UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Canon U.S.A., Inc., and Canon Inc.

Petitioners

v.

Slingshot Printing LLC,

Patent Owner

Case No. IPR2022-01416

U.S. Patent No. 7,938,523

PETITION FOR *INTER PARTES* REVIEW OF U.S. PATENT NO. 7,938,523 (CLAIMS 1-3, 5-7, 10-12, and 14-16)

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EXHIBIT LIST

Exhibit	***Description***
1001	U.S. Patent No. 7,938,523 B2 to Aldrich
1002	File History of U.S. Patent No. 7,938,523
1003	U.S. Patent No. 6,739,708 B2 to Studer *et al*.
1004	U.S. Patent Application Publication No. 2006/0164471 to Studer
1005	U.S. Patent Application Publication No. 2005/0212878 to Studer
1006	U.S. Patent No. 5,671,001 to Elliot *et al*.
1007	"University Physics", 3rd Ed., by Francis W. Sears and Mark W. Zemansky, Addison-Wesley Co. Publishing, 1963 Chapter 13 Surface Tension, pp. 296-308
1008	Wikipedia, the Free Encyclopedia, "Young–Laplace Equation," at *https://en.wikipedia.org/wiki/Young%E2%80%93Laplace_equation* (last visited Aug. 21, 2022)
1009	Seitz, Mathew, "Durable Hydrophobic Polymer Surfaces" (2020) Thesis. Rochester Institute of Technology
1010	Curriculum Vitae of Dr. Stephen Pond
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I. INTRODUCTION

Pursuant to 35 U.S.C. § 311 and 37 C.F.R. § 42.100 et seq., Petitioners, requests *Inter Partes* Review ("IPR") of claims 1-3, 5-7, 10-12, and 14-16 (the "Challenged Claims") of U.S. Patent No. 7,938,523 ("the '523 patent," Ex. 1001), purportedly owned by Slingshot Printing LLC ("Patent Owner").

II. MANDATORY NOTICES

Real Party-in-Interest: The real parties-in-interest are **Canon U.S.A., Inc.** and **Canon Inc.**

Related Matters: The '523 Patent has been asserted against Petitioner Canon U.S.A., Inc. in *Slingshot Printing LLC v. Canon U.S.A., Inc., et al.*, No. 2:22-cv-00123 (E.D.N.Y.), which was filed on January 7, 2022. The '523 Patent was also asserted against HP Inc. in *Slingshot Printing LLC v. HP Inc.*, No. 6:19-cv-00362 (W.D. Tex.), which was transferred from the Waco Division to the Austin Division in the Western District of Texas and reassigned as case No. 2:20-00184 (W.D. Tex.). The case was dismissed with prejudice on April 1, 2021, following the parties' joint stipulation of dismissal. To the best of Petitioners' knowledge, the '523 Patent has not been asserted against other parties.

Lead Counsel: Dion M. Bregman (Reg. No. 45,645); Back-up Counsel: Amanda S. Williamson (Reg. No. 73,683) and Jason E. Gettleman (Reg. No. 55,202).

Service: Service of any documents may be made on Morgan, Lewis & Bockius LLP, 1400 Page Mill Road, Palo Alto, CA, 94304 (Telephone: 650.843.4000; Fax: 650.843.4001). Petitioners consent to e-mail service at: CanonSlingshotIPRs@morganlewis.com.

III. IDENTIFICATION OF CLAIMS AND GROUNDS

’523 Patent: U.S. Patent No. 7,938,523 titled “Fluid Supply Tank Ventilation for a Micro-Fluid Ejection Head” to Charles S. Aldrich was filed on **June 13, 2007** and has an earliest possible priority date of June 13, 2007. It is subject to the pre-AIA provisions of 35 U.S.C. §§ 102 and 103.

Studer 708: U.S. Patent No. 6,739,708 B2 titled “Fluid Interconnect Port Venting for Capillary Reservoir Fluid Containers, and Methods” (“Studer 708”; Ex. 1003) to Anthony D. Studer, Kevin D. Almen, and David J. Benson was filed on April 30, 2002 and published on **October 30, 2003**. It is prior art under § 102(b).

Studer 471: U.S. Patent Application Publication No. 2006/0164471 A1 (“Studer 471”; Ex. 1004) entitled “Replaceable Ink Supply” to Anthony D. Studer, Kevin D. Almen, David J. Benson, David M. Hagen, and Cary R. Bybee was filed on January 21, 2005 and published on **July 27, 2006**. It is prior art under § 102(a).

Studer 878: U.S. Patent Application Publication No. US 2005/0212878 (“Studer 878”; Ex. 1005) entitled “Fluid Supply Having a Fluid Absorbing Material” to Anthony D. Studer, Kevin D. Almen, David J. Benson, David M. Hagen, and Cary

R. Bybee was filed on March 25, 2004 and published on **September 29, 2005**. It is prior art under §102(b).

Elliot: U.S. Patent No. 5,671,001 ("Elliot) to Joseph R. Elliot, J. Paul Harmon, Naoto Kawamura, and John M. Altendorf entitled "Leak Resistant Ink Containment for a Printer" was filed on March 3, 1995 and issued on **September 23, 1997**. It is prior art under § 102(b).

Petitioners request that the Board find each of the Challenged Claims invalid on the following grounds:

Ground	Prior Art	Statutory Basis	Claims
1	Studer 708	§ 102	1, 3, 5, 10, 12, 14
2	Studer 708	§ 103	1, 3, 5-7, 10, 12, 14-16
3	Studer 708 and Studer 471	§ 103	1-3, 5-7, 10-12, 14-16
4	Studer 708 and Studer 471 in view of Elliot	§ 103	6, 7, 15, 16
5	Studer 708 and Studer 878	§ 103	6, 7, 15, 16

IV. CERTIFICATION AND FEES

Petitioners certify that the '523 Patent is available for IPR and that Petitioners are not barred or estopped from requesting this IPR on the grounds identified herein. Any additional fees may be charged to Deposit Account No. 50,0310 (Order No. 132261-0003).

V. <u>THE BOARD SHOULD NOT EXERCISE ITS DISCRETION TO DENY INSTITUTION UNDER 35 U.S.C. § 314(A)</u>

To the extent Patent Owner argues that the Board should exercise its discretion by denying institution under § 314(a), such arguments would be unavailing.

As of the filing of this Petition, trial has not been set in the district court litigation asserted by Patent Owner against Defendants for the '523 Patent but would occur no earlier than late 2024 based on the parties' Case Management Schedule setting *Daubert* motion replies for October 25, 2024 and trial after that date. Ex. 1012, pg.6. Thus, the Board's deadline to issue a final written decision will predate the trial date in the concurrent litigation, which counsels in favor of declining to deny institution under 35 U.S.C. § 314(a). *Apple Inc. v. Fintiv Inc.*, IPR2020-00019, Paper 11 at 3 (PTAB Mar. 20, 2020) (precedential). The six non-exclusive factors set forth in *Fintiv* further support declining to deny institution under 35 U.S.C. § 314(a). *Id*., 5-6.

A. <u>Whether the Court Granted a Stay or Evidence Exists that One May be Granted if a Proceeding is Instituted</u>

Neither party has requested a stay in the District Court, and it is speculative as to whether a stay would be granted if requested. Staying the corresponding litigation, however, would align with Congressional intent. *IOENGINE, LLC v. PayPal Holdings, Inc.*, Nos. 18-452-WCB; 18-826-WCB, 2019 WL 3943058, at *3-4 (D. Del. Aug. 21, 2019) ("Congress intended for district courts to be liberal in granting stays."); 157 Cong. Rec. S1363 (daily ed. Mar. 8, 2011) (statement of Sen. Schumer) (Congress intended to place "a very heavy thumb on the scale in favor of a stay being granted"); *NFC Tech. LLC v. HTC Am., Inc.,* 2015 WL 1069111, at *7 (E.D. Tex. Mar. 11, 2015) ("[A]fter the PTAB has instituted review proceedings, the parallel district court litigation ordinarily should be stayed.").

Petitioners submit that the Board should decline to speculate how the District Court might rule on a potential stay request. *See Sand Revolution II, LLC v. Continental Intermodal Grp. – Trucking LLC*, IPR2019-01393, Paper 24 at 7 (PTAB June 16, 2020) ("In the absence of specific evidence, we will not attempt to predict how the district court in the related district court litigation will proceed because the court may determine whether or not to stay any individual case, including the related one, based on a variety of circumstances and facts beyond our control and to which the Board is not privy."). As such, this factor is neutral.

B. Proximity of the Court's Trial Date to the Board's Projected Statutory Deadline for a Final Written Decision

The district court case involving the '523 Patent is in its early stage with no trial date yet set. The parties had an Initial Conference with the court on July 5, 2022 during which the court entered the parties' Case Management Schedule. The last set date in the schedule is Reply *Daubert* motions set for October 25, 2024, which means trial cannot occur until after October 25, 2024. Ex. 1012, pg.6. Moreover, the median time to trial in the Eastern District of New York is 48.9 months (~4 years).

As the final written decision must be issued within one year of institution, absent extension of up to six months for good cause, the final written decision will be issued well before any trial date that may occur under the parties' current Case Management Schedule or under the median time to trial in the Eastern District of New York. As such, this factor weighs against discretionary denial.

C. <u>Investment in the Parallel Proceeding by the Court and the Parties</u>

Fact discovery is in the very early stages and expert discovery has not yet begun. Claim construction proceedings are not set to start until April 7, 2023 when the parties exchange a list of disputed terms for construction. Ex. 1012, pg.4.

Under the parties' schedule, by the time of the institution deadline, the Court would not have issued any claim construction rulings and likely would neither have ruled on any dispositive motions nor considered any invalidity issues based on the prior art. Thus, institution would save substantial resources of the parties and the District Court, which could rely upon any PTAB claim constructions while also considering whether a stay is warranted to avoid duplicating efforts. As such, this factor weighs against discretionary denial.

D. <u>Overlap Between Issues Raised in the Petition and in the Parallel Proceeding</u>

Defendants have not yet served their invalidity contentions in the district court litigation because those are not due until October 17, 2022. Ex. 1012, pg.4. The invalidity contentions will include the prior art cited in this Petition. As the Board has noted, when overlap exists between the invalidity issues in the Petition and the district court this "overlap may inure to the district court's benefit, however, by simplifying issues for trial should we reach our determination on the challenges raised in the Petition before trial." *MED-EL v. Sonova AG*, IPR2020-00176, Paper 13 at 15 (PTAB June 3, 2020) (declining to exercise discretion under § 314(a)). Given that the final written decision will issue before the trial date, it is more efficient for the Board to handle any overlapping prior art. As such, this factor weighs against discretionary denial.

E. Whether the Petitioners and the Defendants in the Parallel Proceeding are the Same Party

Petitioner Canon U.S.A., Inc. is a defendant in the parallel district court proceeding. Petitioner Canon Inc. is not a party to the parallel litigation. Although this factor arguably weighs in favor of discretionary denial, this interpretation of the factor has been questioned by the Board. *See Cisco v. Ramot*, IPR2020-00122, Paper 15 at 10 (dissent).[1]

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[1] Canon Solutions America, Inc. in the parallel district court litigation is not a real-party-in interest in this proceeding.

F. Other Circumstances that Impact the Board's Exercise of Discretion, Including the Merits

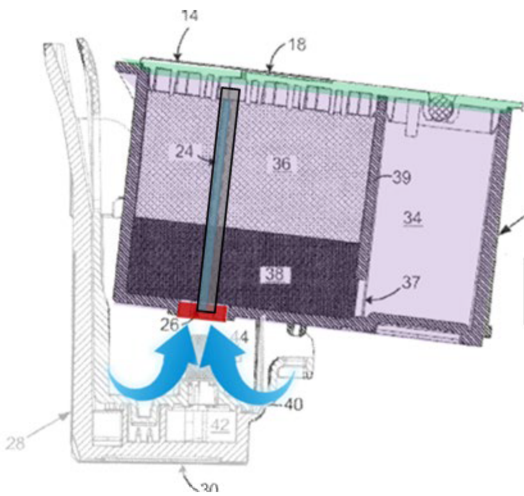
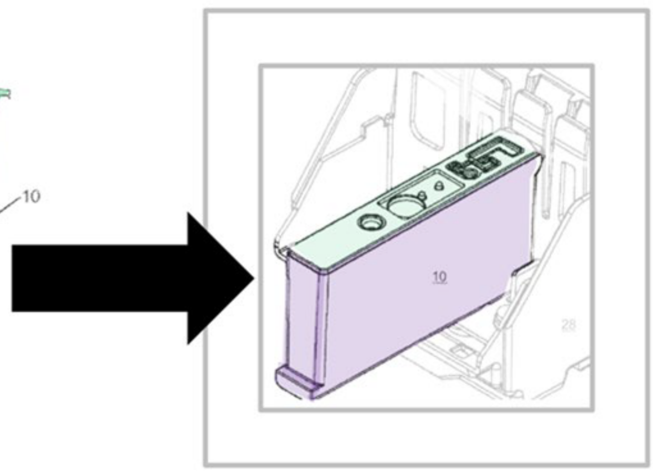
This factor favors institution and is dispositive under the Guidance issued by the USPTO on June 21, 2022 because the unpatentability challenges here are compelling and rely on references that were not before the Office. Additionally, this IPR is the only challenge to the '523 Patent brought before the Board, which favors institution. There is also a strong public interest against "leaving bad patents enforceable," which also favors institution. *Thryv, Inc. v. Click-To-Call Techs., LP*, 140 S. Ct. 1367, 1374 (2020). Finally, given the Board's technically trained judges are well-suited to assess the patentability grounds presented here, it is more efficient for the Board to address the patentability of the '523 Patent. As such, this factor weighs against discretionary denial.

For the foregoing reasons, instituting IPR would be an efficient use of Board resources and provide the most efficient use of judicial resources for overall system efficiency, fairness, and patent quality.

VI. BACKGROUND

A. The '523 Patent

The '523 patent relates to mechanisms and methods for venting replaceable ink cartridges that are separate from and must be installed onto a permanent or semi-permanent printhead that resides inside an inkjet printer as shown below in Figures 5 and 6 (figures haves been colored and annotated throughout this petition unless otherwise indicated). Ex. 1001, 1:20-47, 2:5-23. The ’523 patent explains that “replaceable fluid supply tanks may have or develop a problem of trapping air adjacent to a connection between the fluid supply tank and an ejection head structure.” *Id.*, 1:22-24. This can happen when the ink cartridge is installed in the printer. *Id.*, 1:35-47.

<table>
<tr><th>Figure 6</th><th>Figure 5</th></tr>
<tr><td>
</td><td>
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</table>

During the installation process, air near the exit port 26 (red) enters the cartridge and increases air volume and pressure near the ejection head structure, which can cause ink to seep out of the ink cartridge. Ex. 1001, 1:35-47; Figs. 5 and 6. Similar unwanted ink seepages can occur when the ink cartridge is subjected to changes in atmospheric pressure or temperature that cause expansion or contraction of the air within the cartridge, such as can occur during shipping. *Id.*, 1:21-34. The ’523 patent purports to solve these problems by including an internal vent conduit

24 that connects the exit port 26 (red) with a vent in the cartridge's cover 14 (green), providing a pathway for air to move between them. *Id.*, 2:23-26.

During prosecution, in a First Office Action, the Examiner rejected all claims on prior art grounds. Ex. 1002, 74-79. In response, the applicant amended independent claims 1 and 12 to require "an internal conduit to release air into the atmosphere." *Id.*, 62-66. The Examiner then issued a final rejection of claims 1-3, 6, 7, 12, 13, 15, and 16 on prior art grounds but found dependent claim 4, requiring an "internal vent conduit is in air flow communication with the air space and the cover," allowable if rewritten in independent form. *Id.*, 45, 49-50. Ex. 1002 at 45. Applicants then canceled dependent claims 3 and 4 and incorporated claim 4's limitations in amended, independent claims 1 and 12. *Id.*, 35-38. The Examiner thereafter allowed the claims. *Id.*, 13-18.

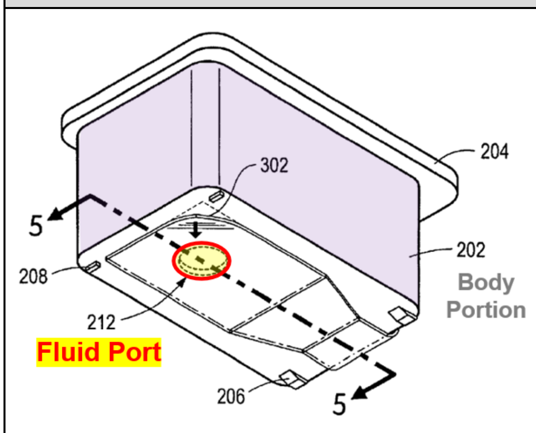
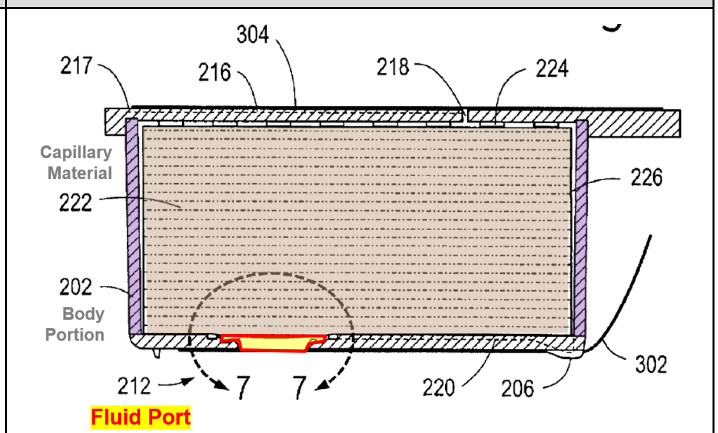
B. <u>The Hewlett Packard Prior Art</u>

1. Studer 708

Studer 708 is a Hewlett-Packard Development Company, L.P. patent that names as inventor Anthony D. Studer, as well as Kevin D. Almen, and David J. Benson. Ex. 1003. Studer 708 was neither cited nor considered by the Examiner during prosecution of the '523 patent.

