection rate of injecting the sorbent into the mercury-containing gas, an amount of the additive in the mixture, or a combination thereof."

Claim 24 depends from claim 6, which depends from claim 5.

See § VII.C.3 regarding EPA Rules. It thus would have been obvious to a POSITA that the mercury content of the cleaned gas must be measured and must be maintained at a desired level—*e.g.,* 70% removal. EX1002, ¶ 48.

1. Ground 2 – Downs/Altman

Downs describes use of an "on-line mercury analyzer" to detect "vapor-phase mercury species." EX1004, [0018]; EX1005, [0021]. Downs measured vapor-phase mercury in flue gas and applied amounts of calcium bromide to the coal from 750 ppm to 1,000 ppm to 375 ppm in testing. EX1004, Figure 3; EX1005, Figure 3.

Altman describes achieving "optimal mercury sorption" and ensuring there is "sufficient activated carbon mercury adsorption capacity at reasonable adsorption injection rates." EX1007, 4:62-5:5. Adjusting sorbent injection rates based on measured mercury content of a flue gas was known to a POSITA by at least 1995, as evidenced by EX1082, Abstract ("By adjusting … the absorbent a permanent high Hg removal is achieved."), 6:42-46 (The amount of … activated carbon … may be adjusted also on basis of the Hg content of the treated gas measured by means of a device 18 arranged in the duct 9.")

A POSITA would have known that by 2004 the EPA put the industry on notice of requiring 70% mercury removal, including EPA's Clean Air Mercury Rule (CAMR). EX1045. It would have been obvious to a POSITA that any mercury control system would have to comply with these laws and regulations.

A POSITA would have considered it obvious to optimize the sorbent injection rate in Altman and/or the amount of bromine additive in Downs since both variables affect mercury removal from a flue gas. EX1004, [0018], Figure 3; EX1005, [0021],

Figure 3; EX1007, 4:62-5:5. A POSITA would have continuously monitored mercury content and would have considered it obvious to optimize the sorbent injection rate as shown by Altman and Felsvang and/or the amount of bromine additive added to the coal as shown by Downs since both variables affect mercury removal from a flue gas. EX1002, ¶¶ 335-340.

2. Ground 3 – Vosteen/Altman

See § XI.C.1 regarding Altman. Vosteen discloses "mercury content of the flue gas, in particular the content of metallic mercury, is measured continuously . . . and on the basis of the measured mercury content the amount of bromine fed and/or bromine compounds . . . is controlled." EX1011, [0022], claim 10. If mercury is removed incompletely, additional bromine compound is fed. *Id.* Vosteen adds Br_2, HBr, and bromide compounds (*e.g.*, NaBr) to the combustion chamber and/or to the coal upstream of the combustion chamber as discussed in § XI.B.2.

A POSITA would have considered it obvious to optimize the sorbent injection rate in Altman and/or the amount of bromine additive in Vosteen since both variables affect mercury removal from a flue gas. EX1011, [0022]; EX1007, 17, 20, Table 2, Figures 5-6. EX1002, ¶¶ 393-400.

3. Ground 5 – Blankinship/Vosteen or Blankinship/ Olson-235

See § XI.C.2 regarding Vosteen. EX1002, ¶¶ 633-639.

Olson-235 describes "continuous measurement of mercury emissions as feedback to assist in control of the sorbent injection rate. Tighter control on the sorbent … will ensure mercury removal requirements are met with minimal material requirements, thus minimizing the associated costs." EX1013, 20:1-11, 14:20–29. Olson-235 discloses that "the rate at which the promoter is added and the rate of promoted sorbent injection are determined by a digital computer based, at least in part, on the monitored mercury content of the cleaned flue gas." EX1013, 6:15-31. Thus, Olson-235 measures the mercury content of the mercury-containing clean flue gas and modifies the injection rate of promoter into the combustor and/or sorbent injection in response to the measured mercury content.

D. Claim 8 – "the sorbent material is chosen from powdered activated carbon, granular activated carbon, carbon black, carbon fiber, aerogel carbon, pyrolysis char, and combinations thereof."

1. Ground 1 – Downs

Downs discloses using a PAC sorbent injection system. EX1004, [0004], [0015]–[0016], claims 15–16; EX1005, [0005], [0018]. EX1002, ¶¶ 242-243.

2. Ground 2 – Downs/Altman

See § XII.D.1. Altman discloses that the activated carbon sorbents can be "particles." EX1007, 5:59-61. EX1002, ¶ 404.

3. Ground 3 – Vosteen/Altman

See § XII.D.2 regarding Altman. Vosteen describes granulated or pulverant activated carbon in its flue gas emission control systems. EX1011, [0019]; EX1002, ¶¶ 403-405.

4. Ground 4 – Blankinship

Blankinship discloses that the Mer-Cure system differs from other post-combustion activated carbon sorbent systems because it "has an on line processor that keeps the resulting material from sticking together and de-agglomerates it to create smaller particle sizes and greater surface area." EX1012, 58. Thus, small activated carbon particles are powdered or granular. Blankinship explains that "[t]here are also variations of sorbent injection that provide ways to introduce activated carbon into flu[e] gas. … There are also ways to agglomerate the carbon or grind it finer on site to achieve better mass transfer." EX1012, 56; EX1002, ¶¶ 522-525.

5. Ground 5 – Blankinship/Vosteen

See §§ XII.D.3–XII.D.4 regarding Vosteen and Blankinship. EX1002, ¶ 624.

E. Claim 9 – "adding an alkaline component to the mercury-containing gas, the alkaline component chosen from alkali elements, alkaline earth elements, alkali salts, alkaline earth salts, and combinations thereof."

1. Ground 2 – Downs/Altman or Downs/Altman/Nelson

Altman discloses that "additional sorbent such as hydrated lime is injected into the flue gas upstream of chamber 34." EX1007, 5:50–54. Nelson describes injecting calcium hydroxide sorbent into flue gas with the PAC sorbent. EX1008, [0064]; EX1009, 3; EX1002, ¶¶ 341-344.

2. Ground 3 – Vosteen/Altman or Vosteen/Altman/Nelson

See § XII.E.1 regarding Altman and Nelson. Vosteen discloses using "lime" and "slaked lime" in its dry emission control system, including by mixing lime with activated carbon. EX1011, [0019]. Lime contains calcium oxide, CaO, and slaked lime contains calcium hydroxide, $Ca(OH)_2$, which are alkaline compounds and alkaline earth salts. EX1016, 33, 196, 671-672. EX1002, ¶¶ 406-410.

3. Ground 5 – Blankinship/Vosteen

See § XII.E.2 regarding Vosteen. Blankinship discloses that non-carbon sorbents "show some promise" and "are designed to be tolerant to higher temperatures." EX1012, 58. EX1002, ¶¶ 643-646.

F. Claim 10–"contacting the sorbent material with a mercury-stabilizing reagent chosen from S, Se, H_2S, SO_2, H_2Se, SeO_2, CS_2, P_2S_5, and combinations thereof."

1. Ground 3 – Vosteen/Altman

Vosteen describes the "addition of a bromine compound and if appropriate a sulphur compound … to the flue gas in a plant section downstream of the furnace." EX1011, [0013]. Sulphur dioxide is present in the flue gas. *Id.*, [0010]. Vosteen states that "bromine compounds oxidize mercury more effectively under the given conditions of high-temperature processes, such as temperature and in particular also at a high sulphur dioxide concentration." *Id.*, [0016]. The sulfur dioxide in the flue gas would contact the sorbent in the flue gas before both are removed in downstream desulfurization and particulate removal devices. EX1002, ¶¶ 411-412.

2. Ground 5 – Blankinship/Vosteen or Blankinship/Olson-235

See § XII.F.1 regarding Vosteen. Olson-235 describes a method "whereby a mercury stabilizing reagent is added to a promoted sorbent … stabilizing reagent(s) may be sequentially added, either before or after the addition and reaction of the halogen/halide…. The halogen/halide preferably comprises Br or HBr, and the mercury-stabilizing reagent may comprise S, Se, H_2S, SO_2, H_2Se, SeO_2, CS_2, P_2S_5, and combinations thereof." EX1013, 15:56-63. EX1002, ¶¶ 647-649.