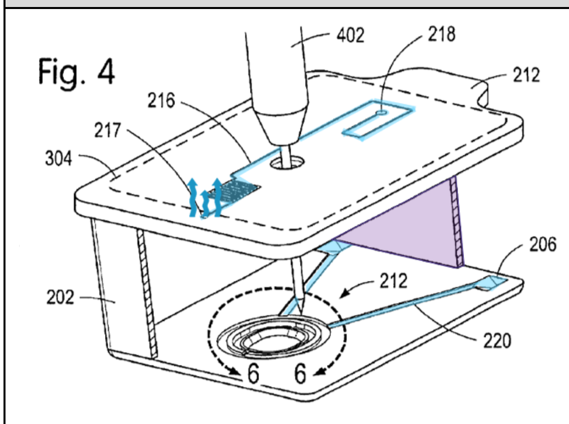
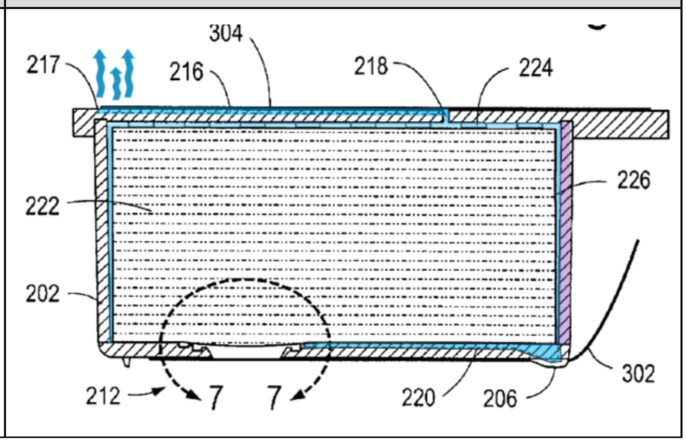
Like the '523 patent, Studer 708 describes mechanisms and methods for venting replaceable ink supply containers. Ex. 1003, Abstract, 7:38-44. According to Studer 708, the "methods of the present invention [] include venting a fluid container to ambient air with a vent located on the upper portion of the container; internally venting the container to channel air from the ambient air vent to an internal location adjacent to the fluid interconnect port; and then restrictedly venting the fluid port." *Id.*, 7:39-44.

Studer 708 teaches that "[o]ne form of replaceable ink jet container comprises a rigid container substantially filled with a capillary foam material, with a fluid interconnect port located at the bottom of the container." Ex. 1003, 1:37-40. "At the time of manufacture and prior to filling the container with ink, the fluid interconnect of the container may be sealed with a sealing tape, which is removed by a consumer prior to installing the ink container in a printer." *Id.*, 1:43-47.

Fig. 3 of Studer 708	**Fig. 5 of Studer 708**
	

Studer 708 explains that a "problem encountered with the use of sealing tape on fluid interconnects in this type of container is that residual ink may be present in the sealed fluid interconnect port, which was either deposited there during the container fill process or was forced out of the capillary material when the container was dropped during shipping and handling.” *Id.*, 1:48-53.

Like the ’523 patent, Studer 708 attempts to solve this problem by incorporating venting mechanisms that allow for atmospheric air to exchange with the area in and around the fluid interconnect port. Ex. 1003, 2:3-7. Studer 708 teaches that a “preferred embodiment of the present invention includes a **vent system** [blue] formed in the container lid (217, 216, 218), as is known in the art; **provisions for allowing air passage around the end of the capillary material; redundant vent paths** (206, 220) formed in the floor of the container **to provide air from the end of the container to the fluid interconnect port region.**” *Id.*, 4:21-27; Fig. 4 and 5.

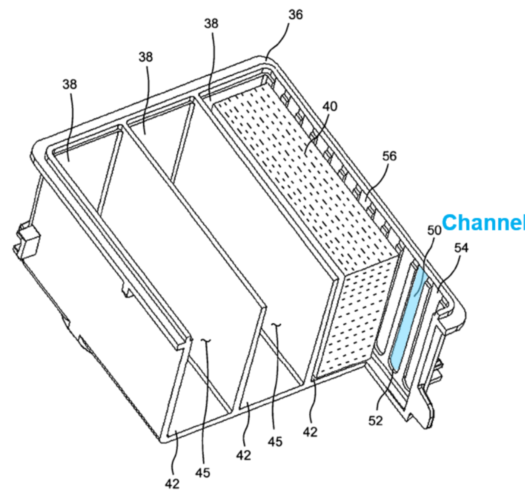
<table>
<tr><th>Studer 708 Fig. 4</th><th>Studer 708 Fig. 5</th></tr>
<tr><td>
</td><td>
</td></tr>
</table>

2. Studer 471

Studer 471 is a Hewlett-Packard Development Company, L.P. patent application publication that, like Studer 708, names as inventor Anthony D. Studer, along with Kevin D. Almen, David J. Benson, David M. Hagen, and Cary R. Bybee. Ex. 1004. Studer 471 was not cited or considered by the Examiner during prosecution of the ’523 patent.

Just like the ’523 patent, Studer 471 describes the design of ink supply cartridges utilizing capillary material, including venting mechanisms used to vent air, relieve pressure buildups, and prevent leakages that can occur when the ink container is exposed to extreme environmental conditions, such as changes in temperature and pressure. Ex. 1004, [0001], [0005]-[0008], [0029]-[0036]. Just like the ’523 patent, Studer 471 teaches the use of “**vent notches or the like that allow the formed air bubble to escape from the cavities**. In this manner, **pressure within the ink chamber may be equalized as the air exits** through one or more openings through the **lid portion**.” Ex. 1004, [0022]. In Studer 471’s preferred embodiment, “**channels 50 [blue] are located vertically so that the ink and air may flow upward toward the lid portion …. and wherein air is then able to escape from the chamber 45** (*e.g.*, through an opening in the lid portion) and possibly through one or more labyrinths of the lid portion” as shown in Figure 4 below. Ex. 1004, [0029].

Studer 471 at Fig. 4



Studer 471 further teaches that "[t]here may be just one channel in one of the walls of the internal chamber or there may be a plurality of channels as needed for a specified configuration" and that "channels 50 can be incorporated in any number of side walls for one or more of the ink chambers." Ex. 1004, [0033].

3. Studer 878

Studer 878 is yet another Hewlett-Packard Development Company, L.P. patent application publication that names as an inventor Anthony D. Studer, along with Kevin D. Almen, David J. Benson, David M. Hagen, and Cary R. Bybee. Ex. 1005. Studer 878 was not cited or considered by the Examiner during prosecution of the '523 patent.

Studer 878 is directed to use of fibers in the capillary material of a replaceable ink cartridge for venting air trapped inside the cartridge to ambient air. Ex. 1005, [0027-0029]. Just like the '523 patent, Studer 878 describes venting mechanisms to vent air from the cartridge by using fibers (blue) sown through the capillary material (pink) of the ink supply cartridge to vent air. Ex. 1005, [0025-0029].

<table>
<tr><th colspan="2">Figs. 2a and 2b of Studer 878</th></tr>
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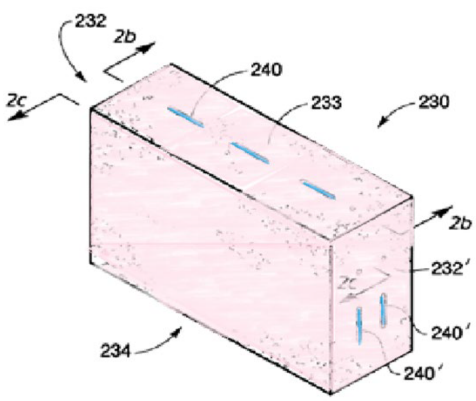

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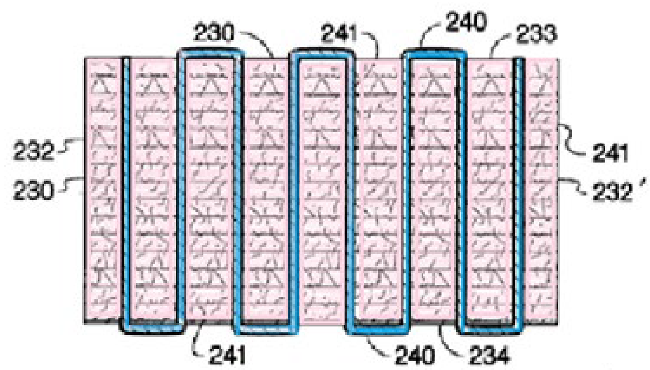

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</table>

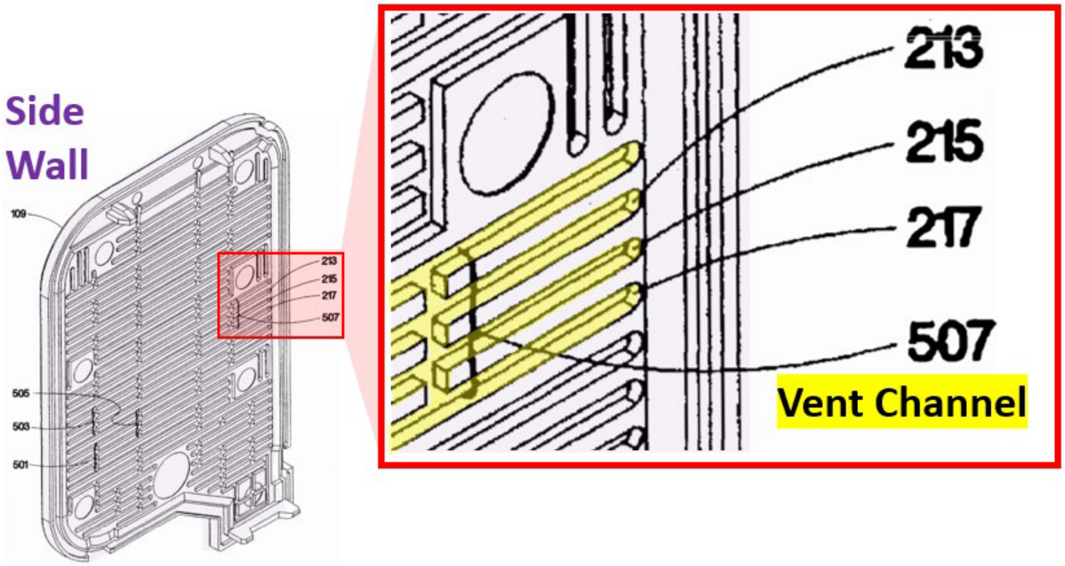
Studer 878 teaches that the "fluid supply may **include larger diameter thread fibers 240 and 240' [blue]** sewn or threaded into the capillary material [pink]," which can have diameters varying from 0.5 mm to 1 mm depending on the embodiment. Ex. 1005, [0023]. "The lower surface energy fiber or thread compared to the surface energy of the capillary material **provides a path for entrapped air or gas to travel more easily in the case of thread fiber 240 from bottom face 234 to top face 233** and in the case of thread fiber 240' air or gas may travel more easily to either end surface 232 or 232'." *Id.*, [0029].

4. Elliot

Elliot is a Hewlett-Packard Co. patent that was not cited or considered by the Examiner during prosecution of the '523 patent.

Elliot is directed to the use venting mechanisms, such as vent channels, in at least one side wall of a capillary-filled container. Ex. 1006, Abstract. Just like the ’523 patent, Elliot teaches the use of polyurethane foam, which it calls a “felted urethane material,” as the capillary material in its ink container to provide the desired negative backpressure on the ink near the printhead nozzles. *Id.*, 4:29-31. Elliot also teaches that **air bubbles** can become trapped in this capillary material that can **cause leakage or “drool”** from the printhead nozzles when subjected to changes in temperature and pressure. *Id.*, 4:53-66.

To **overcome this problem**, Elliot includes “a series of slots running across the inner surface of wall 111 [] molded into the inter surface wall 111.” Ex. 1006, 5:5-6. “Groups of slots [501, 503, 505], which considered together form **a vent channel [507]**, are oriented perpendicular to the relief pockets and are formed on the inner surface of wall” as shown in Figure 5 below. *Id.*, 5:31-33. In Elliot’s preferred embodiment, “the vent channels are **1 mm wide and 0.7 mm deep**.” *Id.*, 5:62-63.

Figure 5 of Elliot


VII. <u>LEVEL OF SKILL</u>

A person having ordinary skill in the art ("PHOSITA") at the time of the alleged invention would have been a person holding at least a Bachelor's or Master's level college degree in Mechanical Engineering, Materials Science, Physics, Electrical Engineering, or a related field, and at least two years of training or experience in the design of inkjet cartridges and printheads. Ex. 1011, ¶¶19-20.

VIII. <u>CLAIM CONSTRUCTION</u>

Petitioners contend that the claim terms in the Challenged Claims should be afforded their plain and ordinary meaning.

IX. ARGUMENT

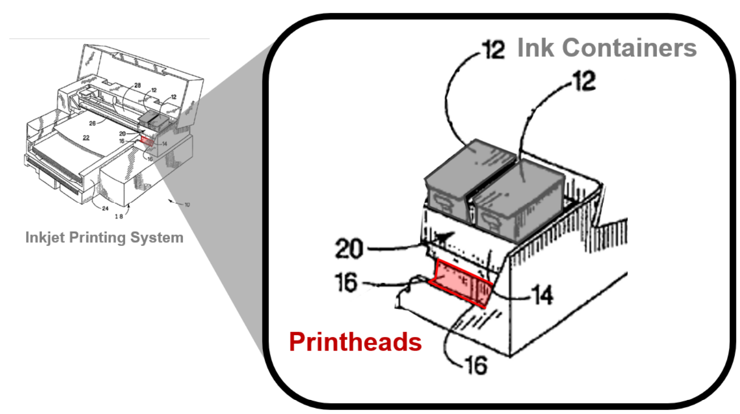
A. Ground 1: Claims 1, 3, 5, 10, 12, and 14 of the '523 patent are anticipated by Studer 708

1. Claim 1[2]

Preamble 1[P]

To the extent the preamble is a limitation of the claim, Studer 708 discloses "[a] **fluid supply tank** for a **micro-fluid ejection head**, the fluid supply tank comprising." Ex. 1011, ¶¶ 69-77.

Studer 708 teaches that "a plurality of **replaceable ink containers 12** that are installed in a receiving station 14. Ink is provided from the **replaceable ink containers 12** [grey] through a manifold (not visible in this view) to **inkjet printheads 16** [red]." Ex. 1003, 2:45-62, 3:45-49.

Studer 708 Fig. 1


[2] A full claim listing can be found in the Appendix.

A PHOSITA would have understood that the term "micro-fluid ejection device" is another word frequently used by Lexmark International, Inc. in its patent applications filed around the priority date of the '523 Patent to refer to a device that includes a printhead, such as an inkjet printer. Ex. 1011, ¶71. To be sure, the '523 patent states that "[a] **widely used micro-fluid ejection head** is in an **ink jet printer**." Ex. 1001, 1:14-17, 1:21-24.

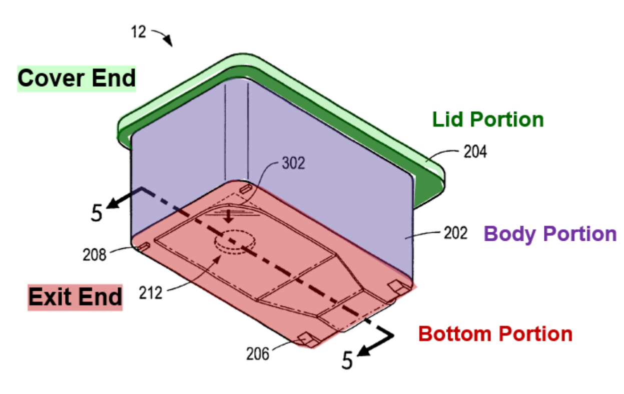
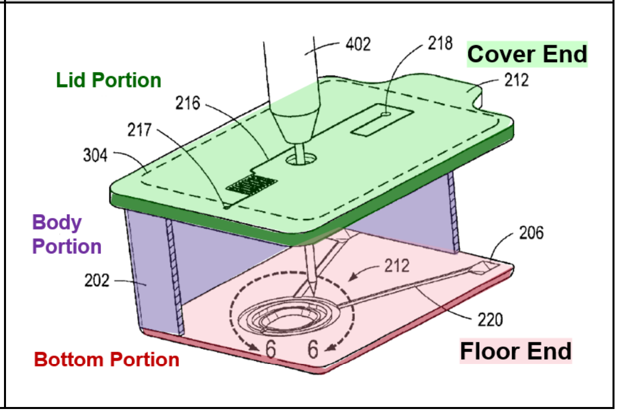
Thus, Studer 708 discloses "**a fluid supply tank** [*e.g.*, ink containers 12] for a **micro-fluid ejection head** [*e.g.*, inkjet printheads 16]."

<u>Limitation 1[A]</u>

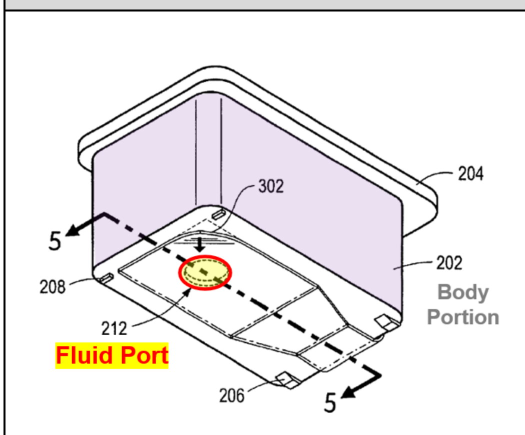
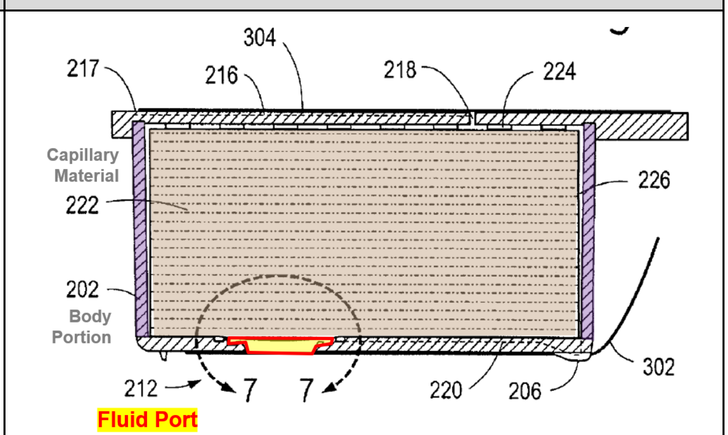
Studer 708 discloses "a **body portion for holding a fluid to be ejected**, the body portion having a **fluid exit port on an exit end** thereof and **a cover on an opposing end** thereof of the body portion, the **cover having an opening in fluid communication with atmosphere**." Ex. 1011, ¶¶ 78-92.

Studer 708 discloses an ink container 12 that generally comprises: (i) a "**body portion 202 [purple]**" forming the "interior of ink container 12," (ii) a **"lid portion 204" with a cover (green) on the top end**, and (iii) a **bottom portion (red) with a "fluid interconnect port 212"** on the exit end as shown in Figures 3 and 4 below. Ex. 1003, 3:44-46, 4:20-29. The **body portion 202** of the ink container **contains** both capillary material and **ink**. Ex. 1011, ¶¶80-86; Ex. 1003, 2:47-49, 3:47-48 ("The

body portion contains a hydrophilic capillary material (not visible in Fig 3) **to retain ink**.”).

<table>
<tr><th>Fig. 3 of Studer 708</th><th>Fig. 4 of Studer 708</th></tr>
<tr><td>
</td><td>
</td></tr>
</table>

To supply the ink retained (by the capillary material) within the body portion 202 of ink container 12 to the printhead 16, Studer 708 teaches that the **body portion 202** of the ink container 12 **includes a fluid interconnect port 212 disposed in the bottom** of the ink container that allows ink to be withdrawn from the ink container as shown in Figures 3 and 5 below. Ex. 1003 at Fig. 3. 5, 1:37-40, 3:25-29, 5:31-41.

<table>
<tr><th>Fig. 3 of Studer 708</th><th>Fig. 5 of Studer 708</th></tr>
<tr><td>
</td><td>
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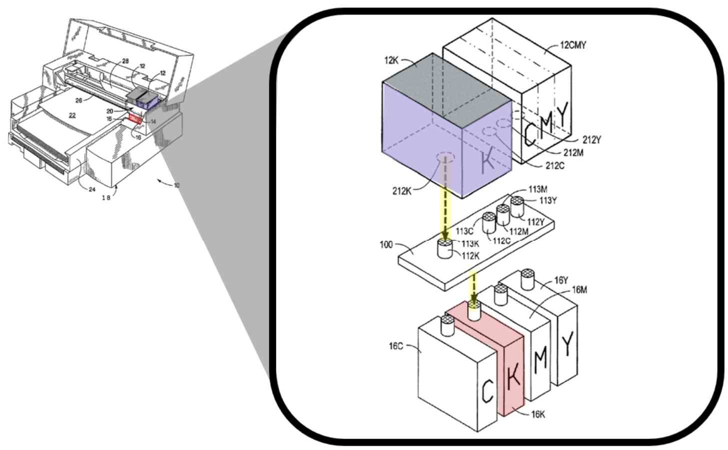
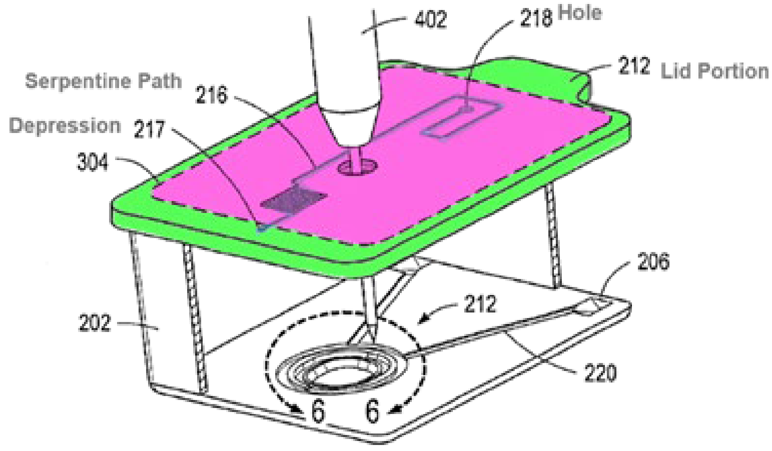
As shown in Figure 2 below, when the **fluid interconnect port 212** in the **exit end** of **ink container 12** engages with tower 113, **ink** retained by the capillary material 222 in ink container 12 **flows out the fluid interconnect port 212** and is then routed **to the printheads 16** by internal channels disposed within the manifold 100 along the pathway highlighted in yellow. Ex. 1011, ¶85.

Fig. 2 of Studer 708



Studer 708 also discloses that the **ink container 12** further comprises a **lid portion 212 with a "vent system formed in the container lid (217, 216, 218)** [and] provisions for allowing air passage around the end of the capillary material." Ex. 1003, 4:21-24. This vent system comprises "**a narrow serpentine depression 216 [that] is molded on the surface of the container lid** connected at one end with a **shallow depression 217**, and at the other end with a **hole 218** passing through the lid." *Id.*, 4:40-43.

Fig. 4 of Studer 708


The **serpentine vent** ensures that the **interior of ink container 12** remains in **fluid communication with the ambient atmosphere** outside of the container. Ex. 1011, ¶¶ 87-90. Studer 708 explains that "**[e]xternal ambient air** may pass from the **shallow depression [217], along the serpentine path 216** under the label 304, and **through the hole 218 *into*** the **container interior**." Ex. 1003, 4:49-52.

Therefore, Studer 708 discloses limitation 1[a]: "a **body portion** [*e.g.*, body portion 202] for **holding a fluid to be ejected** [*e.g.*, ink], the body portion having a **fluid exit port** [*e.g.*, fluid interconnect port 212] on an **exit end** thereof [e.g., the side of the body portion 202 where the fluid interconnect port 212 is located] and a **cover** [*e.g.*, lid portion 204] on an **opposing end** thereof [e.g., the side of the body portion 202 where the lid portion 204 is located] of the body portion, the **cover having an opening in fluid communication with atmosphere** [*e.g.*, vent system 217, 216, 218]."

<u>Limitation 1[B]</u>

Studer 708 discloses "an **internal vent conduit** disposed **between the exit end and the cover** for **removing air adjacent to the fluid exit port** and releasing the air t**hrough the cover to said atmosphere.**" Ex. 1011, ¶¶93-110.

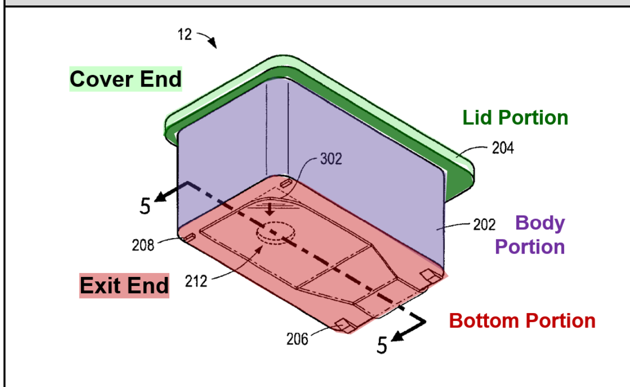
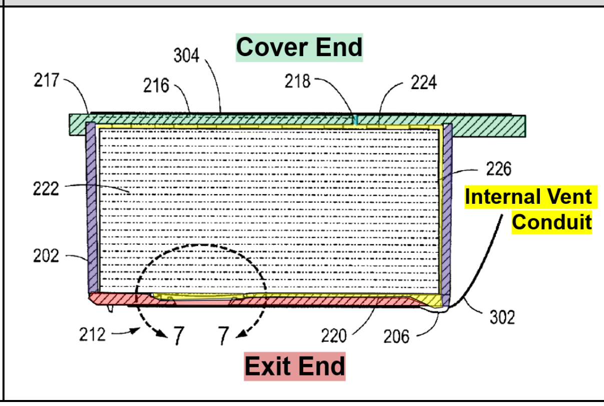
According to Studer 708, the "methods of the present invention [] include [1] [*externally*] venting a fluid container *to* ambient air with a vent located on the upper portion of the container; [2] *internally* venting the container to channel air *from* the ambient air vent *to* an internal location adjacent to the fluid interconnect port; and [3] then restrictedly venting the fluid port." Ex. 1003, 7:38-43. Studer 708 describes (1) venting air from the interconnect port to the vent, *i.e.*, to the ambient environment external to the container and (2) venting air from the vent to the interconnect port, *i.e.*, venting ambient air internally into the container.

While Studer 708 primarily discusses the second method—*internally* venting to ambient air from a vent in the cover along a pathway to an internal location adjacent to the fluid interconnect port—a PHOSITA would understand that air travels in both directions along the venting pathway as dictated by air pressure and thus would also vent air from the interconnect port to the vent cover in the upper portion of the container and out to ambient air. Ex. 1011, ¶94.

A "preferred embodiment of the present invention includes a **vent system** formed in the **container lid (217, 216, 218)** []; **provisions for allowing air passage**

around the end of the capillary material; **redundant vent paths (206, 220) formed in the floor** of the container **to provide air from the end of the container to the fluid interconnect port** region; features adjacent to the interconnect port 212 to facilitate and regulate the absorption of ink into the capillary material." Ex. 1003, 4:21-29.

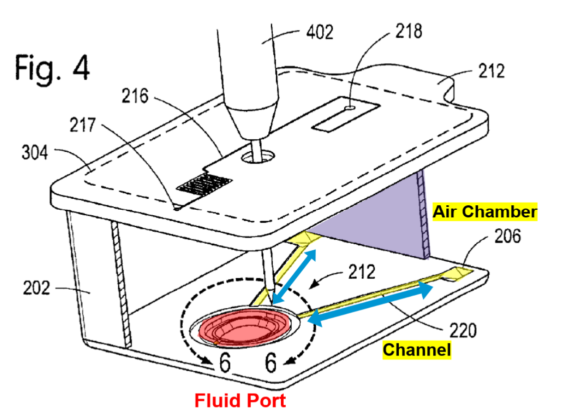
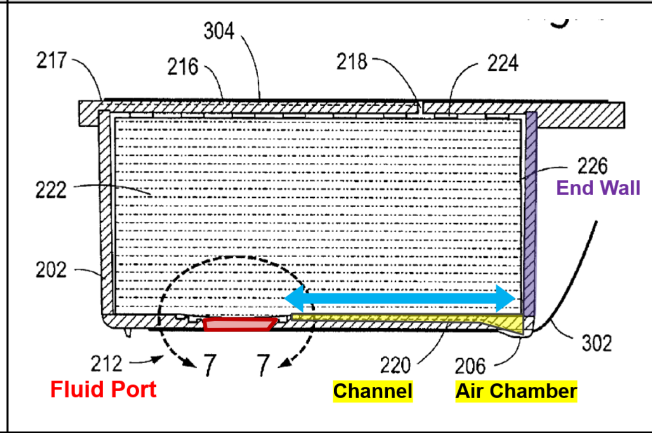
Studer 708 teaches disposing the vent system (*i.e.*, internal vent conduit) between the cover end of lid portion 204 (green) and the exit end (red) of the bottom portion of ink container 12. This vent system (yellow) allows for air to travel within the body portion 202 (purple) around the capillary material 222 between the cover end (green) of lid portion 204 and the exit end (red) of ink container 12. Ex. 1011, ¶99.

Fig. 3 of Studer 708	**Fig. 5 of Studer 708**
	

Studer 708 also teaches that the "underside of lid 212 includes **spacing members 224**, which "serve to insure [sic] that air from the container vent may move into the capillary material 222, replacing ink as the ink is withdrawn from the container during printing" and to **"permit air to move to the end wall 226 of the container."** Ex. 1003, 4:62-66.

"To provide a mechanism for **air to pass** from the top of the container **around the capillary material 222**," Studer 708 further discloses that "the preferred embodiment" of ink container 12 "exploit[s] a **characteristic of the preferred capillary material, bonded polyester fiber (BPF)**" by orienting its fibers "lengthwise in the container, as represented by the dashed lines in FIG. 5, such that an 'end grain' of the material is adjacent to the container interior end wall 226." Ex. 1003, 4:68-5:9. This orientation allows the BPF material to remain in "loose **contact with the end wall 226**," which Studer 708 says "has been empirically determined [to **allow**] **sufficient air [to] flow along the end grain of the capillary material to meet the requirements of the fluid port vent, even when the capillary material is saturated with ink.**" Ex. 1003, 5:9-14.

To provide "**venting from the end of the container 226 to the fluid interconnect port 212**," Studer 708 discloses that "the preferred embodiment includes **redundant vent channels 220**, which are small troughs molded into the container floor," as well as the "**interior of rear feet 206**, [which] are utilized as small air channels to **provide reliable air communication from the end of the container to the vent channels**" along the pathways highlighted in yellow below in Figures 4 and 5. Ex. 1003, 5:21-30; Ex. 1011, ¶103.

<table>
<tr><th>Fig. 4 of Studer 708</th><th>Fig. 5 of Studer 708</th></tr>
<tr><td>
</td><td>
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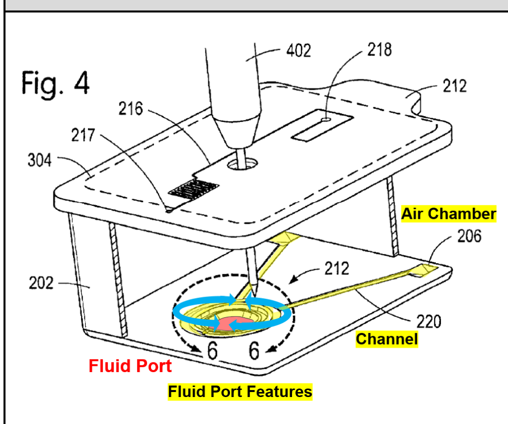
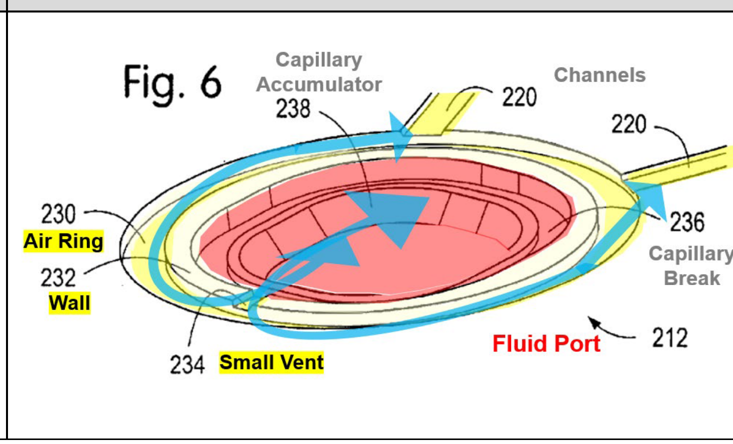
Studer 708 discloses that certain "[fluid] interconnect port features of the preferred embodiment are configured to **adequately vent the interconnect port [212]** while limiting the flow of air to the port." Ex. 1003, 6:20-22. According to Studer 708, "[t]he features include an **air path ring 230**, **a wall 232** with a small **air vent 234**, capillary break 238, and a capillary accumulator 236" through the pathway highlighted in yellow in Figures 5 and 6 below. *Id.*, 6:26-28; Ex. 1011, ¶104.

<table>
<tr><th>Fig. 5 of Studer 708</th><th>Fig. 6 of Studer 708</th></tr>
<tr><td>
</td><td>
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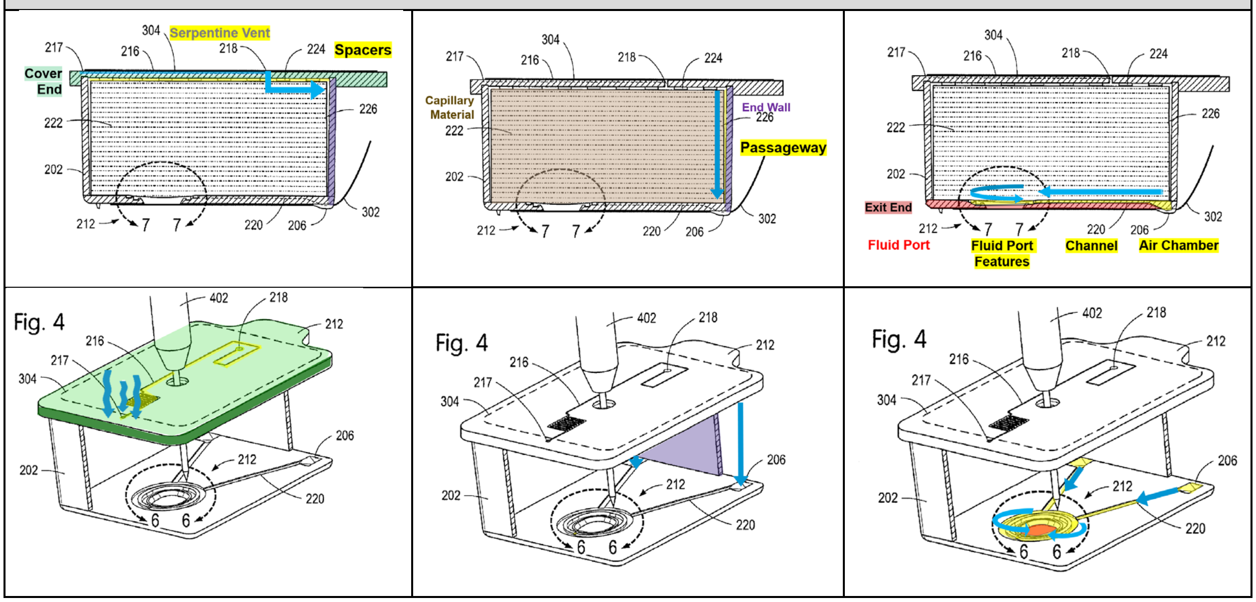
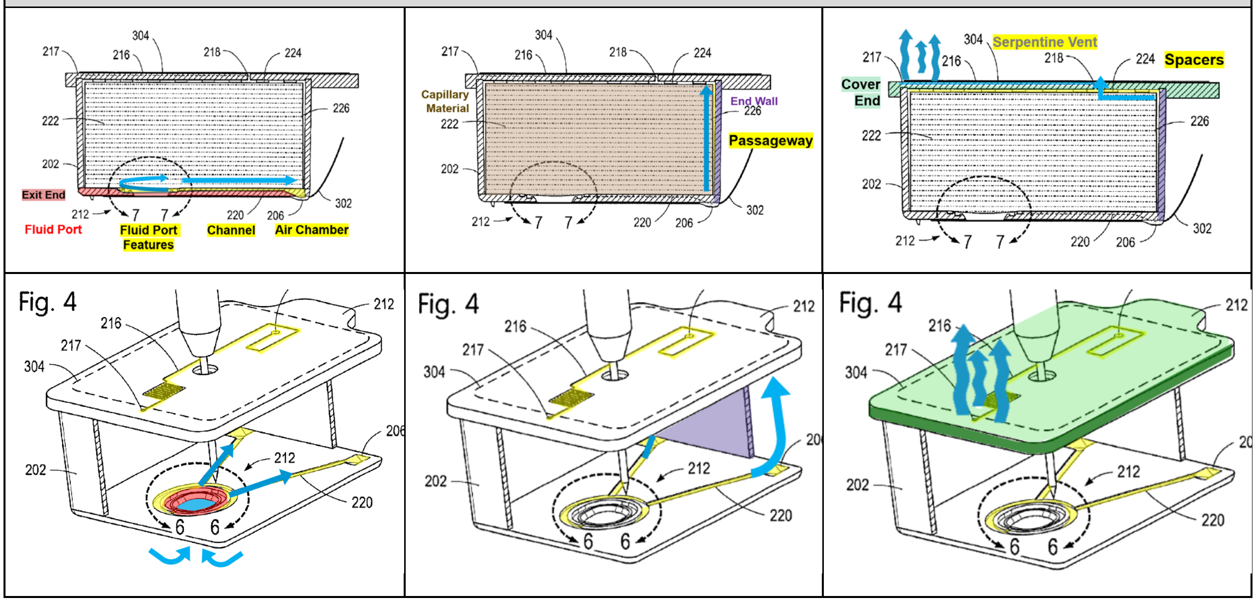
Each time the capillary material 222 absorbs ink that has accumulated within the chamfered walls of the capillary accumulator 238, "the volume formerly occupied by the ink is replace[d] by air flowing through the small vent 234”—*i.e.*, air that was vented from the ambient atmosphere into the interior of the ink container 12 through the serpentine vent and directed to the fluid interconnect port through the internal vent conduit. Ex. 1011, ¶105; Ex. 1003, 7:24-25.