G. Claim 11–“further comprising contacting the sorbent material with a secondary component chosen from halogens, hydrogen halides, Group V halides, Group VI halides, and combinations thereof.”

Claim 12–“the secondary component is chosen from halogens, halide salts, HI, HBr, HCl, and combinations thereof.”

Claim 13–“the secondary component is chosen from I_2, HI, and combinations thereof.”

Claims 12-13 depend from claim 11.

1. Grounds 1–2 – Downs, Downs/Altman

Regarding claims 11-12, Julien discloses that “94-99% of the chlorine in coal is volatilized and emitted as gaseous HCl during pulverized firing.” EX1014, 165; EX1072, 199 (Table 1). Thus, coal-fired power plant flue gas necessarily contains HCl that would contact the sorbent. EX1002, ¶¶ 244-245, 345-346.

2. Ground 3 – Vosteen/Altman

See § XII.G.1 regarding Julien. Regarding claims 11-12, Vosteen describes the “addition of a bromine compound … to the flue gas in a plant section downstream of the furnace.” EX1011, [0013]. The bromine compound can be “an aqueous solution of hydrogen bromide or sodium bromide.” *Id.*, [0014].

Regarding claims 11-13, Vosteen also discloses that “[i]odine compounds oxidize mercury more effectively compared with bromine compounds…. The iodine compound can be fed … as a supplement to, or partial replacement of, the added bromine compound." *Id.*, [0016]. The iodine compound can be iodine (I_2). *Id.*, claim 6.

The HBr or I_2 added by Vosteen to the flue gas would contact the sorbent in the flue gas before the sorbent is removed in a particulate removal device such as an ESP. EX1002, ¶¶ 413-416.

3. Ground 4 – Anticipation – Blankinship

See § XII.G.1 regarding Julien regarding claims 11-12. EX1002, ¶¶ 526-527.

4. Ground 5 – Blankinship/Vosteen and Blankinship/Olson-235

See §§ XII.G.1 and XII.G.2 regarding Julien and Vosteen for claims 11-13. EX1002, ¶¶ 650-654.

H. Claim 19 – "the coal comprises added sorbent enhancement additive that comprises the bromide compound."

The '225 Patent does not define "sorbent enhancement additive."

1. Grounds 1–2 – Downs, Downs/Altman

Downs reports adding bromide compounds, HBr or Br_2 as the bromine-containing reagent 10 that is premixed with incoming coal 16. EX1004, [0015], [0021]; EX1005, [0018], [0024]. Downs also discloses calcium bromide injected into the combustion chamber through a coal burner. EX1004, [0018]; EX1005, [0021]; EX1002, ¶¶ 246-251.

2. Ground 3 – Vosteen/Altman

Vosteen discloses that "bromine compound, for example, sodium bromide, can be added in solid form, for example as salt, or liquid form, for example as aqueous solution, to the waste mixture, coal or the like to be burnt, upstream of the furnace. The addition can also be made to a plant section upstream of the furnace, for example ... to a coal mill…. The compound can also be fed during the combustion process…. [or] after the combustion, for example in a downstream waste-heat boiler." EX1011, [0013]; EX1002, ¶¶ 417-419.

3. Ground 4 – Anticipation – Blankinship

Blankinship explains that Alstom's KNX™ calcium bromide solution "can be added to the boiler or to the coal to oxidize the mercury and facilitate its capture in wet scrubbers" or in electrostatic precipitators (ESPs). EX1012, 56, 58. Calcium bromide is a "bromide compound" because it is "a substance composed of atoms or ions of two or more elements in chemical combination" in which "constituents are united by bonds or valence forces." EX1015, 291. Since Blankinship discloses mercury removal increasing from 20-30% to 60-80% or 90% with KNX addition, KNX is a halide sorbent enhancement additive. EX1002, ¶¶ 528-534.

4. Ground 5 – Blankinship/Vosteen

See §§ XII.H.2-XII.H.3. EX1002, ¶ 620.