Internally Venting Air From the Atmosphere to the Fluid Port



A PHOSITA would have recognized that the internal air vent conduit in ink container 12 not only allows ambient air to enter the spaces adjacent to the fluid interconnect port 211 but also removes air adjacent to the fluid interconnect port 212 and releases it to the atmosphere as dictated by air pressure. Ex. 1011, ¶¶106-109. This happens because the internal vent conduit stretches from immediately next to the fluid interconnect port 212 at air path ring 230, to vent paths 220, to foot vent cavities 206, to the rear wall air space 226, to the air space 224 beneath lid 204, which is in air flow communication to lid through hole 218, to the label covered serpentine trench 216, which terminates in uncovered depression 217, and communicates air to the ambient atmosphere surrounding the ink container as shown in the figures below. *Id.*, ¶¶106-109.

Externally Venting Air from Ink Fluid Port to Atmosphere



Studer 708 confirms that the internal vent conduit regulates the pressure within ink container 12 in at least three different ways: "[1] [externally] venting a fluid container ***to*** ambient air with a vent located on the upper portion of the container; [2] ***internally*** venting the container to channel air ***from*** the ambient air vent ***to*** an internal location adjacent to the fluid interconnect port; and [3] then restrictedly venting the fluid port." Ex. 1003, 7:38-43.

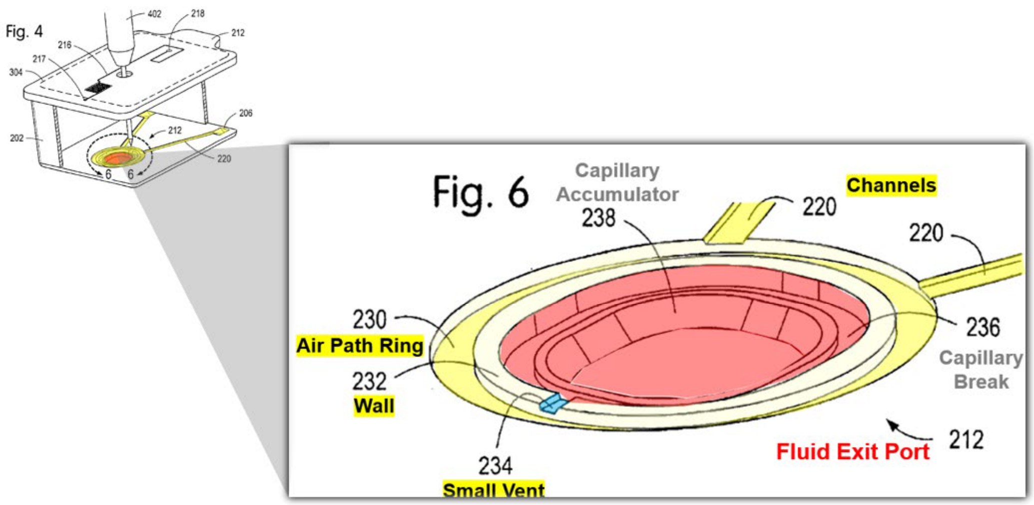
Studer 708 therefore discloses limitation 1[b]: "an **internal vent conduit** [*e.g.*, (i) channels formed by spacing members 224, (ii) passageway between capillary material 222 and end wall 226, (iii) vent channels 220 and air chambers

206, and (iv) the fluid interconnect port venting features, including small vent 234, wall 232, and air path ring 230)] **disposed between** the **exit end** [*e.g.*, bottom portion] and the **cover** [*e.g.*, vent system (217, 216, 218) formed in the container lid 204] for removing air adjacent to the fluid exit port and releasing the air through the cover to said atmosphere."

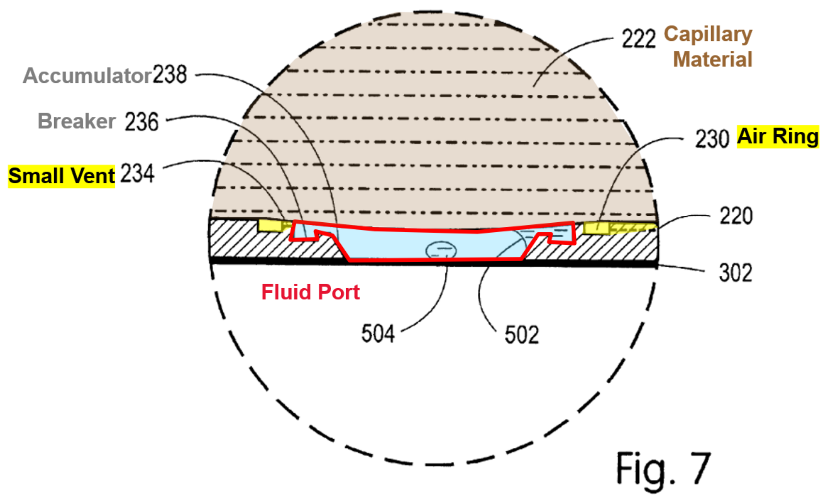
Limitation 1[c]

Studer 708 discloses "an **air space** in the **fluid exit port** wherein the **internal vent conduit** is in **air flow communication** with the **air space** and the **cover**." Ex. 1011, ¶¶112-118.

The internal vent conduit is in air flow communication with the fluid interconnect port 212 because the small vent 234 (blue) of the internal vent conduit (yellow) vents air to and from the air path ring 230 into the fluid interconnect port 212.

Fig. 4 and 6 of Studer 708


Studer 708 further discloses that an air space (blue) is formed in the fluid interconnect port 212 (red) by the top face of the wall 232 coming into contact with the bottom of the capillary material 222, thereby making small vent 234 the sole passageway between the fluid interconnect port and the rest of the ink container 12 as shown below in Figure 7. Ex. 1003, 5:35-45, 6:20-37, Figs. 5-7.

Fig. 7 of Studer 708


A PHOSITA would have understood from Figures 6 and 7 of Studer 708 that the air vent 234 of the internal vent conduit is in air flow communication with the air space (blue) because the small vent 234 is shown formed by a channel cut through the ring wall 232, which bounds the fluid exit port air space. Air may freely pass between the inside ring wall 232 to the outside of ring wall 232 outside of the ring wall, *i.e.*, into the air ring volume 230, through the open passage 234 in ring wall 232. Ex. 1011, ¶¶114-116.

Studer 708 therefore discloses limitation 1[c]: an "an **air space** in the **fluid exit port** [*e.g.,* air between the fluid interconnect port and capillary material] wherein the **internal vent conduit [*e.g.*, (i) channels formed by spacing members 224, (ii) passageway between capillary material 222 and end wall 226, (iii) vent channels 220 and air chambers 206, and (iv) the fluid interconnect port venting features, including small vent 234, wall 232, and air path ring 230)]** is in **air flow**

communication with the **air space** [*e.g.,* air between the fluid interconnect port and capillary material] and the **cover** [*e.g.*, lid portion 204]."

2. Claim 10

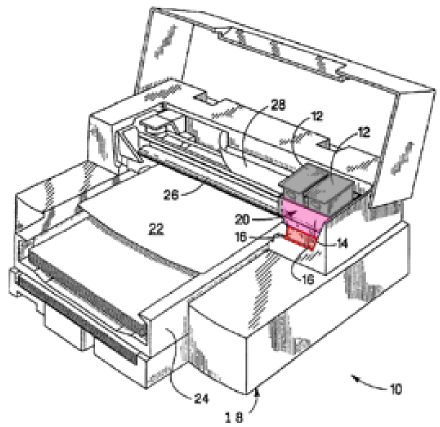
Preamble 10[P]

Generally, the preamble is not limiting. To the extent the preamble is a limitation of the claim, Studer 708 discloses "[a] method for enhancing the operation of a micro-fluid ejection device." Ex. 1011, ¶¶131-135.

Even if the preamble here were a limitation, it is broader than limitation 1[P] discussed in Section IX.A.1. and is thus disclosed for the same reasons. While 1[P] purportedly limits the claimed invention to a "fluid supply tank for a micro-fluid ejection head," 10[P] at best limits the claimed invention to a "micro-fluid ejection device," which would encompass any device capable ejecting micro-droplets of ink, such as an inkjet printer with a printhead. Ex. 1011, ¶131.

As shown in Figure 1 below, Studer 708 discloses "a typical inkjet printing system 10 [*i.e.*. inkjet printer] with its lid open," which includes printhead 16. Ex. 1003, 2:44-49.

Studer 708 Fig. 1



To the extent that the claim is limited to "enhancing the operation" of the "micro-fluid ejection device," Studer 708 also discloses this limitation. Ex. 1011, ¶¶132-135. The "venting mechanisms" of the ink container 12 enhance the operation of the inkjet printer in several different ways, including "reduc[ing] the occurrence of residual fluid in the fluid interconnect region of the replaceable container" by "allowing air to replace fluid in the sealed fluid interconnect port of a container substantially filled with a capillary material, thus enabling absorption of residual fluid into the container capillary material" and improving print quality and experience. Ex. 1003, 1:65-2:7, 7:38-43; Ex. 1011, ¶¶135-136. A "further advantage is that they provide the container with an area to store ink that could come out of the capillary material over time due to altitude excursions, dropping, or shipping." Ex. 1003, 7:32-35. "This ability to locally retain residual ink resulting from environmental and stress events keeps ink away from the fluid interconnect label or seal," which enhances the print quality of the inkjet printer. Ex. 1003, 7:35-37; Ex. 1011, ¶¶135-136.

Limitation 10[A]

Studer 708 discloses "disposing an internal vent conduit in a fluid supply container for the micro-fluid ejection device, wherein the vent conduit is disposed in air flow communication between an air space of a fluid exit end of the container and a container cover opposite the fluid exit end, the container cover having an opening in fluid communication with atmosphere." Ex. 1011, ¶¶136-137.

This limitation is analogous to limitation 1[P]-1[C] and is disclosed by Studer 708 for the same reasons provided above in Section IX.A.1. Ex. 1011, ¶¶137-138.

Limitation 10[B]

Studer 708 discloses "installing the fluid supply container on the micro-fluid ejection device so that any trapped air between the container and the device is urged to said atmosphere through the internal vent conduit through an atmospheric vent in the cover." Ex. 1011, ¶¶139-141.

This limitation is analogous to limitation 1[B]-1[C] and is disclosed by Studer 708 for the same reasons provided above in Section IX.A.1. Ex. 1011, ¶¶139-141.

3. Claims 3 and 12

Claims 3 and 12 depend from claims 1 and 10, respectively, and add: "wherein **the cover comprises a serpentine vent structure** and the **internal vent conduit** is in **air flow communication** with the **serpentine vent structure**."

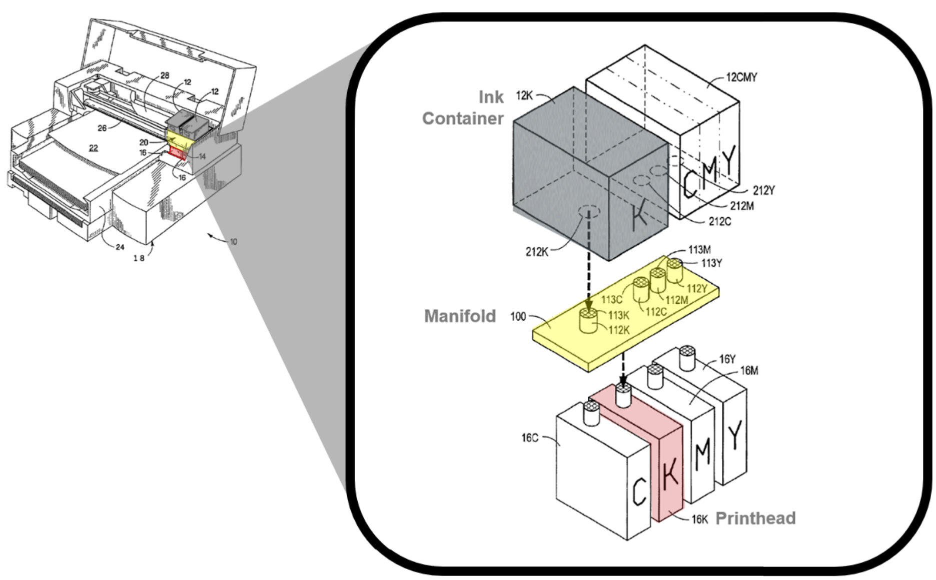
Per Section IX.A.1., Studer 708 uses a **serpentine vent structure**, *e.g.*, narrow serpentine depression 216, disposed in the cover that allows for air flow communication between the vent conduit and ambient air. Studer 708 explains that "**[e]xternal ambient air** may pass from the **shallow depression [217], along the serpentine path 216** under the label 304, and **through the hole 218 *into*** the **container interior**." Ex. 1003, 4:49-52.

Studer 708 therefore discloses that "the **cover** [*e.g.*, lid portion 204] comprises a **serpentine vent structure** [*e.g.,* narrow <u>serpentine</u> depression 216] and the **internal vent conduit** [*e.g.,* (i) channels formed by spacing members 224, (ii) passageway between capillary material 222 and end wall 226, (iii) vent channels 220 and air chambers 206, and (iv) the fluid interconnect port venting features, including small vent 234, wall 232, and air path ring 230] is in air flow communication with the serpentine vent structure." Ex. 1011, ¶¶119-123, 141-142.

4. Claims 5 and 14

Claims 5 and 14 depend from claims 1 and 10, respectively, add: "wherein the **fluid supply tank** is **removably attached to** an **ejection head structure."** Studer 708 discloses this limitation.

Studer 708 teaches that the ink containers 12 (grey) are physically separate from the corresponding printheads 16 (red) and removably connected (*i.e.*, attached) together through the manifold 100 (yellow) of the scanning carriage 20 housing the printheads 16.

Studer 708 Figs. 1 and 2


To supply the printheads 16 with ink from the ink containers 12, the ink container 12 is installed on manifold 100 of the receiving station 14, which is configured to establish a "reliable fluid interconnect" between the ink containers 12 and printheads 16. Ex. 1003, 3:27-38, 2:45-49, 3:14-16.

Studer 708 therefore discloses that "the **fluid supply tank** [*e.g.*, ink container 12] is **removably attached** [e.g., replaceably attached] to an **ejection head structure** [*e.g.*, printhead 16 on receiving station 14]." Ex. 1011, ¶¶124-129.

B. <u>Ground 2</u>: Claims 1, 3, 5-7, 10, 12, and 14-16 of the '523 patent Are Rendered Obvious by Studer 708

1. Claims 1, 3, 5, 10, 12, and 14

To the extent that the Board does not find that Studer 708 discloses Limitation 1[B] and/or 10[B], then it would have been obvious to a PHOSITA for the same reasons discussed above in Section IX.A. Ex. 1011, ¶151.

To the that the extent that the Board does not find that Ground 1 relies upon the same (preferred) embodiment of Studer 708 but rather different embodiments of ink container 12, then ample motivation existed for a PHOSITA to modify and/or combine various embodiments to arrive at the ink container 12 relied upon in Ground 1. Ex. 1011, ¶¶152-156.

First, while certain figures and descriptions in Studer 708 refer to different embodiments, these embodiments are disclosed in adjacent figures, and Studer 708 itself indicates the interchangeable nature of the various embodiments. Ex. 1011, ¶153; Ex. 1003, 7:62-67.

Second, the alternative embodiments are **analogous** to the preferred embodiment of the ink container 12. Ex. 1011, ¶154. Although the number, location, and arrangement of components might differ across alternate embodiments, those embodiments not only share the same basic components—*e.g.*, a lid with a container vent on the cover end, a body portion with side walls that form an interior, and a bottom with a fluid exit port on the exit end—they also use those components to perform the same basic functions—*e.g.*, body portion 202 contains both ink and a capillary material for retaining the ink, small vent 234 acts as an air flow restrictor to fluid interconnect port 212. *Id*. While the degree in which alternative embodiments differ varies, those differences are largely confined to the number, size, and arrangement of the internal venting mechanisms. *Id*. Simply put, the standardized and interchangeable components of the alternative ink container embodiments would encourage a PHOSITA to modify the components of an existing embodiment and/or combine components from multiple embodiments to create an entirely new embodiment not otherwise disclosed in Studer 708. Ex. 1011, ¶154.

Third, Studer 708 itself provides sufficient motivation for a PHOSITA to combine the embodiments of ink container 12. Ex. 1011, ¶155. While Studer 708 teaches that the bonded polyester fiber (BPF) material used in the preferred embodiment of ink container 12 allows "sufficient air [to] flow along the end grain of the capillary material to meet the requirements of the fluid port vent, even when the capillary material is saturated with ink," Studer 708 makes clear that "another capillary material [may be] used in place of BPF." Ex. 1003, 5:14-20. Indeed, Studer 708 expressly identifies two such capillary materials—"polyurethane foam or melamine." *Id*., 5:5-20. A PHOSITA would also have been motivated to modify the preferred embodiment by replacing the BPF material with polyurethane foam for reasons of improved ink retention volume fraction, chemical compatibility with desired ink formulations, particulate cleanliness to lessen filter clogging, tailored capillary force profile for ink release, ink reservoir shape and cost. Ex. 1007, ¶155.