I. Claim 20 – "the coal is combusted in a combustion chamber at a coal-combustion facility, wherein the HBr, bromide compound, or combination thereof, is added to the coal before the coal enters the combustion chamber, wherein the addition of the HBr, bromide compound, or combination thereof, to the coal is performed at the coal-combustion facility."

1. Grounds 1–2 – Downs, Downs/Altman

Downs describes that "coal pulverizers 28 intimately mix the bromide reagent 10 with the coal 16, and the pulverized coal conveying system 30 to the several coal burners (not shown) ensures an even distribution of the reagent 10 across the boiler furnace 14." Downs describes $CaBr_2$ and HBr as bromide reagents. EX1004, [0019], [0021]; EX1005, [0022], [0024]; EX1002, ¶ 252-257.

2. Ground 3 – Vosteen/Altman

Vosteen describes that "bromine compound, for example, sodium bromide, can be added … as aqueous solution, **to the … coal or the like to be burnt, upstream of the furnace**." EX1011, [0013] (emphasis added). EX1002, ¶¶ 420-422.

3. Ground 4 – Anticipation – Blankinship

Alstom's KNX pre-combustion offering applies calcium bromide to the coal prior to combustion to promote mercury oxidation" and that Alstom installs the "equipment used to inject the [KNX] solution. EX1012, 58. EX1002, ¶¶ 535-537.

4. Ground 5 – Blankinship/Vosteen

See §§ XI.I.2-XI.I.3.

J. Claim 22 – "the sorbent is contacted with a halogen or halide promoter prior to the addition of the sorbent to the mercury-containing gas."

1. Ground 2 – Downs/Altman/Nelson

Nelson describes exposing activated carbon sorbent to a bromine-containing gas before the sorbent is mixed with mercury-containing flue gas. EX1008, [0040]; EX1009, 4. A POSITA had reason to substitute Nelson's brominated-activated carbon sorbent for Altman's activated carbon sorbent in the Downs/Altman process because Nelson indicates that exposure of sorbent to Br_2 or HBr gas "significantly increases the carbonaceous materials ability to remove mercury species." EX1008, [0041], Figures 12 & 14; EX1009, 4. A POSITA would have known that this approach would have increased overall mercury capture. EX1002, ¶¶ 347-351. For example, it was known since the 1930s to remove mercury vapors by injecting halogen-impregnated activated-carbon sorbents into a mercury-containing flue gas. EX1049, 1:33–41.

2. Ground 3 – Vosteen/Altman/Nelson

See § XII.J.1 regarding Nelson. A POSITA had reason to substitute Nelson's brominated-activated carbon sorbent for Altman's activated carbon sorbent in the Vosteen/Altman process for the stated reasons. EX1002, ¶¶ 423-426.

3. Grounds 4–5 – Blankinship, Blankinship/Vosteen or Blankinship/Olson-235

Blankinship describes use of a bromine-treated or untreated activated carbon sorbent and indicates that both sorbent types are being "deployed at a number of power plants." EX1012, 56. A brominated sorbent would have been brominated prior to injection of the sorbent to the mercury-containing gas. EX1002, ¶¶ 538-540.

Olson-235 describes contacting a base sorbent 10 with a halogen or halide promoter 20 prior to injection of the sorbent into flue gas 50. EX1013, Figure 1, 10:17-37. EX1002, ¶ 627.

K. Claim 23 – "the sorbent is free of contact with a halogen or halide promoter prior to the addition of the sorbent to the mercury-containing gas."

A POSITA had reason to select halogen-free activated carbon due to its lower cost as compared to halogen-activated carbons especially where sufficient mercury removal can be achieved without resorting to halogen-activated carbons. EX1002, ¶ 260.

1. Ground 1 – Downs

Downs did not characterize the activated carbon sorbent as being pre-brominated or impregnated with halogens prior to injection. EX1004; EX1005; EX1002, ¶¶ 258-261.

2. Ground 2 – Downs/Altman or Downs/Altman/Nelson

See § XII.K.1 regarding Downs. Altman did not characterize the activated carbon sorbent as being pre-brominated or impregnated with halogens prior to injection. EX1007. Nelson tests Norit DARCO FGD, which is not halogen- or halide-promoted. EX1008, Ex. 1; EX1009, 5.