2. Claims 6 and 15

Claims 6 and 15 depend from claims 1 and 10, respectively, and add: "a **conduit having cross-sectional dimensions that provide a non-fluid wettable vent channel**."

The objective of providing an uninterrupted air flow path from the exit port to the ink container lid air vent port is clearly advanced by sizing the side and floor channels so that any ink obstructing them may be readily reabsorbed by the adjacent capillary material (and not block the air flow paths)—a primary objective met by Studer 708's design for the small vent 234 and floor channels 220. When designing the internal vent conduit formed by the small vent 234, floor channels 220, and air passageway, a PHOSITA would have successfully arrive at the necessary proportions to ensure that the resulting internal vent conduit provides a non-fluid wettable vent channel. Ex. 1011, ¶158. An ordinary design procedure would have been to form prototype test structures in an engineering model shop, with a set of channel cross-sections in a range below those that calculation indicated would provide capillary strength, for the inks being used, at levels lower than the capillary strength selected for the ink storage capillary material. *Id*.

To perform this calculation, a PHOSITA would employ the standard Young-LaPlace equation to estimate the capillary strength (pressure) that would be generated by a channel conduit covered by the ink storage capillary material. Ex. 1011, ¶159; Ex. 1007, pgs.296-308; Ex. 1008. The Young-Laplace equation calculates the capillary pressure, P_c, for an ink having a surface tension of γ, in an open circular tube of radius R_c, wherein the fluid and the capillary forming solid material have a wetting contact angle of θ. Ex. 1007, pg.308.

Young-LaPlace Equation: $P_c = 2\gamma\cos(\theta)/R_c$.

The cosine of the contact angle that the ink and capillary material form determines whether the capillary exerts a positive (attractive) or negative (repulsive) pressure on the ink. Ex. 1011, ¶160. This term in the Young Laplace equation accounts for the balance of the attraction force between the solid material surface (conduit material walls) and the liquid (ink) and the attraction between the solid material surface and the air. *Id*. If the solid material is equally attracted to the ink and to the air, the capillary pressure becomes zero, and the contact angle will measure 90^{o}. *Id*.

A material is said to be wettable hydrophilic if the contact angle is less that 90^{o} (cosine θ positive) and non-wettable if the contact angle is greater than 90^{o}

(cosine θ negative). Ex. 1011, ¶161; Ex. 1007, pgs.304-306; Ex. 1009, pgs.7-8. When the inkjet ink involved is water-based, wettable is also termed hydrophilic and non-wettable is termed hydrophobic. Ex. 1011, ¶161. Materials used in drop-on-demand printheads and ink containers have water contact angles ranging from ~ 10° for the inner surfaces (e.g., gold or silicon nitride/oxide) of a nozzle to ~ 108° for a polypropylene plastic ink container. *Id*. The plastics commonly used for ink containers will have water contact angles in the range of 70° to 110°, unless fluorinated or surface treated for greater hydrophobicity, or surface treated to be more hydrophilic. *Id*.

For a groove, channel, or other interstitial space the capillary pressure may be estimated using the above Young-Laplace equation by adopting a representative cross-sectional area of the capillary feature, A_c, and then calculating an effective capillary radius, R_c, from this area, $\pi R_c^2 = A_c$, for the feature. Ex. 1011, ¶162. The capillary pressure of a conduit feature will be proportional to the ink surface tension. *Id*. For inks that are water-based, the surface tension of water, 72 dyne/cm at 25 °C, represents the maximum value of the surface tension. Ex. 1007, pgs.298-299. The many other ingredients that are necessary for a functional ink (*e.g.* humectants, colorants, anti-chelating agents, biocides, pH buffers) all have the effect of lowering the surface tension from that of water to a lower value. If the surface tension is too high, then printing on plain bond paper may be poor due to excessive bleeding within image areas as high ink surface tension impedes drying absorption into the paper fibers. Ex. 1011, ¶162. A very high ink surface tension for a practical water-based ink would be $\gamma = 60$ dynes/cm. *Id*. This value would be a conservative upper starting point for experimentation. *Id*. Most inks will have lower values, a surface tension of 30 - 40 dyne/cm is common. *Id*. A range of ink surface tension values would be used to cover a same ink container design expected to be used for different inks, each having a unique surface tension and measured contact angle with respect to the candidate ink container materials. *Id*.

A PHOSITA would use the Young Laplace equation to calculate a covered groove with a cross section of 0.5 mm x 0.5 mm, an effective cross sectional area $A_c = 0.25$ mm^2, and an effective capillary radius $R_c = 0.28$ mm. The Young-Laplace equation estimates a capillary pressure of $P_c \sim 1.7 \times \cos\theta$ inches of H_2O for such a capillary and 60 dyne/cm ink. Ex. 1011, ¶163. If the ink container were a non-wettable plastic, such as polypropylene, then $\cos\theta = \cos(108^o) = -.31$ so that the capillary groove would repel ink with a pressure $P_c \sim (1.7) \times (-.31) \sim -0.52$ inches H_2O. Ex. 1011, ¶162. If, instead, a plastic material such as the ULTEM 1010 polyethermide, preferred by Aldrich (Ex. 1001, 3:45-49), were used, then the material is hydrophilic with a contact angle of ~ 75° and the 0.5 x 0.5 mm covered groove would attract ink with a capillary pressure of $P_c \sim 1.7 \times \cos(75^o) \sim 1.7 \times 0.26 \sim + 0.44$ inches H_2O. *Id*. If, instead, the ink had a surface tension of 30 dyne/cm, these capillary pressures would be halved, *i.e.* only + 0.22 inches of H2O for a polyethermide channel, 0.5 mm x 0.5 mm.

Using the Young-Laplace equation as a guiding tool, a PHOSITA would understand that no vent conduit dimensions, formed in a plastic having a contact angle less than 90°, can produce a non-fluid wetting conduit which creates a repelling force to counteract ink intrusion. Ex. 1011, ¶163. A PHOSITA would further recognize that the hydrophobic contact angles of cost acceptable plastics will provide only minor repelling pressures, even for grooves having dimensions as small as 0.5 mm x 0.5 mm. *Id*.

A Young-Laplace calculation of capillary dimensions providing capillary pressures in the range of a ~ 0.4 inches of H_2O to 2 inches of H_20 would find that channels having cross-sectional areas of ~ cprovide that range for inks having a surface tension of 60 dyne/cm and a completely wetting plastic, *i.e.*, contact angle θ = 0°. Ex. 1011, ¶164. This cross-sectional area range represents the air conduit capillary pressures a PHOSITA might consider for an ink storage tank wherein the chosen capillary material holds ink with capillary pressures of 2 inches of H_20 or more. *Id*.

This range of cross-sections could be provided by having model shop prototypes of vent channels machined in widths and depths ranging from 0.25 mm to 4 mm, in steps of 0.25 mm to .5 mm, using the candidate ink container plastic materials. Ex. 1011, ¶165. The model shop formed experimental vent channels would be covered with the candidate ink absorbing capillary material to the same approximate depth of capillary material and initial ink height, thereby completing a set of model vent channels having different cross-sectional areas and width to test the top-of-channel bridging behavior of the capillary material. *Id*.

This range is also consistent with the disclosures in the '523 patent concerning conduit dimensions that reduce or eliminate wetting, which states that the "surface tension of fluid in the tank is a consideration for the dimensions of the width and depth of the vent conduit 24. Ex. 1011, ¶166. Fluids having a surface tension similar to the surface tension of water may have vent conduit 24 dimensions having a width (W) of about 1 millimeter and a depth (D) of about 1 millimeter in order to reduce or eliminate wetting of the conduit 24 with the fluid." Ex. 1001, 5:13-19.

Thus, Studer 708 renders claims 6 and 15 unpatentable as obvious. Ex. 1011, ¶¶157-169.

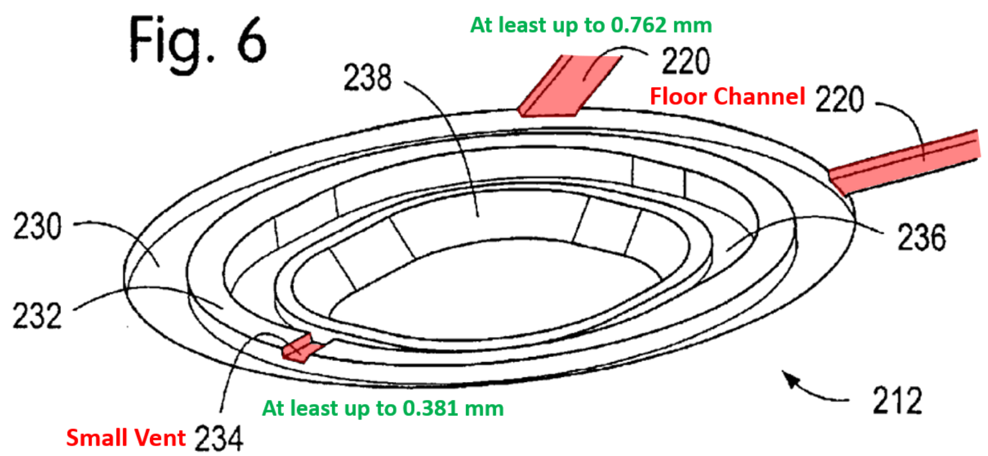
3. Claims 7 and 16

Claims 7 and 16 depend from claims 1 and 10, respectively, and add: "a conduit having a **width** ranging from **about 0.5 to about 2.0 millimeters** and a **depth** ranging from **about 0.5 to about 2.0 millimeters**." Studer 708 renders this limitation obvious for several independent reasons.

First, per Section IX.B.2., incorporated here, Studer 708 renders obvious the added limitation of claims 7 and 16 because a PHOSITA would have arrived at various ranges between 0.25 mm to 4 mm for the widths and depths of the vent conduit through application of the Young Laplace equation and subsequent routine experimentation. Ex. 1011, ¶171.

Second, Studer 708 would have itself motivated a PHOSITA to arrive at the claimed range. Ex. 1011, ¶172. Studer 708 teaches that the small vent 234 of the internal vent conduit has been empirically proven to "act[] as an air flow restrictor" that "limit[s] the rate at which air is vented [from the channels] to the fluid interconnect port" when it has a dimension of "0.015 inches"—*i.e.*, 0.381 millimeters. Ex. 1003, 6:47-53. While only "vents with a smallest dimension ranging up to 0.015 inches were evaluated," Studer 708 makes clear that, in other embodiments, a different smallest dimension may be more effective." *Id*. Because the small vent 234 "restricts" air flowing from the floor channel 220, a PHOSITA would have understood that the dimensions of the small vent 234 are smaller than that of the floor channel 220.[3] Ex. 1011, ¶172.

Fig. 6 of Studer 708



As shown above and below, while Studer 708 does not disclose a precise range of dimensions for the floor channel 220, a PHOSITA would have understood from at least Figures 6 and 7 that the dimensions of the floor channel 220 in the preferred embodiment are at least twice (if not three times) that of the small vent 234—*i.e.*, at least up to 0.762 millimeters (if not 1.143 millimeters). Ex. 1011, ¶173.

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[3] Because Studer 708 refers to small vent 234 as "small," a PHOSITA would understand that the small vent 234 is meaningfully smaller than the vent channel 220. Ex. 1011, ¶171-172 n.2.

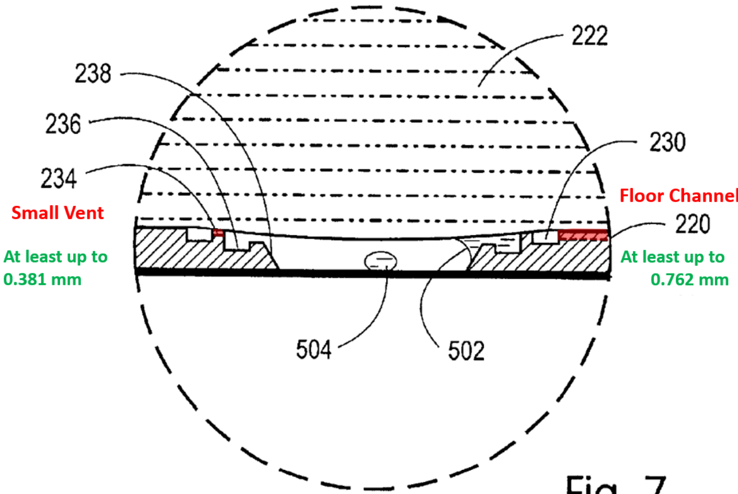
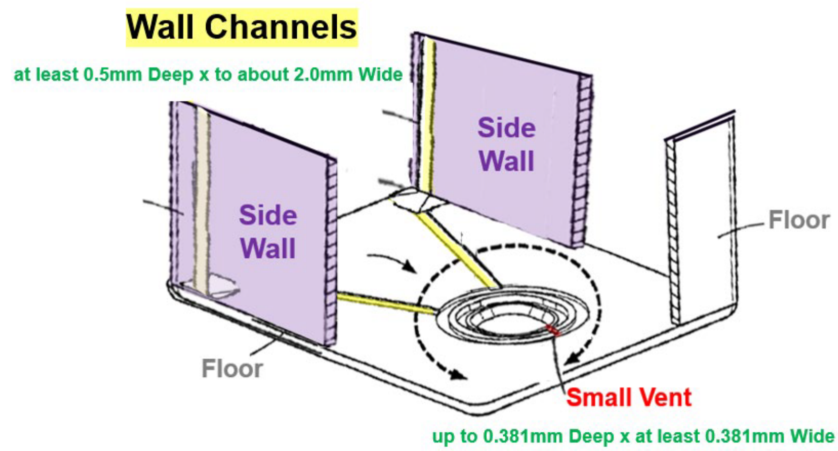


Fig. 7

Because a PHOSITA would have understood that the dimensions of the floor channel 220 can ranged from 0.5 millimeters up to at least 0.762 millimeters, Studer 708 renders obvious the added limitation of claims 7 and 16. *Id*. Ex. 1011, ¶¶171-174.

C. <u>Ground 3:</u> Claims 1-3, 5-7, 10-12, and 14-16 are Rendered Obvious by Studer 708 and Studer 471

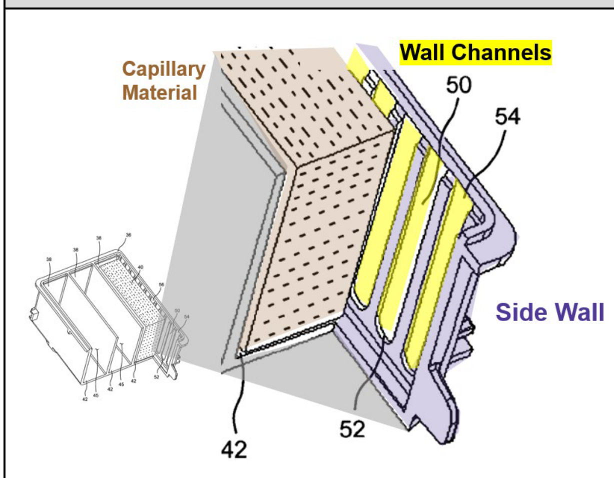
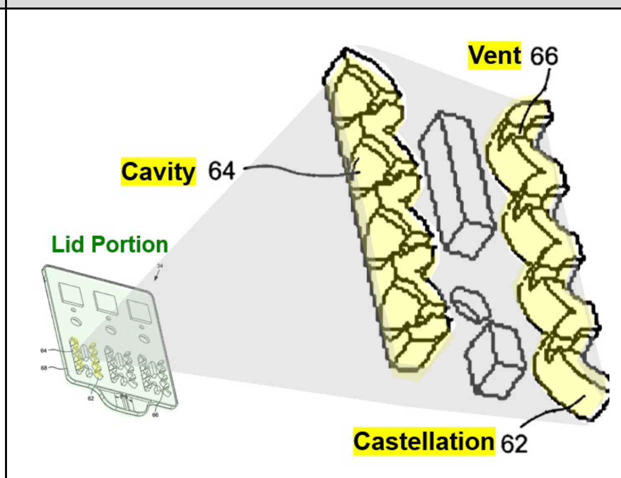
To the extent that the Board does not find that Studer 708 anticipates and/or renders the "internal vent conduit" limitation, Studer 708 as modified in view of Studer 471 (hereinafter, the "Studer 708/471 Combination") discloses and renders obvious claims 1, 3, 5-7, 10, 12, and 14-16, as well as dependent claims 2 and 11 of the '523 patent.

The Studer 708/471 Combination


As shown below, a PHOSITA would have been motivated to modify the preferred embodiment of Studer 708's ink container 12 by replacing the BPF capillary material with a polyurethane foam or melamine and disposing vent channels vertically along each interior side wall of ink container 12 having a width and depth each ranging from about 0.5 to about 2.0 millimeters based on Studer 471's teaching that vent channels located vertically along the interior side wall and having "a depth of **approximately 0.5 mm [and] a width of approximately 3.0 mm**" provide a non-fluid wettable vent channel. Ex. 1004, [0032]; Ex. 1011, ¶¶239-255.

1. Claims 1, 3, 5, 10, 12, and 14

Whereas Studer 708 teaches disposing vent channels along the interior floor (e.g., redundant floor channels 220) of a capillary-filled ink container 12 for venting air from the fluid exit port to the ambient environment outside the ink container (and vice versa), Studer 471 provides a similar venting mechanism for a capillary-filled ink container 12 within an identical inkjet system by disposing vent channels vertically along the interior side wall. Ex. 1004, [0029] (teaching that, "in this example, channels 50 are located vertically so that the ink and ***air may flow upward toward the lid portion*** … and wherein air is then able to escape from chamber 45 (*e.g.*, through an opening in the lid portion) and possibly through one or more labyrinths of the lid portion."); [0039] (explaining that "the semi-hemispherical castellation features coincident with the channels help facilitate air bubble growth and retention at the top of the accumulator channels.").