A POSITA had reason to select halogen-free activated carbon due to its lower cost. EX1002, ¶ 329.

3. Ground 3 – Vosteen/Altman or Vosteen/Altman/Nelson

See § XII.K.2 regarding Altman and Nelson. EX1002, ¶¶ 427-430.

4. Grounds 4–5 – Blankinship, Blankinship/Vosteen

Blankinship describes that "activated carbon and brominated activated carbon injection technology are being deployed at a number of power plants." EX1012, 56. EX1002, ¶¶ 541-544.

L. Claims 25–26 – "the coal comprises [subbituminous–cl. 25; lignite–cl. 26] coal."

1. Grounds 1-2 – Downs, Downs/Altman

Downs describes that the coal-fired boiler fuel 16 can be subbituminous or lignite coals. EX1004, [0020]; EX1005, [0023]; EX1002, 262-265.

2. Ground 3 – Vosteen/Altman

Vosteen's process for "removing mercury from flue gases of high-temperature plants" includes "for example bituminous coal-fired or lignite-fired power stations." EX1011, [0008].

A POSITA would have considered the types of coal burned in coal-fired power plants. It would have been obvious to a POSITA to use a subbituminous coal because it is a type of coal used in electricity generation and is intermediate to bituminous and lignite coals in terms of native-halogen content. EX1012, 58; EX1065, iv–viii; EX1002, ¶¶ 431-434.

3. Ground 4 – Blankinship

Blankinship discloses that "Alstom says KNX is most attractive for a client burning sub-bituminous coal" and that "[l]ignite can be a good candidate for the process as well." EX1012, 58. EX1002, ¶¶ 545-551.

4. Ground 5 – Blankinship/Vosteen

See §§ XII.L.2–XII.L.3.

M. Claim 27 – "the mixture is combusted in a combustion chamber of a coal-combustion facility upstream of a scrubber, a particulate control system, or a combination thereof, wherein the particulate sorbent is added to the mercury-containing gas before the mercury-containing gas encounters the scrubber, the particulate control system, or the combination thereof."

Claim 28 – "the particulate control system comprises an electrostatic precipitator, a baghouse, a fabric filter, or a combination thereof."

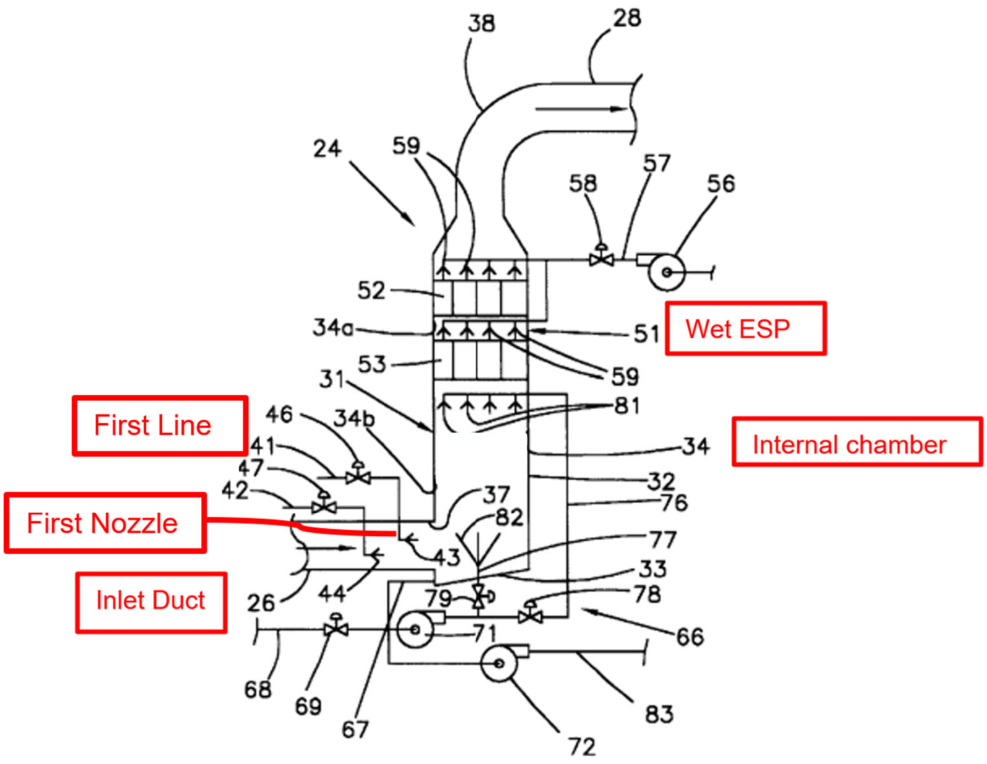
Claim 28 depends from Claim 26, which depends from Claim 1.