Fig. 4 of Studer 471	**Fig. 5 of Studer 471**
	

According to Studer 471, **"[t]his fluid communication tends to equalize pressure within the ink container."** Ex. 1004 [0038]; [0041] (teaching that "Labyrinth 70 ***allows air to vent*** with respect to the pressure outside the ink container while minimizing the WVTR of the ink in the reservoir block … [and] also tends to

equalize the pressure within the ink container as ink is drained from the ink reservoir block during printing."). "During a change in pressure or temperature," for example, Studer 471 teaches that "these bubbles tend to retain free ink in the channels when the ink supply is in both the lid-up and more importantly, the lid-down orientation. As the surface tension of the ink increases and the width and depth of the channels decrease, this mechanism becomes more effective." *Id*.

After replacing the BPF capillary material in Studer 708's container 12 with polyurethane foam or melamine (Ex. 1003 at 5:14-17, 7:62-67), a PHOSITA would look to Studer 471—an analogous prior art reference from the same inventor (Anthony Studer), within the same field of endeavor as Studer 708 (capillary-filled ink containers), using melamine—and would have been motivated by Studer 471 to add vent channels vertically to the interior side walls of ink container 12 so that the venting mechanisms continue to allow for air to pass from the top of the container around the capillary material to the area adjacent the fluid exit port on the bottom of the container, as shown below in the Studer 708/471 Combination. Ex. 1011, ¶¶188-196.

<table>
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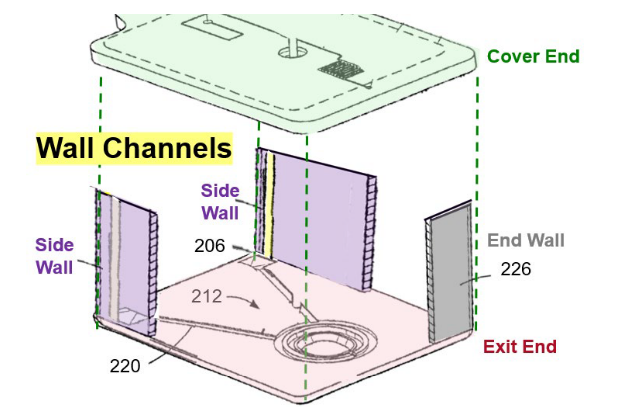
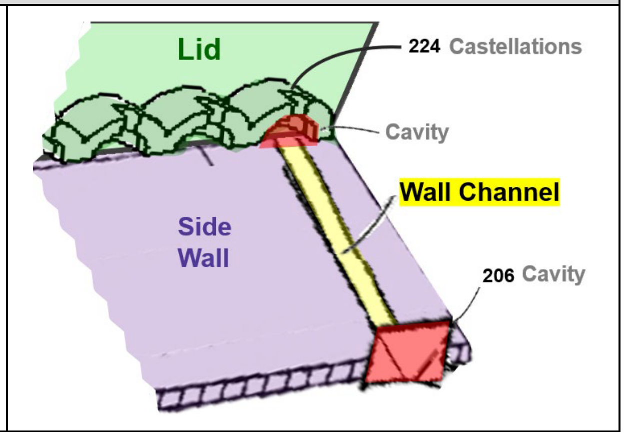
<tr><td>
</td><td>
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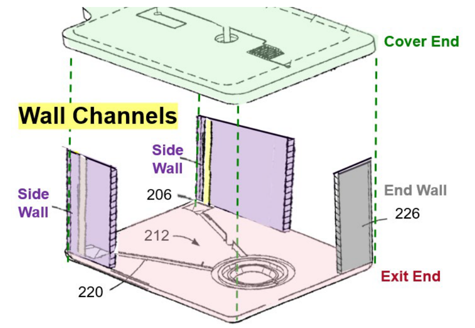
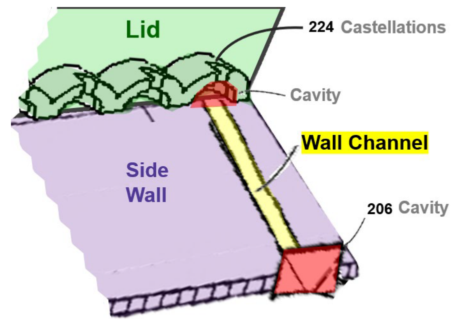
The Studer 708/471 Combination therefore renders obvious claims 1, 3, 5, 10, 12, and 14. Ex. 1011, ¶¶181-203.

2. Claims 2 and 11

Claims 2 and 11 depend from claims 1 and 10, respectively, and add: "a **channel disposed in an interior side wall of the fluid supply tank**."

As explained above and below, the Studer 708/471 Combination discloses this added limitation because it includes **vent channels located vertically along each interior side wall of ink container 12**—such that at least one vent channel is laterally aligned with its respective cavity 206 and spacing member (i.e., castellations) 224— so that the venting mechanisms continue to allow for air to pass from the top of the container around the melamine capillary material to the area adjacent the fluid exit port on the bottom of the container. Ex. 1011, ¶¶207-208.

<table>
<tr><th colspan="2">Studer 708/471 Combination</th></tr>
<tr><td></td><td></td></tr>
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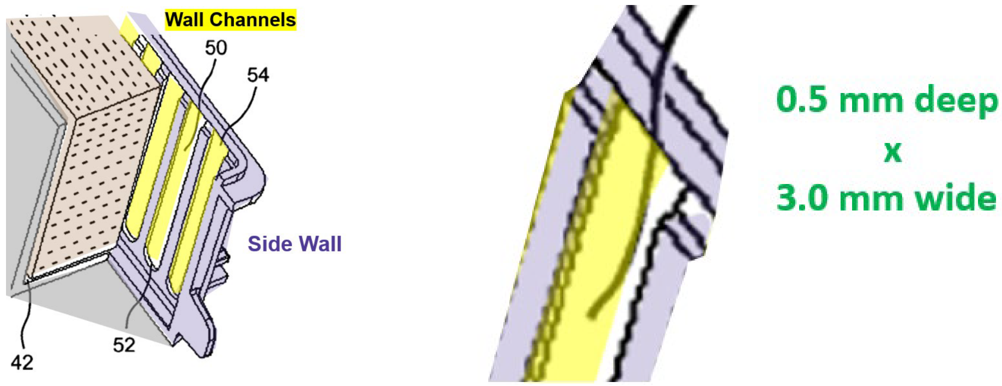
3. Claims 6 and 15

Claims 6 and 15 depend from claims 1 and 10, respectively, and add: "a conduit having cross-sectional dimensions that provide a non-fluid wettable vent channel." This added limitation is disclosed by Studer 708/471 Combination for several reasons. Ex. 1011, ¶¶216-231.

First, Studer 471 expressly teaches that the cross-sectional dimensions of channel 50 provide a non-fluid wettable vent channel. Id., ¶¶216-217. "While the channels 50 shown in FIG. 4 are substantially rectangular in cross-sectional shape," Studer 471 discloses that "there are other geometric configurations that may be used," such as a "cylindrical cross-sectional shape." Ex. 1004, [0030], [0031]. "By way of further example," Studer 471 teaches that "channels 50 illustrated in FIG. 4 may have a depth of approximately **0.5 mm, a width of approximately 3.0 mm**, and a length that extends from substantially top to bottom of the ink container 12." *Id*., [0032]. Per Section IX.B.2, *supra*, [t]hese cross-sectional dimensions sufficiently provide a non-fluid wettable vent channel." Ex. 1011, ¶217.

Figure 4 of Studer 471



Second, Studer 471 teaches adding a "surface finish" to "one or more of channels 50, such as "a semi-rough, non-directional surface finish of approximately 0.8 μm" that "tends to **inhibit ink from flowing into or out of the channel** in microscopic grooves." Ex. 1004, [0034]. Accordingly, a PHOSITA would have added a surface finish to the vent channels in the Studer 708/471 Combination to ensure that they provide a non-fluid wettable vent conduit. Ex. 1011, ¶218.

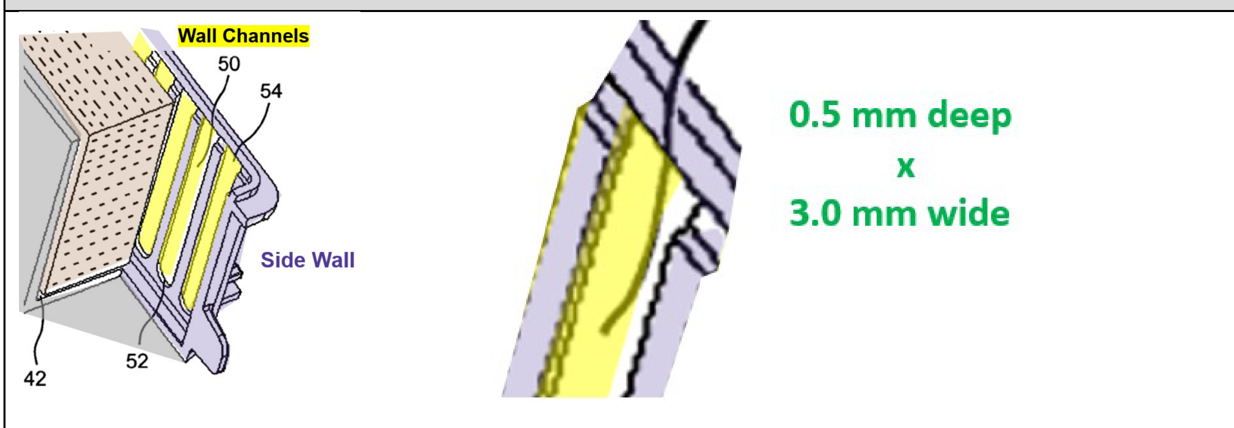
Third, per Section IX.B.2., *supra*, a PHOSITA would have separately arrived at the claimed proportions through routine experimentation and application of the Young-LaPlace equation. Ex. 1011, ¶¶ 219-230. Ex. 1011, ¶ 227. The calculated range is also consistent with the vent channel dimensions disclosed by Studer 471. Ex. 1011, ¶¶ 227. A PHOSITA could have also used that as a starting point for optimizing the vent channels 50 through the routine experimentation described above. *Id*.

4. Claims 7 and 16

Claims 7 and 16 depend from claims 1 and 10, respectively, and add: "a conduit having a width ranging from about 0.5 to about 2.0 millimeters and a depth ranging from about 0.5 to about 2.0 millimeters." This added limitation is disclosed by the Studer 708/471 Combination for several reasons. Ex. 1011, ¶¶233-235.

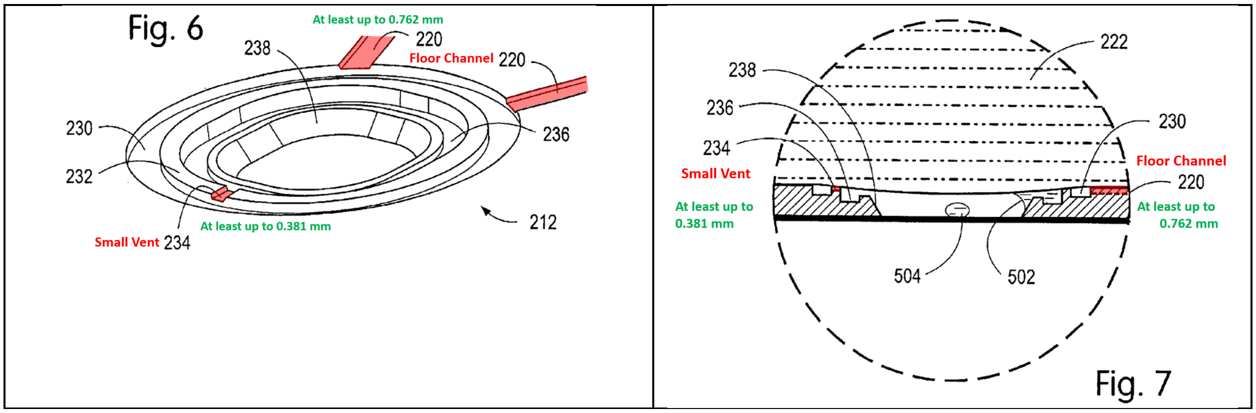
First, as explained above, Studer 471 teaches that "channels 50 illustrated in FIG. 4 may have a depth of **approximately 0.5 mm, a width of approximately 3.0 mm**, and a length that extends from substantially top to bottom of the ink container 12." Ex. 1004, [0032]. In the context of sizing vent channels, a vent channel having a "width of approximately 3.00 mm" is "about 2.0 mm" because a channel with cross-sectional dimensions of 0.5 mm deep by 3.00 mm wide still provides a sufficiently "non-fluid wettable vent channel." Ex. 1011, ¶233.

Figure 4 of Studer 471



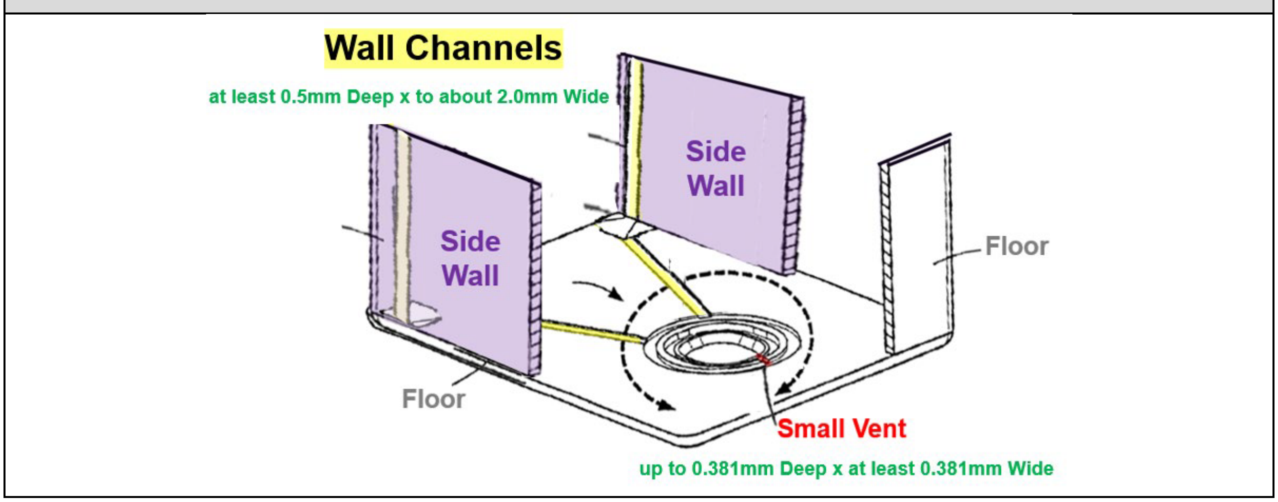
Second, a PHOSITA, starting with a channel having cross-sectional dimensions of 0.5 mm deep by 3.0 mm wide as taught by Studer 471, would have arrived at various ranges between 0.25 mm to 4 mm for the widths and depths of the vent conduit through application of the Young Laplace equation and subsequent routine experimentation. Ex. 1011, ¶234. To be sure, Studer 471 explicitly teaches that that the channel 50 can made narrower to increase the "efficiency and robustness in a lid-down orientation," or deeper to "increase robustness in a lid-up orientation (e.g., during shipping/storage). Ex. 1004, [0032].

Third, per Section IX.B.3, *supra*, while Studer 708 does not explicitly disclose a precise range of dimensions for the floor channel 220, a PHOSITA would have understood from at least Figures 6 and 7 that the dimensions of the floor channel 220 in the preferred embodiment are at least twice (if not three times) that of the small vent 234—*i.e.*, at least up to 0.762 millimeters (if not 1.143 millimeters). Based on at least these disclosures, a PHOSITA would have understood that the dimensions of the floor channel 220 of the internal vent conduit could be between 0.5 millimeters up to at least 0.762 millimeters. Ex. 1011, ¶234.



PHOSITA would have likewise used the same or equivalent dimensions for wall channel as that of the floor channel 220 in the Studer 708/471—*i.e.*, up to at least 0.762 millimeters (if not 1.143 millimeters). Ex. 1011, ¶235. Indeed, for those embodiments that add vent channels to the interior side walls, Studer 708 explicitly teaches that the added "vent channels [are] **similar** to the redundant vent channels 220 formed on the floor of the container." Ex. 1003, 5:18-20; Ex. 1011, ¶235.

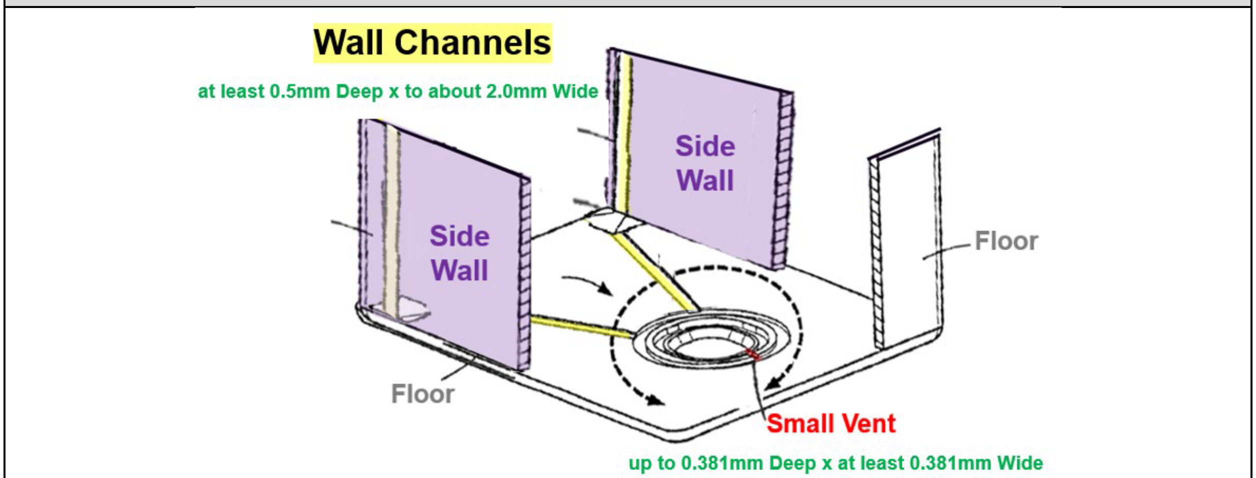
The Studer 708/471 Combination



5. Motivation to Combine: Studer 708 and Studer 471

For at least the following reasons, a PHOSITA would have been motivated to modify Studer 708's preferred embodiment by replacing the BPF capillary material with a polyurethane foam or melamine from an alternative embodiment and then disposing vent channels along the interior side wall 50 to arrive at the Studer 708/471 Combination shown below. Ex. 1011, ¶235.