1. Ground 1 – Downs

Downs describes a coal-fired electric utility plant configuration comprising a boiler with "sorbent … removed from the flue gases in a downstream particulate collector" 26 such as an ESP or FF, or a wet FGD system 22. EX1004, [0004], [0014]-[0015], [0023], Figures 4–6; EX1005, [0005], [0018], [0026], Figures 4–6. EX1002, ¶¶ 266-272.

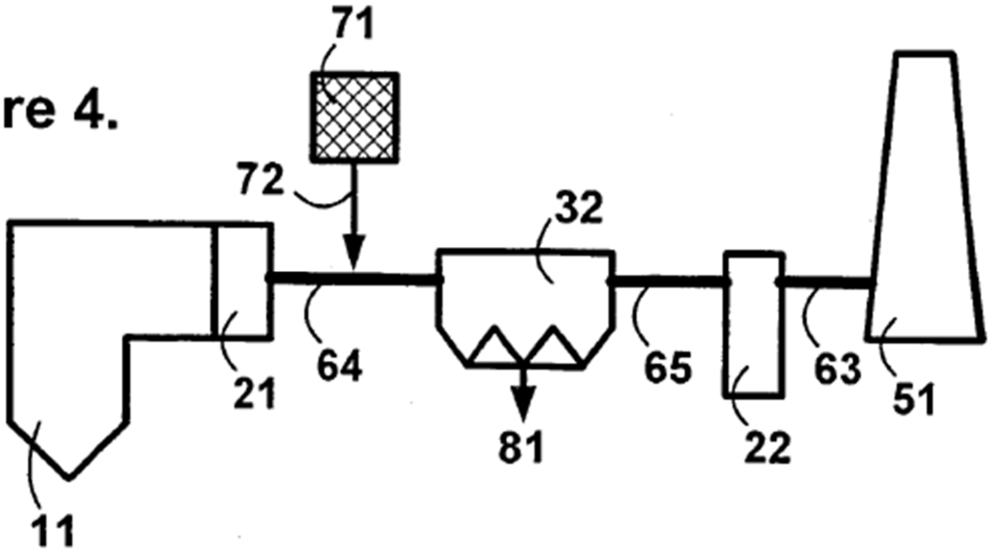
2. Ground 2 – Downs/Altman or Downs/Altman/Nelson

See § XII.M.1 regarding Downs. Altman's Figure 2 depicts coal combustion in boiler 12 and sorbent injection upstream of wet electrostatic precipitator (ESP) 51, which is a "particulate control device" that collects sorbent. EX1007, 3:41-45; 4:17–21, 58–61; 5:27–29; Figure 2; EX1002, ¶¶ 330-331.



Nelson describes combusting coal in boiler 11 and injecting sorbent from bin 71 upstream of ESP 32. EX1008, [0059], [0062], Figure 4.

Figure 4.



3. Ground 3 – Vosteen/Altman or Vosteen/Altman/Nelson

See § XII.M.2. Vosteen describes a "coal-fired power station of Bayer AG in Uerdingen" having "a slag-tap filed boiler [that "are charged with coal"] and a flue gas emission control system typical of a power station." EX1011, [0045], [0047]. Vosteen further discloses "[t]he bromine compound, for example, sodium bromide, can be added in solid form, for example as salt, or liquid form, for example as aqueous solution, to the waste mixture, coal or the like to be burnt, upstream of the furnace." *Id.*, [0013]. A POSITA would understand this disclosure to teach that the bromine compound is added directly to the coal upstream of the furnace before the coal enters the combustion chamber. EX1002, ¶¶ 435-441.