The Studer 708/471 Combination



First, Studer 708 and 471 are analogous to the claimed subject matter in the '523 patent because they are all within the same field of endeavor and address the same problem—namely, venting a capillary-filled ink container that is removably connected to a printhead. Ex. 1011, ¶¶ 240-241. Just like the '523 patent, Studer 708 and Studer 471 are generally directed to capillary-filled ink containers that are removably connected to a printhead, and more specifically, to managing the air pressure and air pockets within capillary-filled ink containers. *Id*. And just like the

’523 patent, Studer 708 and Studer 471 use the same venting mechanisms to regulate pressure within the replaceable ink container—namely, a vent channel disposed between the serpentine vent formed in the container lid and the fluid exit port in the container bottom. *Id*.

Studer 708 and 471 also share three of the same inventors—Anthony D. Studer, Kevin D. Almen, and David J. Benson—the same assignee—Hewlett-Packard Development Company L.P.—and even utilize the same inkjet printing system. *Compare* Ex. 1003, Figs. 1-2 *with* Ex. 1004, Figs. 1-2; *compare* Ex. 1003, Title Page *with* Ex. 1004, Title Page. Ex. 1011, ¶¶242-243.

<table>
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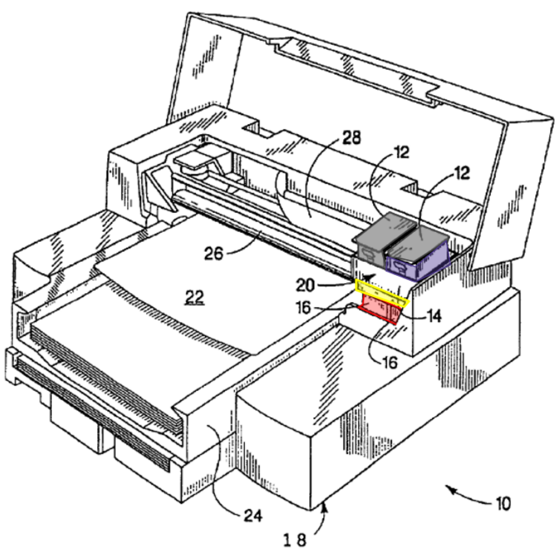
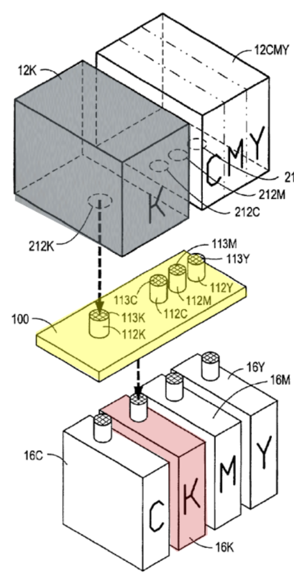
<tr><td>
</td><td>
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Second, a PHOSITA would have been motived to modify the preferred embodiment of Studer 708 in view of Studer 471 by adding additional vent channels along the interior side wall of the ink container 12 to arrive at the Studer 708/471 Combination. Ex. 1011, ¶¶244-249.

Although the preferred embodiment of the ink container 12 uses BPF capillary material, Studer 708 discloses that BPF may be replaced with polyurethane foam or melamine (Ex. 1003 at 5:14-17, 7:62-67), which a PHOSITA would recognize provides certain benefits, including improved ink retention volume fraction, tailored capillary force profile for ink release, ink reservoir shape, and cost. Ex. 1011, ¶245.

Upon substituting the polyurethane foam or melamine for BPF, a PHOSITA would have been further motivated by Studer 708 to add additional vent channels between the ink container lid and bottom. Ex. 1011, ¶246. Indeed, Studer 708 teaches that, if an alternative capillary material is used, such as polyurethane foam or melamine, then "**additional provisions**" such as "**vent channels** . . . similar to the redundant vent channels 220 formed on the floor of the container" may be necessary for "**allowing air to pass from the top of the container around the capillary material**." Ex. 1003, 5:16-20. These "additional provisions" are necessary because polyurethane foam and melamine fit more snuggly against the container side wall and, unlike BPF, may not allow for sufficient airflow along the end grain of the material on the side wall. Ex. 1011, ¶246; Ex. 1003, 5:9-20.

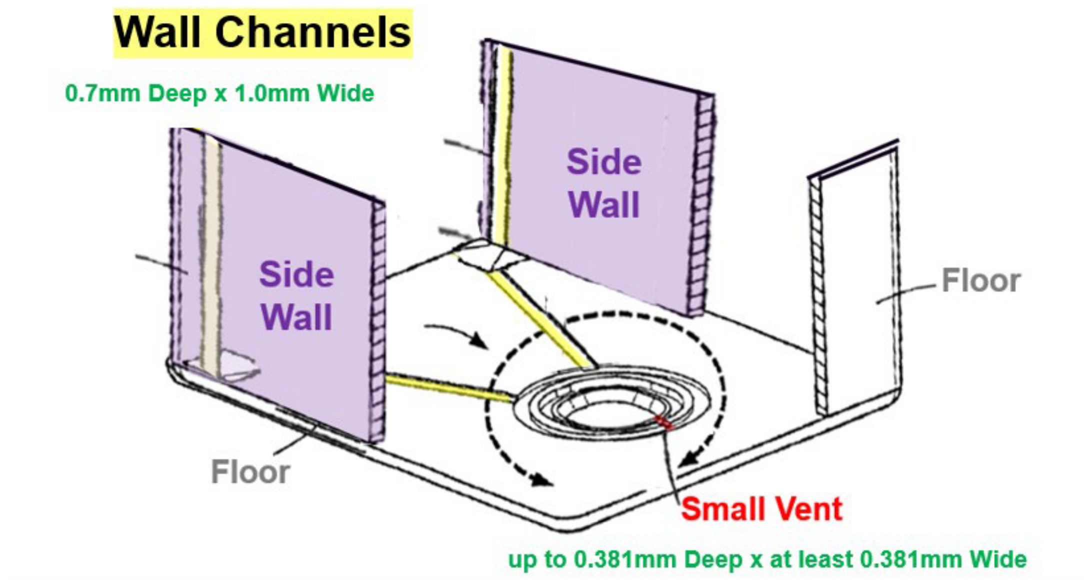
After determining that additional vent channels must be added to the ink container 12, a PHOSITA would then look to the analogous Studer 471 reference for guidance, which disposes **vent channels** vertically along the interior side wall of a replaceable ink **container filled with capillary materials**, such as **melamine**. Despite teaching that the melamine "**foam block** may be **designed to fit snugly** within the internal ink chamber 45," Studer 471 teaches locating the vent channels "vertically" along the interior side wall "so that the ink and ***air may flow upward toward the lid portion*** (not shown in FIG. 4), and wherein air is then able to escape from chamber 45 (*e.g.*, through an opening in the lid portion) and possibly through one or more labyrinths of the lid portion."). Ex. 1004, [0029]. These disclosures would lead a PHOSITA to further modify the preferred embodiment of Studer 708 by adding vent channels vertically along the interior side wall of ink container 12 to allow for sufficient air flow around the capillary material. Ex. 1011, ¶¶247-249.

Third, a PHOSITA would have a reasonable expectation of success in making the Studer 708/471 Combination. Studer 708 teaches that its various embodiments and components are interchangeable and it shares the same printing system (and many of the same components) with Studer 471. Ex. 1011, ¶¶250-251. For this reason, it would have been a routine and obvious matter for a PHOSITA to modify various features and embodiments from Studer 708 and 471, including the simple, routine, and low-cost nature of replacing the BPF capillary material with a polyurethane foam or melamine and adding two more vent channels to the interior side wall of ink container 12. *Id*.

D. <u>Ground 4:</u> Claims 6, 7, 15 and 16 are Rendered Obvious by Studer 708 and Studer 471 in view of Elliot

To the extent that the Board does not find that the Studer 708/471 Combination discloses the added limitations of claims 6-7 and 15-16, those limitations would have been obvious in further view of Elliot. Ex. 1011, ¶¶253.

After modifying Studer 708's preferred embodiment to utilize a polyurethane foam or melamine and disposing vent channels along the interior side wall as taught by Studer 471, a PHOSITA would have looked to Elliot to determine an appropriate range of sizes for the vent channels and used the cross-sectional dimensions disclosed by Elliot—*i.e.*, "**1 mm wide and 0.7 mm deep**"—to ensure that "[t]he balance of forces acting upon the ink thus remain in equilibrium even during environmental changes and the backpressure of the foam continues to prevent drool from the printhead orifi." Ex. 1006, 5:61-63.

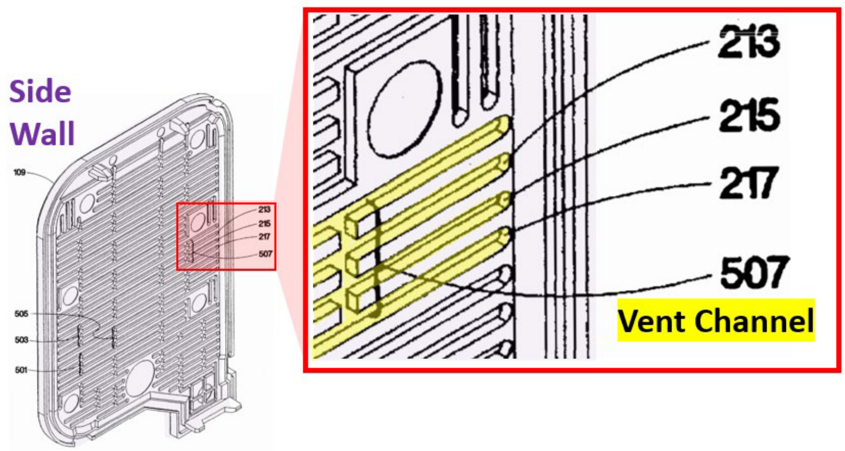
The Studer 708/471 Combination in view of Elliot


1. Claims 6 and 15

Claims 6 and 15 depend from claims 1 and 10, respectively, and add: "a **conduit having cross-sectional dimensions that provide a non-fluid wettable vent channel**."

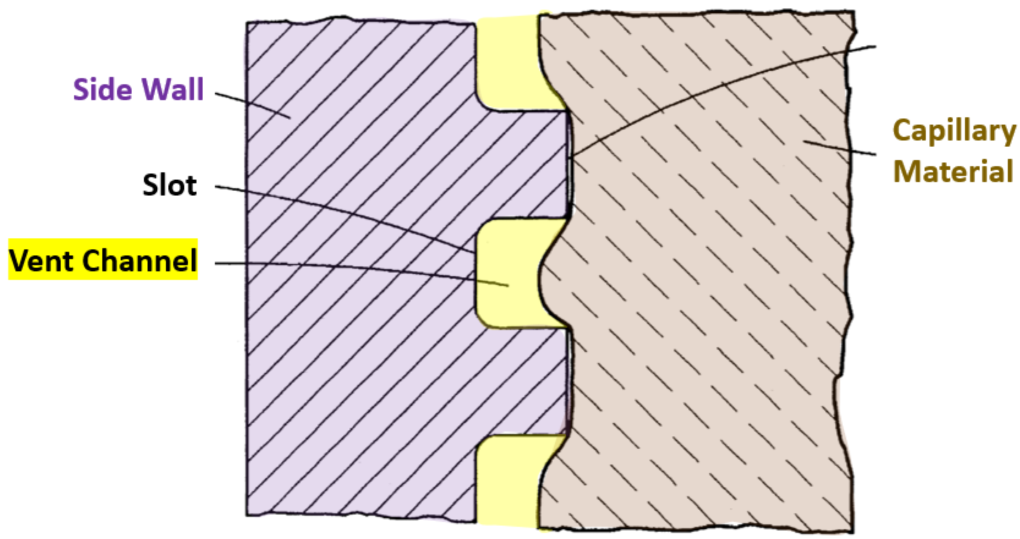
Like Studer 708 and 471, Elliot teaches the use of capillary materials, which it calls a "felted urethane material," in its ink container to provide the desired negative backpressure on the ink near the printhead nozzles. Ex. 1006, 4:29-31; Ex. 1011, ¶257. Air bubbles can become trapped in this capillary material and cause leakage or "drool" from the printhead nozzles when subjected to changes in temperature and pressure. Ex. 1006, 4:52-65; Ex. 1011, ¶256. To overcome this problem, Elliot uses "[g]roups of slots [501, 503, 505], which considered together form **a vent channel [507]**, are oriented perpendicular to the relief pockets and are formed on the inner surface of the wall." Ex. 1006, 5:31-33.

Figure 5 of Elliot



Referring to Figure 5 above, Elliot states: "[i]t can be seen that vent channel 507 couples the relief pockets 213, 215, and 217 so that air may be exchanged between them. A path is formed of a plurality of vent channels to couple all of the relief pockets to the dry zone in the upper portions of the ink container and eventually to the atmospheric vent 107." Ex. 1006, 5:34-39. The "structure of relief pockets and the **interconnecting vent channels allow air to move between external air and along a surface of the foam**. . . The **balance of forces** acting upon the **ink thus remain in equilibrium** even during environmental changes and the backpressure of the **foam continues to prevent drool from the printhead orifi**." *Id.*, 5:40-52. In Elliot's preferred embodiment, "each slot is **1 mm wide and 1 mm or less deep**," "the spacing between each of the relief pocket slots is 1 mm," and "the vent channels are **1 mm wide and 0.7 mm deep**." *Id.*, 5:6-8, 5:61-63. These cross-sectional dimensions "reduce or eliminate wetting of the [vent channels] with the fluid." Ex. 1011, ¶258.

Figure 4 of Elliot



For at least these reasons, a PHOSITA would have sized the vent channels disposed along in the interior side walls of the Studer 708/471 Combination to be 1 mm wide and 0.7 mm deep in order to provide a non-fluid wettable vent channel, thereby rendering obvious claims 6 and 15. Ex. 1011, ¶259; *Compare* Ex. 1006, 5:6-8, 5:61-63 *with* Ex. 1001, 5:15-19.

2. Claims 7 and 16

Claims 7 and 16 depend from claims 1 and 10, respectively, and add: "a conduit having a width ranging from about 0.5 to about 2.0 millimeters and a depth ranging from about 0.5 to about 2.0 millimeters." This added limitation would have been obvious in further view of Elliot because, as explained above in Section IX.D.1., a PHOSITA would have been motivated to size the vent channels of the Studer 708/471 Combination using the dimensions of the "vent channels" disclosed by Elliot—*i.e.*, "**1 mm wide and 0.7 mm deep**." Ex. 1006, 5:61-63; Ex. 1011, ¶¶261-264.

3. Motivation to Combine

Ample motivation existed for a PHOSITA to have looked to Elliot to determine the cross-sectional dimensions needed to provide a non-fluid wettable vent channel within the ink container 12 of the Studer 708/471 Combination. Ex. 1011, ¶¶265-271.

First, Elliot, Studer 708, and Studer 471 are analogous to the claimed subject matter in the '523 patent because they are all within the same field of endeavor and address the same problem—namely, venting a capillary-filled ink container that is connected to a printhead. Ex. 1011, ¶266. Just like the '523 patent, Elliot, Studer 708, and Studer 471 are generally directed to capillary-filled ink containers that are connected to a printhead, and more specifically, to managing the air pressure and air pockets within capillary-filled ink containers. And just like the ’523 patent, Elliot, Studer 708, and Studer 471 use the same venting mechanisms to regulate pressure within the ink container—namely, a channel disposed between the cover and floor of the ink container. *Id*.

Second, Studer 708 itself provides sufficient motivation for a PHOSITA to look to Elliot when making the above combination. Ex. 1011, ¶267. Like Studer 708 and Studer 471, Elliot teaches the use of polyurethane foam, which it calls a “felted urethane material,” as the capillary material in its ink container to provide the desired negative backpressure on the ink near the printhead nozzles. Ex. 1006, 4:29-31. Elliot also teaches that air bubbles can become trapped in this capillary material that can cause leakage or “drool” from the printhead nozzles when subjected to changes in temperature and pressure. Ex. 1006, 4:52-65.

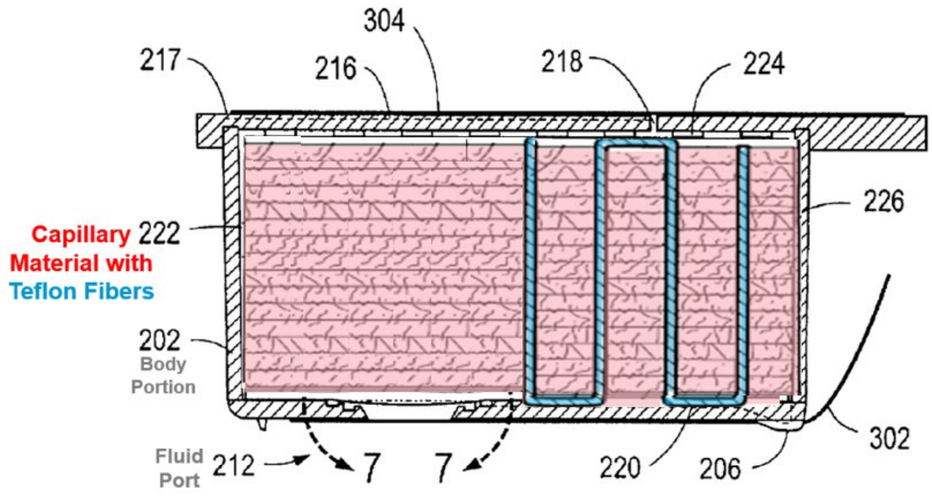
To overcome this problem, Elliot includes “a series of slots running across the inner surface of wall 111 are molded into the inter surface wall 111.” Ex. 1006, 5:4-6. “Groups of slots [501, 503, 505], which considered together form **a vent channel [507]**, are oriented perpendicular to the relief pockets and are formed on the inner surface of the wall” as shown in Figure 5 below. *Id.*, 5:31-33. According to Elliot, the “structure of relief pockets and the **interconnecting vent channels allow air to move between external air and along a surface of the foam**. . . The **balance of forces** acting upon the **ink thus remain in equilibrium** even during environmental changes and the backpressure of the **foam continues to prevent drool from the printhead orifi**." *Id.*, 5:40-52. In Elliot's preferred embodiment, "the vent channels are **1 mm wide and 0.7 mm deep**." *Id.*, 5:61-63. Based on these disclosures, a PHOSITA would be motivated to relied upon Elliot to optimize the dimensions of the vent conduit in the Studer 708/471 Combination. Ex. 1011, ¶¶268-269.