4. Grounds 4–5 – Blankinship

Blankinship discloses that "Alstom's KNX pre-combustion offering applies calcium bromide to the coal prior to combustion to promote mercury oxidation" and that Alstom installs the "equipment used to inject the [KNX] solution." EX1012, 58.

Blankinship discloses that "[p]ower plants without an FGD would likely use sorbent injection, mostly an activated carbon, upstream of a particulate control device. The particulate control can be either the plant's existing device or a compact baghouse installed following the primary particulate control, with sorbent injection between the primary control and the new baghouse." *Id.*, 56.

Blankinship explains that Mer-Cure systems are "targeted primarily to ESP configurations, [but] Alstom has also installed it on wet scrubber applications where the combination of Mer-Cure and KNX worked well." EX1012, 58. EX1002, ¶¶ 552-558, 629.

N. Claim 29 – "the combustion chamber is a coal combustion furnace."

Claim 29 depends from claim 19.

1. Ground 1 – Downs

Downs describes and depicts coal-fired electric utility plants having a combustion furnace. EX1004, [0012]–[0015]; EX1005, [0014]–[0018]; EX1002, ¶¶ 273-274.

2. Ground 2 – Downs/Altman

See § XII.N.1 regarding Downs. Altman discloses that injection of activated carbon into flue gas was known in the art for removing mercury in coal-fired boilers before April 1997. EX1007, 2:24–2:31; EX1002, ¶ 332.

3. Ground 3 – Vosteen/Altman

See § XII.N.2 regarding Altman. Vosteen describes its "process for removing mercury from flue gases of … power stations." EX1011, [0001], [0045]. An example of such a facility is the "coal-fired power station of Bayer AG in Uerdingen" with boilers 91, 91' (also referenced as a furnace). EX1011, [0046]-[0047]. EX1002, ¶ 442-444.

4. Ground 4 – Blankinship

Blankinship describes reducing "mercury emissions from power plants and other industrial facilities." EX1012, 56. The combustion boiler would necessarily include a furnace. *Id.*, 58. EX1002, ¶¶ 559-560.

5. Ground 5 – Blankinship/Vosteen

See §§ XII.N.3–XII.N.4. EX1002, ¶ 630.

XIII. CONCLUSION

Petitioner respectfully requests that the Petition be instituted and that the Challenged Claims be cancelled as unpatentable.

Dated: July 18, 2025

Respectfully submitted,

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CERTIFICATE OF COMPLIANCE

Pursuant to 37 C.F.R. § 42.24(d), the undersigned certifies that the foregoing Petition, exclusive of the exempted portions as provided in 37 C.F.R. § 42.24(a), contains 13,681 words which is no more than 14,000 words and therefore complies with the type-volume limitations of 37 C.F.R. § 42.24(a). The word count was calculated by starting with Microsoft Word's total document word count and subtracting the words for the Table of Contents, the Exhibit List, the Mandatory Notices, the Certificate of Compliance, and the Certificate of Service.

This paper also complies with the typeface requirements of 37 C.F.R. § 42.6(a)(2)(ii) and the type style requirements of 37 C.F.R. § 42.6(a)(2)(iii) and (iv).

Dated: July 18, 2025

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CERTIFICATE OF SERVICE

In accordance with 37 C.F.R. §§ 42.6(e) and 42.105, the undersigned certifies that on July 18, 2025, a complete and entire copy of the PETITION FOR *INTER PARTES* REVIEW (“petition”), Power of Attorney, and related Exhibits were served on Patent Owner at the correspondence address of record for the subject patent,

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via Priority Mail Express or by means at least as fast and reliable as Priority Mail Express.

Further, a courtesy copy was served via electronic mail on the Patent Owner’s counsel at the following addresses:

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