Third**,** a PHOSITA would also have a reasonable expectation of success when sizing the vent channels of the Studer 708/471 Combination according to Elliot's disclosed dimensions. Ex. 1011, ¶270. Given the interchangeable nature of various features in the disclosed embodiments, it would have been a routine and obvious matter for a PHOSITA to combine, replace, and even modify various features from Studer's various embodiments. *Id*. Furthermore, given that Studer 708 expressly articulates the interchangeability and modification of the disclosed embodiments, a PHOSITA would have had a reasonable expectation of success in sizing the dimensions of the vent channels to the dimensions taught by Elliot. Ex. 1011, ¶270.

E. <u>Ground 5:</u> Claims 6, 7, 15 and 16 are Rendered Obvious by Studer 708 and Studer 878

To the extent that the Board does not find that Studer 708 discloses the "internal vent conduit" limitation, then it would have been obvious in view of Studer 878. Ex. 1007, ¶¶272-284.

After modifying Studer 708's preferred embodiment to utilize a polyurethane foam or melamine, a PHOSITA would have looked to Studer 878 to determine an appropriate location and dimension for the additional vent channels needed to compensate for the added capillary force of melamine, as taught by Studer 708. Ex. 1011, ¶¶301-310. Based on Studer 878's teachings, a PHOSITA would have added the thread fibers 240 and 240' from Studer 878 to the capillary material thus arriving at the Studer 708/878 Combination shown below. Ex. 1011, ¶¶301-310.

The Studer 708/878 Combination


In the Studer 708/878 Combination, the thread fiber 240 and 240' sewn into the capillary material from Studer 878 (blue) allows for airflow communication from the channels formed by the spacing members 224 at the top of Studer 708's ink container passing vertically through the capillary material to the floor channels 220 and air chambers 206 of Studer 708 and ultimately to Studer 708's fluid interconnect port venting features, including small vent 234, wall 232, and air path ring 230, thus forming the claimed "internal vent conduit." Ex. 1011, ¶¶271-283.

The Studer 708/878 Combination therefore discloses "an internal vent conduit" (*e.g.*, (i) channels formed by spacing members 224, (ii) thread fibers 240 and 240', (iii) floor vent channels 220 and air chambers 206, and (iv) the fluid interconnect port venting features, including small vent 234, wall 232, and air path ring 230). Ex. 1011, ¶¶276-281.

1. Claims 6 and 15

Claims 6 and 15 depend from claims 1 and 10, respectively, and add: "a conduit having cross-sectional dimensions that provide a non-fluid wettable vent channel."

Studer 878 teaches that the TEFLON thread fiber 240 and 240' "provides a **path for entrapped air or gas to travel more easily** in the case of thread fiber 240 from the bottom face 234 to top face 233 and in the case of thread fiber 240' from air or gas may travel more easily to either end surface 232 or 232'." Ex. 1005, [0027]-[0028]. According to Studer 878, "the fluid supply may include larger diameter thread fibers 240 and 240' sewn or threaded into the capillary material. In this embodiment, thread fibers 240 and 240' are each formed from polytetrafluoroethylene having a diameter of **0.5 millimeters**. In alternative embodiments, thread fibers 240 and '240 each may have **diameters of about 5**

micrometers to about 1.0 millimeter." Ex. 1005, [0027]; *Cf*. Ex. 1001 at 5:15-19. ("Fluids having a surface tension similar to the surface tension of water may have vent conduit 24 dimensions having a width (W) of about 1 millimeter and a depth (D) of about 1 millimeter in order to **reduce or eliminate wetting of the conduit** 24 with the fluid.").

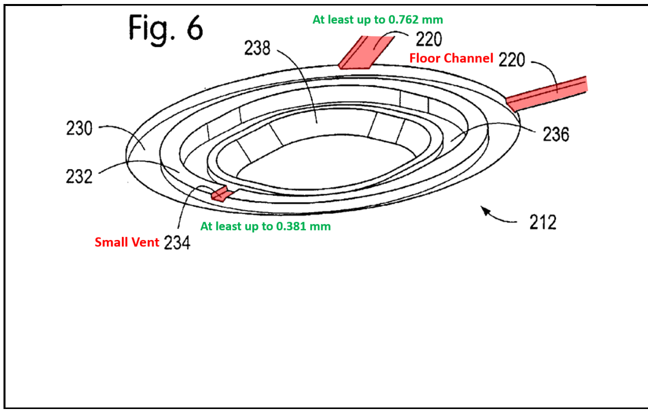
Thus, the Studer 708/878 Combination renders obvious claims 6 and 15. Ex. 1011, ¶¶290-293.

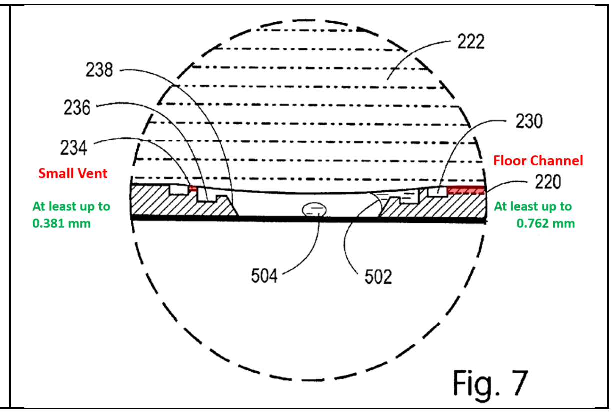
2. Claims 7 and 16

Claims 7 and 16 depend from claims 1 and 10, respectively, and add: "a conduit having a width ranging from about 0.5 to about 2.0 millimeters and a depth ranging from about 0.5 to about 2.0 millimeters." The Studer 708/471 Combination discloses this limitation for at least two different reasons.

First, Studer 878 discloses that "the thread fibers 240 and 240' are each formed from polytetrafluoroethylene having a diameter of 0.5 millimeters," or alternatively, may "each have a diameter in the range from ***about*** 5 micrometers to ***about*** 1.0 millimeter," which "provides **a path for entrapped air or gas to travel more easily**." Ex. 1005, [0027], [0029]. Simply put, the thread fibers 240 and 240' create an air space that allows air to migrate from air pore to air pore along the TEFLON fiber surface. Ex. 1011, ¶296. Because Studer 878 teaches that the thread fibers 240 and 420' "each may have a diameter in the range of from 5 micrometers to about 1.0 millimeters," a PHOSITA would have known that the air space created by the 1000 micron (1 mm) TEFLON fiber threads would be no larger than about 100 microns. *Id*.

Second, a PHOSITA would have understood from Studer 708 that the cross-sectional dimensions of the conduit formed by the thread fibers 240 and 240' of Studer 878 must, at the very least, be greater than that of the small vent 232 and could range up to at least 0.762 mm—*i.e.*, at least twice (if not three times) the size of the small vent 232. Ex. 1011, ¶297. While Studer 708 does not explicitly disclose a precise range of dimensions for the floor channel 220, a PHOSITA would have understood from at least Figures 6 and 7 that the dimensions of the floor channel 220 in the preferred embodiment are at least twice (if not three times) that of the small vent 234—*i.e.*, at least up to 0.762 millimeters (if not 1.143 millimeters). Based on at least these disclosures, a PHOSITA would have understood that the dimensions of the floor channel 220 of the internal vent conduit could be between 0.5 millimeters up to at least 0.762 millimeters. Ex. 1011, ¶234.

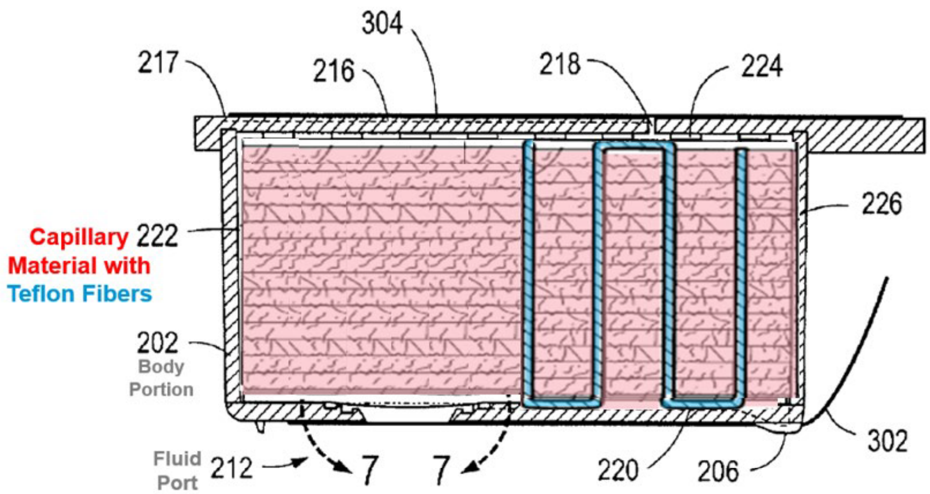




PHOSITA would have likewise used the same or equivalent dimensions for the conduit created by the thread fibers as that of the floor channel 220—*i.e.*, up to at least 0.762 millimeters (if not 1.143 millimeters). Ex. 1011, ¶235. Indeed, for those embodiments that add vent channels, Studer 708 explicitly teaches that the added "vent channels [are] **similar** to the redundant vent channels 220 formed on the floor of the container." Ex. 1003, 5:18-20; Ex. 1011, ¶235.

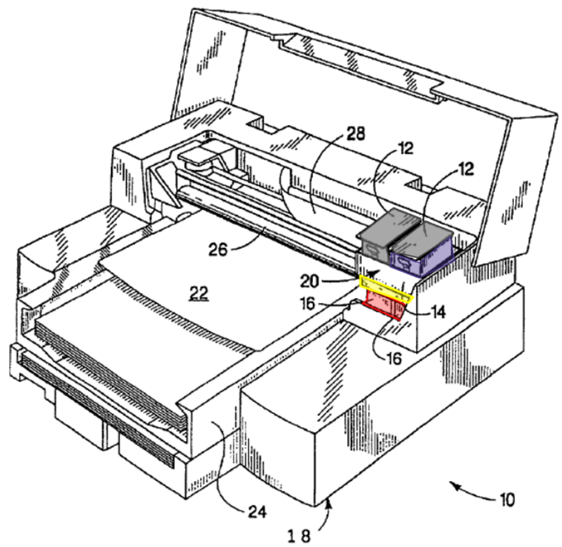
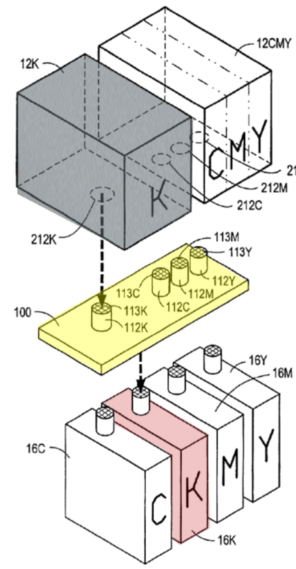
3. Motivation to Combine: Studer 708 and Studer 878

For at least the following reasons, a PHOSITA would have been motivated to replace the BPF capillary material 222 in Studer 708's ink container 12 with Studer 878's BPF capillary material 230 (threaded with thread fibers 240) as shown in the illustration below. Ex. 1011, ¶¶301-310.

The Studer 708/878 Combination


First, Studer 708 and 878 are analogous to the claimed subject matter in the ’523 patent because they are all within the same field of endeavor and address the same problem—namely, regulating the internal pressure of a capillary-filled ink container that is removably connected to a printhead through ventilation to the ambient air. Ex. 1011, ¶302. Just like the ’523 patent, Studer 708 and 878 regulate pressure within the replaceable ink container using the same venting mechanisms—namely, a channel disposed between the cover and floor of the container, spacers between the cover and capillary material, and a vent formed in the cover. *Id*.

Studer 708 and Studer 878 also share three of the same inventors—Anthony D. Studer, Kevin D. Almen, and David J. Benson—the same assignee—Hewlett Packard—and even utilize the same inkjet printing system for operably connecting a replaceable ink container to a removably-connected printhead as shown by the figures below. *Id.*,¶303; *compare* Ex. 1003, Title Page *with* Ex. 1005, Title Page.

Figs. 1/5 of Studer 708 and 878	**Figs. 2/6 of Studer 708 and 878**
	

Second, Studer 708 itself would have provided sufficient motivation for a PHOSITA to make the above modification to the preferred embodiment of ink container 12. Ex. 1011, ¶305. While Studer 708 teaches that the BPF material used in the preferred embodiment of ink container 12 allows "sufficient air [to] flow along the end grain of the capillary material to meet the requirements of the fluid port vent, even when the capillary material is saturated with ink," Studer 708 makes clear that "another capillary material [may be] used in place of BPF," such as the BPF material with sewn fibers disclosed by Studer 878. *Id*.

Third, the advantages of Studer 878's design would also have motivated a PHOSITA to make the above modification to Studer 708's preferred embodiment of ink container 12. Ex. 1011, ¶¶ 306-310. Control of the backpressure created by the chosen capillary material within predictable limits is important to the operation of the inkjet printing system at its highest possible print speed. Id., ¶306. Air bubbles in the capillary material are a known source of unpredictable backpressure that can cause unwanted blockages and leakages. *Id*. Consequently, a PHOSITA would have been motivated to improve the Studer 708 design to incorporate means of eliminating or diminishing the size of air bubbles that may be induced in the capillary volume, especially by changes in the printer environmental temperature and atmospheric pressure or by mechanical shocks. *Id*.

A PHOSITA would have recognized that the addition of the hydrophobic threads disclosed by Studer 878 to the BPF capillary storage material disclosed by Studer 708 would solve the potential problem of air bubble unpredictability present in the Studer 708 design and would also provide defined air movement pathways to optimize the capillary material's storage characteristics and the management of included air bubbles. Ex. 1011, ¶¶ 306-310. Further, it would have been obvious that, by judicial placement of the hydrophobic thread stitches, the internal air conduit of Studer 708 could be made more reliable by providing additional air pathways vertically in the capillary material from the Studer 708 bottom vent channels 220 to the top air space. *Id*.

***Fourth**,* a PHOSITA would have a reasonable expectation of success in modifying the preferred embodiment of Studer 708 by utilizing the capillary material with thread fibers 240 and 240' disclosed in Studer 878. Ex. 1011, ¶¶ 306-310. Given the commonality of the printing systems and interchangeable nature of various features in the disclosed embodiments, it would have been a routine and obvious matter for a PHOSITA to combine various features from Studer 878 with Studer 708. *Id*.

X. CONCLUSION

Trial should be instituted, and the Challenged Claims should be cancelled as unpatentable.

Date: August 23, 2022

Respectfully submitted,

By */ Dion M. Bregman /*
Dion M. Bregman (Reg. No. 45,645)

Attorneys for Petitioners
Canon USA Inc. and Canon Inc.

APPENDIX: CLAIM LISTING

Claim 1. A fluid supply tank for a micro-fluid ejection head, the fluid supply tank comprising:

> a body portion for holding a fluid to be ejected, the body portion having a fluid exit port on an exit end thereof and a cover on an opposing end thereof of the body portion, the cover having an opening in fluid communication with atmosphere;
>
> an internal vent conduit disposed between the exit end and the cover for removing air adjacent to the fluid exit port and releasing the air through the cover to said atmosphere; and
>
> an air space in the fluid exit port wherein the internal vent conduit is in air flow communication with the air space and the cover.

Claim 2. The fluid supply tank of claim 1, wherein the internal vent conduit comprises a channel disposed in an interior side wall of the fluid supply tank.

Claim 3. The fluid supply tank of claim 1, wherein the cover comprises a serpentine vent structure and the internal vent conduit is in air flow communication with the serpentine vent structure.

Claim 5. The fluid supply tank of claim 1, wherein the fluid supply tank is removably attached to an ejection head structure.

Claim 6. The fluid supply tank of claim 1, wherein the internal vent conduit comprises a conduit having cross-sectional dimensions that provide a non-fluid wettable vent channel.

Claim 7. The fluid supply tank of claim 1, wherein the internal vent conduit comprises a conduit having a width ranging from about 0.5 to about 2 millimeters and a depth ranging from about 0.5 to about 2 millimeters.

Claim 10. A method for enhancing the operation of a micro-fluid ejection device, comprising:

> disposing an internal vent conduit in a fluid supply container for the micro-fluid ejection device, wherein the vent conduit is disposed in air flow communication between an air space of a fluid exit end of the container and a container cover opposite the fluid exit end, the container cover having an opening in fluid communication with atmosphere; and
>
> installing the fluid supply container on the micro-fluid ejection device so that any trapped air between the container and the device is urged to said atmosphere through the internal vent conduit through an atmospheric vent in the cover.

Claim 11. The method of claim 10, wherein the internal vent conduit comprises a channel disposed in an interior side wall of the fluid supply container.

Claim 12. The method of claim 10, wherein the atmospheric vent in the cover comprises a serpentine vent structure and the internal vent conduit is in air flow communication with the serpentine vent structure.

Claim 14. The method of claim 10, wherein the fluid supply container is removably attached to an ejection head structure for the micro-fluid ejection device.

Claim 15. The method of claim 10, wherein the internal vent conduit comprises a conduit having cross-sectional dimensions that provide a non-fluid wettable vent channel.

Claim 16. The method of claim 10, wherein the internal vent conduit comprises a conduit having a width ranging from about 0.5 to about 2 millimeters and a depth ranging from about 0.5 to about 2 millimeters.

<u>CERTIFICATE OF WORD COUNT</u>

Pursuant to 37 C.F.R. § 42.24(d), Petitioner hereby certifies, in reliance on the word count feature provided by the word-processing system used to prepare this Petition, that the number of words in this Petition is 13,910. Pursuant to 37 C.F.R. § 42.24(a), words in the table of contents, table of authorities, mandatory notices under § 42.8, certificate of service, certificate of word count, appendix of exhibits, and claim listing were excluded.

Dated: August 23, 2022

<u>/ Dion M. Bregman /</u>
Dion M. Bregman (Reg. No. 45,645)

CERTIFICATE OF SERVICE

Pursuant to 37 C.F.R. 42.6(4) and 42.105, lead counsel for Petitioners hereby certify that on August 23, 2022, copies of this Petition and all supporting exhibits were sent via Priority Mail Express to the correspondence address of record for the ’523 patent:

133676 - Goldberg Segalla LLP
711 3rd Avenue, Suite 1900
New York, NY 10017

A courtesy copy of this Petition and supporting exhibits was also served via email on August 23, 2022 on Patent Owner’s counsel of record in the district court litigation against Slingshot Printing LLC involving this patent:

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Dated: August 23, 2022

Respectfully Submitted,

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